Healthy food choices
Drivers and Barriers - Evidence from the Swiss Food Panel

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Publication Date:
2014

Permanent Link:

https://doi.org/10.3929/ethz-a-010279224 →

DISS. ETH Nr. 21862

HEALTHY FOOD CHOICES: DRIVERS AND BARRIERS - EVIDENCE FROM THE SWISS FOOD PANEL

A dissertation submitted to

ETH ZURICH

For the degree of

Doctor of Science (Dr.sc. ETH Zurich)

presented by

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2014

Christina Hartmann was financed by the Swiss Federal Office of Public Health.

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Abbreviations

BMI	Body Mass Index
EPIC	European Prospective Investigation into Cancer and Nutrition
FFQ	Food Frequency Questionnaire
GPAQ	Global Physical Activity Questionnaire
NCD	Non-communicable disease
OECD	The Organisation for Economic Co-operation and Development
PA	Physical activity
PUFA	Polyunsaturated fatty acids
SDT	Self-determination theory
SSB	Sugar sweetened beverages
TSQR	Treatment Self-Regulation Questionnaire
WHO	World Health Organisation

Part I

General Introduction

General Introduction

A study was conducted with undergraduates from the discipline of nutritional science at the University of Giessen, Germany (Lorger & Leitzmann, 1979). They showed that those who have the highest knowledge about nutrition do not eat better than undergraduates from other disciplines. Nutrition knowledge is often considered a key skill for healthy eating behaviour, but actually there is a gap between knowledge and behaviour (Worsley, 2002). Public Health efforts to raise awareness through consumer education for the consequences of an unhealthy lifestyle do not seem very successful since many people still eat an unhealthy diet and are physically inactive. Even if the informed consumers are aware of the health effect of their behaviour, and they know about the 'healthy' choices, they do not change their behaviour substantially, at least in the long term. Unhealthy diets, overconsumption and inactivity promote weight gain and lifestyle-related non-communicable diseases (e.g. obesity, cardiovascular diseases) can result. The worldwide prevalence of obesity nearly doubled between 1980 and 2008 (World Health Organisation, 2014b), and considering the ramifications of obesity and lifestyle diseases it is important to detect risk groups and further explore what factors promote or hinder health behaviour.

Aim of this thesis

The present dissertation aims to identify factors related to individual psychological conditions, personal food skills and the eating context that either promote or prevent healthy food choices. Based on recent studies, new drivers and barriers for healthy food choices were identified. Furthermore, evidence is provided that helps us to understand why some people are successful in managing a balanced diet and body weight, while others have difficulty in implementing healthy food choices within their daily routine. Understanding the processes that impact behaviour on a population-wide basis are mandatory for successful public health strategies and health promotion campaigns. By using data gathered on a population level, relevant influences on health behaviour in different socio-demographic groups were detected, and risk groups for negative diet-related health behaviour were identified. All evidence presented in this thesis is based on data from a longitudinal adult survey conducted in Switzerland. The thesis is divided into three parts. Part I comprises a general introduction dedicated to selected factors influencing food choices and aspects of a Westernized lifestyle. Theoretical backgrounds and the current state of research are introduced. Part II contains new studies

based on data from the Swiss Food Panel that aim to provide further evidence regarding factors influencing food choices, exercise participation and body weight management. Part III involves an overall discussion about central findings of the studies and the Swiss Food Panel project.

1 Western society's unhealthy lifestyle

Human health is significantly influenced by nutrition. Nutrition not only encompasses sufficient energy supply and a source of all essential nutrients, but also it can contribute to long-term health and disease prevention. But the contemporary lifestyle of Western societies is characterized by unhealthy diets, inactivity, overweight and obesity. An unhealthy diet and inactivity are two out of four common risk factors (the other two are tobacco use, harmful use of alcohol) for the development of non-communicable diseases (NCD) (World Health Organisation, 2013). Obesity substantially contributes to the development of a number of NCDs (e.g. cardio-vascular diseases, diabetes) that are the most common causes of death not only in Western societies, but also worldwide (World Health Organisation, 2013).

1.1 Unhealthy diets

Over the past few decades or so, food consumption has changed and dietary patterns have undergone major shifts towards a so-called Western diet. Diets became more energy dense – dominated by food from animal sources and processed foods high in sugar – but generally low in fruit, vegetables and satiating fibre-rich foods. Availability and convenience of high-fat, palatable foods increased and their energy density is considered to be a major driver in the obesity epidemic (Swinburn et al., 2011). These foods are also less satiating and people have difficulty in compensating for higher energy intakes. Another high-calorie food that is widely available and thus, very frequently consumed in most countries (Adair & Popkin, 2005), are sugar-sweetened beverages (soft drinks). Their high sugar content and less satiating effect leads to high intake rates that contribute to weight gain in children and adults (Malik et al., 2006). Also, alcohol is very common in Europe with beer having the highest consumption (Popova et al., 2007). Alcohol is not only energy dense and can promote weight gain (Colditz et al., 1991), but also it is in a dose-repose relationship associated with some types of cancer (World Health Organisation, 2014a). Energy from alcohol is likely to be added to energy intake from food, which results in an oversupply of energy (Colditz, et al., 1991). High alcohol consumption was reported to be more likely in people with an unhealthy dietary and lifestyle pattern (Berrigan et al., 2003; Sjoberg et al., 2003). Another typical characteristic of the Western diet is a high consumption of meat. Recently published mortality data from the European Prospective Investigation Into Cancer and Nutrition (EPIC) study indicates a

moderate positive association between processed meat consumption and the mortality risk from coronary arterial diseases (Rohrmann et al., 2013). Even more evidence was reported with regard to red meat consumption and the development of type 2 diabetes mellitus (Pan et al., 2011) and cancer (World Cancer Research Fund, 2007). Processed meat especially seems to be harmful based on its high content of salt and pickling salt (Kusche-Vihrog & Oberleithner, 2012) as well as the formation of toxic compounds when heated (Daniel et al., 2012). Meat is also high in fat and energy; especially some kinds of processed meat can contribute to an oversupply of energy and make it more difficult to hold the energy intake and expenditure in balance. Thus, it was reported as a predictor for long-term weight gain (Wang & Beydoun, 2009). In contrary to a high meat intake, consumption of fruits and vegetables is typically low in a Westernized diet. Fruit and vegetables are not only important sources for vitamins, minerals and other bioactive compounds, but also they help to keep energy intake low due to their relatively low energy density. However, the recommendation of five fruits and vegetables every day is not reached by most consumers (Lock et al., 2005).

1.2 Inactivity

Physical activity (PA) helps to maintain energy balance – not least because of its modifying effect on body composition. PA reduces fat mass and increases muscle mass. This results in an increase in the resting metabolic rate, which can have a positive weight-modulating effect even in states of inactivity. The dose-response relationship of PA and positive health outcomes is not yet clear, but it is evident that moderate-intensity PA activity levels are already beneficial and do not need a training effect to elicit health benefits (Hardman & Stensel, 2009). Not only does PA beneficially affect health parameters, it is also associated with psychological well-being (Fox, 1999). Nevertheless, a large portion of the population is insufficiently physically active (Sjöström et al., 2006). In Switzerland in 2007, approximately 32% of the adult population meets the recommended three vigorous training sessions per week (endurance-type, e.g. jogging), and 9% meets the minimal recommendation of half an hour of moderate intensity PA on most days of the week (e.g. cycling) (Martin et al., 2009). Low PA levels are more common in women (Bauman et al., 2009; Bull et al., 2004), in people living in rural areas (Martin et al., 2005) and in older people (Sallis, 2000).

PA is a complex interplay of different determinants. Baumann et al. (2012) have categorized these determinants as intrapersonal (e.g. motivation), interpersonal (e.g. family),

environmental (e.g. built environment) and policy (e.g. formal education) related, which vary in their influence intensity over a lifecourse (Figure 1.1) (Bauman et al., 2012).

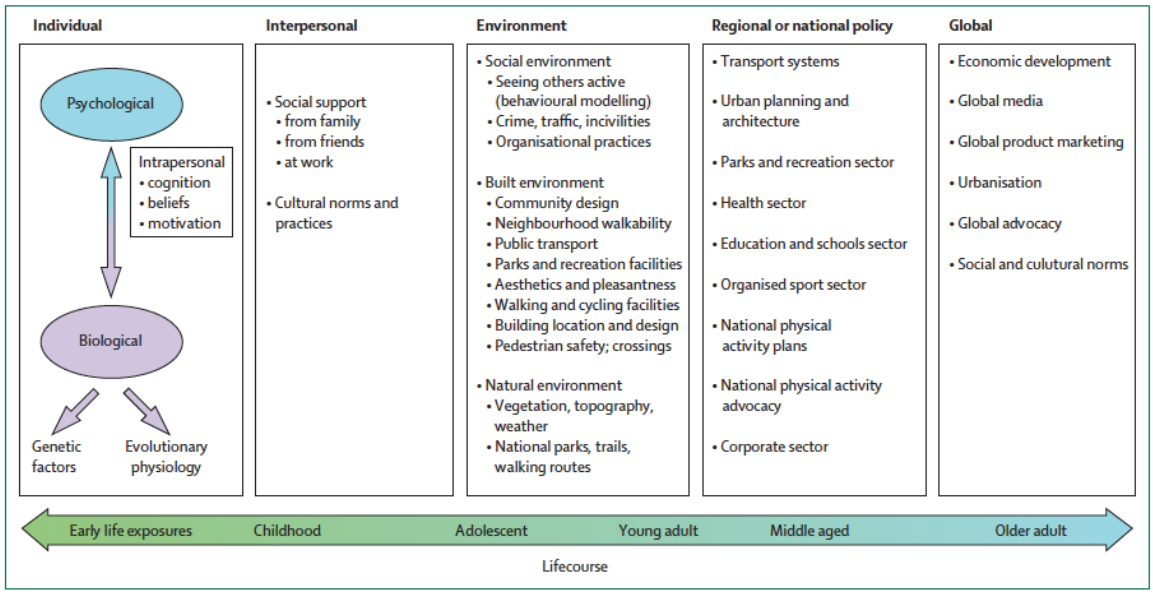

Figure 1.1. Determinants of physical activity from the individual, intrapersonal, environmental and policy level (Bauman, et al., 2012, p. 259).

Next to external aspects of the built environment, such as ‘walkability’ or public transport, intrapersonal factors, such as beliefs and motivation, determine PA behaviour. In a representative sample of European adults, the most frequently given motive for exercise participation was to maintain good health (42%), release tension (30%) and to get fit (30%) (Zunft et al., 1999). A considerable number of people start being physically active at least moderately, but the majority drop out within one year (Sallis et al., 1986). The most common perceived barriers, the ‘super barriers’(Brinthaupt et al., 2010; Kruger et al., 2007), for long-term adherence to PA are lack of time, being physically unable (Booth et al., 1997; Owen & Bauman, 1992) and lack of enjoyment (Brinthaupt, et al., 2010; Kruger, et al., 2007; Salmon et al., 2003). Overcoming barriers for long-term adherence to exercise is an essential part of promoting higher exercise levels in the population. Nevertheless, little is still known about factors that promote maintenance, quitting or adopting PA.

1.3 Overweight and obesity

Overweight and obesity are prevalent in both developed and developing countries. According to the World Health Organisation (WHO), in 2008, 34% of the male population and 35% of the female population over 20 years old were overweight, and an additional 10% of the male population and 14% of the female population, were obese. Obesity results from a chronic imbalance between energy intake and energy expenditure that leads to excess fat storage. Visceral fat accumulation especially is associated with a high risk for cardio-vascular diseases and constitutes an indicator for metabolic syndrome. Overweight and obesity are mostly referred to as a multifactorial conditions based on a complex interplay of different factors related to the environment, genetic predisposition, physiological conditions and behaviour. While the environment makes a significant contribution in promoting food consumption and inactivity ('obesogenic' environment), the genetic predisposition alone usually does not lead to excess fat storage. Obesity and overweight result from an interaction of genetic predisposition with environmental factors, or in George Bay's words 'The genetic background loads the gun, but the environment pulls the trigger.' (Bray, 2004, p.1).

The most frequently used measure to assess overweight and obesity is the Body Mass Index (BMI). The BMI is a simple calculated ratio between a person's body weight and body height (BMI = kg/m^2). According to the international standard of the WHO, BMI values are classified in underweight, normal range, overweight and obese (Table 1.1).

Table 1.1 The International Classification of adult underweight, overweight and obesity according to body mass index (BMI, World Health Organisation, 2006)

Classification	BMI (kg/m^2); Principal cut-off points
Underweight	<18.50
Severe thinness	<16.00
Moderate thinness	16.00 - 16.99
Mild thinness	17.00 - 18.49
Normal range	18.50 - 24.99
Overweight	≥25.00
Pre-obese	25.00 - 29.99
Obese	≥30.00
Obese class I	30.00 - 34.99
Obese class II	35.00 - 39.99
Obese class III	≥40

2 Factors influencing food choices

Food choices have been studied from different disciplinary perspectives and theoretical frameworks, and a lot of factors are revealed as influential in the food decision process. Influential factors are numerous and interrelated, vary in degree and depend on contextual components (Furst et al., 1996). One attempt to capture and outline factors that play a role in the food choice process has been made by Furst et al. (1996). They grouped factors into the life course, personal system and influences (Figure 2.1). For example, influences such as ideals or resources are shaped by a person's life course, and effect peoples' personal food system. Apart from within-individual factors that play a substantial role in the food decisions process, environmental factors have also a strong impact on food choices. Perhaps one of the most influential is culture. It defines what is edible and appropriate, and mostly determines what is available.

People make a lot of food decisions every day and are influenced by a lot of factors attributable, but not restricted, to their personal social environment, their knowledge about eating and their food preferences. This chapter is dedicated to some selected potential factors that influence food choices. In particular, factors related to psychological conditions, food skills and factors associated with the eating context; their theoretical framework and current state of research is addressed.

2.1 Psychological conditions

2.1.1 The omnivore's dilemma

In ancient times, humans needed to survive in environments with limited food choices by constantly searching for new food sources, and simultaneously preventing the consumption of poison substances. This ambivalent behaviour was named by Rozin (1990) as the 'omnivore's dilemma'. The 'innate' response to unfamiliar foods defined by rejection of the unknown (neophobia), is a characteristic feature of an eating organism. Next to neophobic tendencies, there are two additional genetically predisposed behaviours that determine food preferences: a conditioned rejection of food following post-ingestive problems after consumption (Rozin, 1990), as well as a preference for a sweet taste and an aversion to a bitter taste (Cowart, 1981).

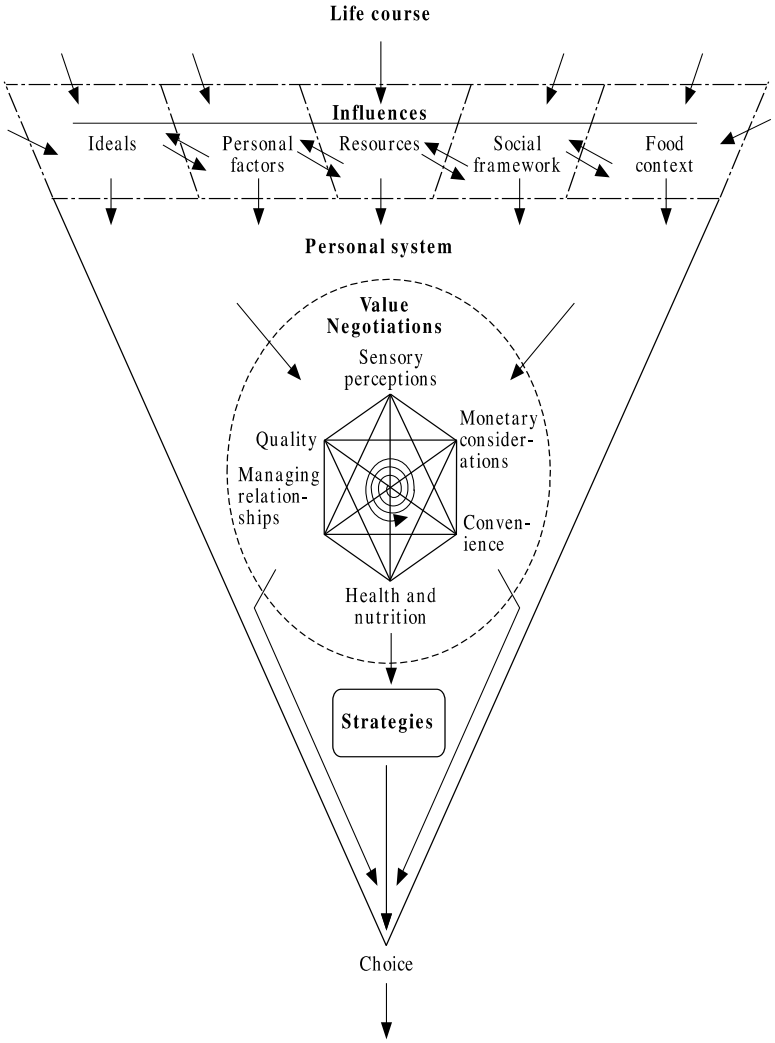

Figure 2.1. The conceptual food choice model depicts the types of factors involved in a food decision process (Furst, et al., 1996, p. 251). The arrows indicate the relationships of the components, which shape each other.

Food neophobia naturally increases after weaning, and children refuse unknown foods – except for those high in sugar (Steiner, 1974). It has its peak in children aged around two to six years old, while it normally decreases with older age when positive food experiences are made (Dovey et al., 2008). In the establishment of food preferences, social influences play an important role. With parental encouragement to try new foods, and by observing others eating the food, neophobic reactions can be reduced (Birch, 1999). Through repeated exposure to different food items in non-coercive settings, food neophobia decreases based on 'learned safety' (Kalat & Rozin, 1973). The development of preferences for foods such as dark-green vegetables, which taste bitter in nature, is largely based on positive experiences.

Although, food neophobia decreases with age through exposure and experience, it can be present in adults as well. However, previous research lacks some clear evidence regarding an association between age and food neophobia in adults (Meiselman et al., 2010). Nevertheless, people vary greatly in their attitudes towards food, and food neophobia might be one factor that influences the variation of people's acceptance and interest in new foods. Most people eat what is familiar to them, and one of the most important barriers for adopting new eating behaviours is poor taste expectation (Glanz et al., 1998; Gough & Conner, 2006). People who are more neophobic reject food items even before tasting them because they expect a negative taste from the unfamiliar food (Pliner et al., 1995). Neglecting unfamiliar foods and those that deviate from the cultural norm, such as seitan, might be a barrier in some people to initiate dietary changes. The establishment of a new dietary pattern through the replacement of unhealthy familiar foods via healthier products (e.g. a soy-based meat substitute) might be hindered by a lack of willingness to seek and explore new options. However, it is still unclear how food neophobia impacts eating behaviour and diet quality in adults. In Chapter 5 of this thesis, a study is presented that examines the prevalence of food neophobic tendencies in Switzerland. Furthermore, it explores how food neophobia is related to food choices and different socio-demographics that are linked to food exposure, such as urban living or level of income.

2.1.2 Eating styles

Another individual psychological condition that strongly affects food choice and eating behaviour is a person's eating style. Eating styles – emotional eating, external eating and restrained eating – are three different types of eating behaviour. They have been associated with weight gain in some studies (Hays et al., 2002; Klesges et al., 1992), and they are a major topic examining the underlying mechanism for eating behaviour differences in normal weight and overweight people.

Eating in states of emotional arousal, such as anger, sadness, boredom or stress, has been defined as 'emotional eating'. This can be qualified as a controlled emotion regulation strategy, and it can also become habitual or indeed compulsive (Tice & Bratslavsky, 2000). Eating to regulate mood and emotions is an acquired behaviour (Nguyen-Rodriguez et al., 2008; Snoek et al., 2007), and probably a common strategy in a substantial part of the population, which is not restricted to people with eating disorders (Macht & Gwenda, 2011) or those in specific weight categories (van Strien et al., 1986). In a population-based study in

Finland, 30% of the female participants and 26% of the male participants reported stress-driven eating and drinking episodes, at least occasionally (Laitinen et al., 2002). In the same study, 'stress-driven' eaters ate energy-dense, high-fat foods more frequently and had higher BMIs. In another study, people who tended to eat in states of emotional arousal, ate more palatable, sweet, high-fat foods compared to non-emotional eaters or unstressed emotional eaters (Oliver et al., 2000). In fact, palatability seems to be a crucial factor in emotional eaters to cope with emotions because it is thought to improve mood ('comfort food') (Macht & Gwenda, 2011). Restrained eaters cognitively restrict their food intake in order to lose or maintain weight. A strong restriction of food intake can be counter effective insofar as it is prone to breakdown (disinhibition) caused by stress, external eating cues or emotional distress, for example. Indeed, students who were dieters or restrained eaters were more likely to eat more in stressed situations than unrestrained eaters (Oliver & Wardle, 1999). In another study, restrained and unrestrained eaters were exposed to a specific food smell and thought; the restrained eaters consumed more of that specific food than the unrestrained eaters (Fedoroff et al., 2003). However, studies often fail to find an association between restrained eating and weight or BMI (de Lauzon-Guillain et al., 2006; Koenders & van Strien, 2011), which might be partially caused by periods of lower energy intake in restrained eaters (Wardle & Beales, 1987) and generally higher levels of PA (Anschutz et al., 2009). External eaters are people who are especially sensitive to external eating-related cues and tend to eat when they see or smell food, regardless of their hunger state (van Strien, et al., 1986). In an obesogenic environment in which a lot of eating occasions are offered, it might be extremely difficult for an external eater to resist those opportunities, which can rapidly end up as overeating.

A relatively complex interplay between the different eating styles with contextual factors makes it difficult to predict eating and weight development in people with high tendencies to eat in restrained, external or emotionally driven styles. Nevertheless, weight modulation plays a significant role in the development of eating styles. For risk groups, such as emotional eaters, it might therefore be beneficial to adhere to a PA routine. PA not only helps maintain energy balance, but also it can alleviate negative mood states (Yeung, 1996) and reduce symptoms of depression (Dunn et al., 2005; Lee et al., 2012). Thus, critical emotional situations in which an emotional eater would overeat might be less likely. To test the weight-modulating effect of PA in emotional eaters, we conducted a moderator analysis (Chapter 6).. Furthermore, we explored whether emotional eaters tended to consume sweet, high-fat foods more frequently and have higher BMIs compared with non-emotional eaters.

2.1.3 Motivation and self-determination

Food choices and PA are both health behaviours than can be directly influenced by an individual, but people often have difficulty staying on track for a longer period of time. Even if they are able to initiate behaviour change, they easily fall back into old routines. The identification of necessary psychological resources for long-term adherence to health-promoting behaviours is essential to successfully initiate permanent health behaviour changes. To predict positive long-term outcomes of behavioural change, a theory of motivation – the Self-Determination Theory (SDT) – is increasingly applied in the health domain.

The SDT was introduced by Deci and Ryan (1985). It is based on the assumption that the three psychological needs – competence, autonomy and relatedness – are essential for self-motivation, growth tendencies and well-being (Ryan & Deci, 2000). They postulated that a person's intrinsic motivation is based on the need for feeling 'self-determined competent' and effective (Deci & Ryan, 1985). In contrast, external rewards, such as monetary incentives, lead people to feel controlled and less self-determined, which undermines their need for autonomy. Although less important, relatedness means a person's need for a meaningful connection with others to feel attached. Students who regarded their teacher as more autonomy supportive, warm and caring were more intrinsically motivated (Ryan & Grolnick, 1986), and participants in a weight loss programme who perceived their intervention team as more autonomy supportive had higher autonomous reasons to stay in the program (Williams et al., 1996). Need satisfaction is considered as significant for intrinsic motivation and behaviour in different domains, such as work, sport or health care (Ryan & Deci, 2000). Social-contextual factors can either facilitate or disrupt need satisfaction and thus self-determined action and well-being (Deci & Ryan, 2000, 2002).

Based on these basic issues, the SDT approach further differentiates between five types of motivation that lie along a continuum from most to less self-determined (Figure 2.2). The most central distinction is between controlled forms of motivation (external, introjected) and autonomous forms of motivation (identified, integrated, intrinsic). People who feel controlled in their behaviour; for example, driven by guilt, frustration or demands by others, (which often appears in the health behaviour domain), lacks some self-determined action, are prone to discouragement after a failure and are less persistent in their behaviour (Ryan et al., 1995). In contrast, autonomously motivated people have identified with the activity's value

and experience volition. Different intervention studies in the health domain have been conducted that aimed to increase participants' autonomy in behavioural regulation. For instance, Silva et al. (2011) conducted a longitudinal randomized controlled trail with overweight and middle-obese females. The intervention was based on increasing autonomous regulation towards exercise and weight control by providing different options to choose from, supporting autonomous decision-making, and limiting external contingencies and controls. Autonomous regulation increased in the intervention group and participants were more moderate or vigorously physically active and had higher weight loss in the long term after the intervention was completed than the control group (Silva et al., 2011). The types of motivation and self-regulation are important determinants in health behaviour, and studies based on the SDT approach have mushroomed across different domains in the past decades with promising new perspectives (Deci & Ryan, 2008).

In Chapter 7, a longitudinal study is presented in which the SDT approach was applied with the focus on healthy body weight motivation. More detailed, based on the SDT approach, underlying motives for the desire to reach or maintain a healthy body weight were assessed. We further investigated whether different types of body weight motivation were associated with one-year changes in food choices and PA behaviour.

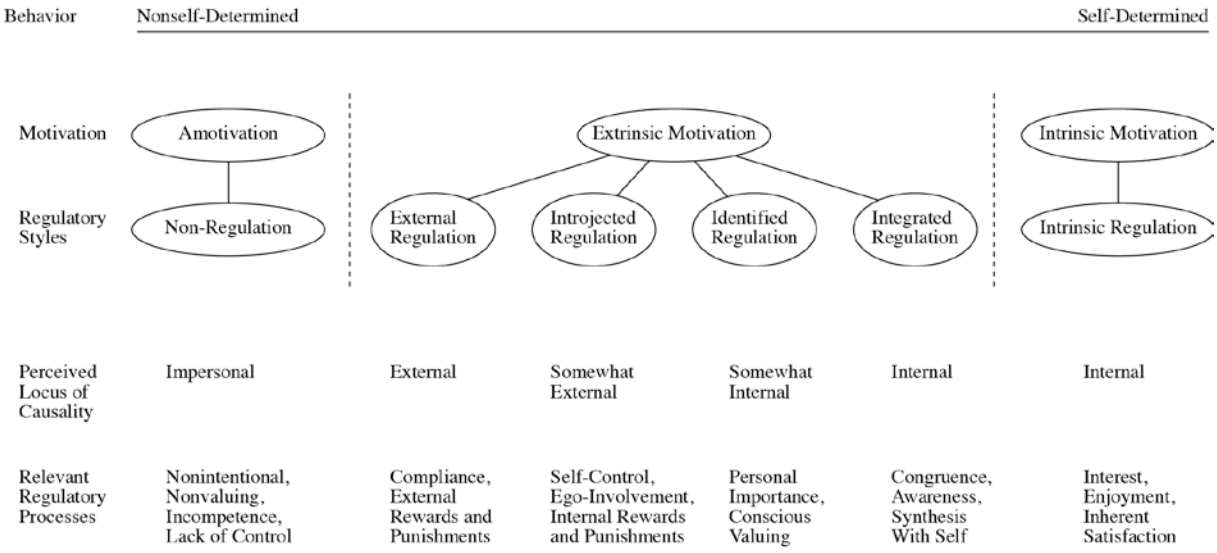

Figure 2.2. Self-determination continuum showing types of motivation with their regulatory styles, loci of causality and corresponding process (Ryan & Deci, 2000, p. 72).

2.2 Food skills

2.2.1 Cooking skills

People experience increasing time pressures brought about by their job, family responsibilities and leisure activities (Jabs & Devine, 2006). Time-saving behaviour related to daily food preparation and an increasing convenience orientation are significant aspects in daily food choices (Bava et al., 2008; Jabs & Devine, 2006). Especially in households with working parents, coping strategies to speed up meal preparation time by the increased consumption of fast food were observed (Darian & Klein, 1989; Devine et al., 2009). Additionally, family meal occasions declined over time (Gillman et al., 2000). Significantly, a family's dining table is not only a place of food socialisation and communication, but also it is a place where food values, skills and eating habits are transferred. Research suggests that family meals are perceived not only as positive by parents and adolescents (Fulkerson et al., 2006), but also are associated with better eating behaviour, a higher intake of fruit and vegetables, and thus better diet quality in adolescents (Neumark-Sztainer et al., 2003) and adults (Boutelle et al., 2003). Furthermore, adolescent girls who had more than five family meals per week were less likely to develop extreme weight control behaviours within five years follow-up, even after adjustment for socio-demographic factors, BMI and parental encouragement to diet (Neumark-Sztainer et al., 2008).

A release of the traditional family meal leads to the individualisation of meal consumption. An intergenerational transmission of cooking skills at home might also be less important nowadays. Cooking skills are not necessary anymore for daily food supply, and thus are less often practiced. As a consequence, people's diets become increasingly heteronomous, because of a higher proportion of ready-to-eat foods in the diet (Devine, et al., 2009). They lose control over food ingredients, flexibility and choice variety. Most of the available convenience food and fast food items tend to be high in fat, sugar, sodium and saturated fatty acids, and therefore are of poor dietary quality. Increasing fast food and snack food (e.g. chocolate bars) consumption are thought to contribute to the development of overweight and obesity in children (Gillis & Bar-Or, 2003) and adults (Jeffery & French, 1998; Pereira et al., 2005), and might also negatively affect the development of taste preferences (salty, fatty, sweet) in the next generation.

Nevertheless, the effect of cooking skills on diet quality is unclear and only a few studies were conducted addressing this relationship. In a study with young adults, those who were able to cook reported less frequent fast food consumption, and they were also more

likely to meet dietary objectives for fruit and vegetables as well as fat intake (Larson et al., 2006a). In another study, adolescents who were more involved in food purchasing and preparation at home consumed more fruit and vegetables (Larson et al., 2006b). Nevertheless, empirical support for an association between socio-demographic factors and cooking skills is scarce and it is still unknown what factors predict cooking skills. Although cooking might seem to be an unquestionably important skill in domestic nourishment, the influence of cooking skills on the quality of adults' diets and food decisions is understudied. One reason is based on the fact that there was no cooking skill scale available to measure cooking skills on a population level. In Chapter 8 of this thesis, a newly developed cooking skill scale is proposed, and further exploration is undertaken on how cooking skills relate to food choices and what psychological factors predict cooking skills in men and women.

2.2.2 Nutrition information usage

Nutrition tables are an attempt to induce consumers to change their behaviour and make better-informed food decisions. Consumers' motivation to spend time on nutrition tables is influenced by different contextual factors that determine if consumers consider nutritional information or if other aspects such as taste, convenience or price play a more important role in the food decision process (Grunert & Wills, 2007).

Interest in nutrition education is essential for searching for nutrition information. Interest is determined by factors such as perceived personal relevance of nutrition or personal emotional links to eating. A health-conscious person who perceives nutrition as an important part of their lifestyle might be more motivated to search for relevant information than a person who rejects the theme at all. Interest in nutrition is more common among women, older and highly educated people (Grunert & Wills, 2007).

Message simplicity is an important determinant in increasing interest and acceptance of nutrition information. For example, mass-media is crowded with different and even contradictory information about nutrition and weight loss approaches that may lead to consumer confusion, uncertainty or even 'public apathy' (Mendelsohn, 1973) rather than helping to raise awareness for health-promoting behaviour. Two factors are crucial for effective nutrition information. First, the consumer has to like and understand the information; and second, the information has to be used by the consumer (Grunert & Wills, 2007). People with higher nutritional knowledge use nutrition labels and information more often and their knowledge is widely used as an indicator for understanding the nutrition information

(Drichoutis et al., 2005). However, the impact of nutrition information usage on diet is less clear. For example Neuhouser et al. (1999) found that reading nutrition tables is associated with a significant lower fat-intake, and the authors concluded that those who want to reduce their dietary fat use nutrition tables as a reference (Neuhouser et al., 1999). In contrast, Steenhuis et al. (2004) found no effect of fat labelling in the supermarket on total fat intake (Steenhuis et al., 2004). The use of nutrition labels varies between different demographic groups and consumer characteristics. Females are more likely to use nutrition tables than males (Neuhouser, et al., 1999), and younger people were found to be more interested in labels than older people, children or adolescents (Campos et al., 2011). Some consumers receive information, for example, from doctors, dieticians, friends or relatives (van Dillen et al., 2003).

Nevertheless, searching for nutrition information is an active process, which is in contrast to the accidental exposure to information through labels on packages or advertisements, for example. It requires additional effort to search, evaluate and include the information in the decision-making process (Drichoutis, et al., 2005; Grunert & Wills, 2007). The consumer has to weigh the additional cost of researching and the time spent reading against the additional benefit of healthier food choices (Drichoutis, et al., 2005). People who are health-conscious might be able to more easily reach official sources of information (e.g. brochures, websites), because they might be interested in the nutrition theme and thus are more willing to invest the effort. But nutrition information use is not restricted to food labels or nutrition tables on food packages, and different consumer groups might use and profit from different communication channels for nutrition information. So far, little research has been conducted to prove this hypothesis, and additionally take consumers' food behaviour into account. Therefore, in Chapter 9, a study is presented, which is centred on consumer segmentation. The segmentation was based on different communication channels for nutrition information and consumers' interest in nutrition and diet-related health consciousness. Whether the use of different communication channels predicts better food choices was also examined.

2.3 Eating context

2.3.1 Eating pattern

Time-pressure (Jabs & Devine, 2006), increasing mobility (Organisation for Economic Co-operation and Development (OECD), 2012) and time-saving behaviour, such as eating on the run or having lunch at the desk, not only accompanied consumers' demand for pre-prepared and ready-to-eat food, but also is associated with a relief of the traditional three meals a day pattern resulting in an increased consumption of snacks and meal skipping. Breakfast is the most frequently skipped meal (Ruxton & Kirk, 1997; Sakata et al., 2001), although it is considered an important part of a regular eating rhythm. Frequent breakfast skipping was reported to occur in the context of unhealthy eating habits with low fruit and vegetable intake (Lazzeri et al., 2013) and coexistence with risk factors such as low exercise levels, frequent alcohol intake, smoking and high BMI (Keski-Rahkonen et al., 2003; Sakata, et al., 2001). Breakfast skipping is also often observed in obese people with low energy intake in the morning (morning anorexia), and the highest energy consumption in the evening (Night Eating Syndrome) (Bertéus Forslund et al., 2002; Stunkard, 1959) as well as unplanned overeating during the day with high-sugar snacks (Schlundt et al., 1992).

Changes in meal patterns and an increase in snack frequency is a trend observed in different countries all over the world (Piernas & Popkin, 2010). Snacks are contrary to meals defined by a smaller food volume and typically occur between main meals as a casual, individualistic and unstructured eating occasion. The snacking consumer coincides with an increased prevalence of overweight and obesity (Booth, 1988). Initiated by the notion that high eating frequency is associated with a tendency to eat more, and that typical snack foods (e.g. chocolate bars, sweet pastry) are most often energy dense, it is regarded as a potential risk factor for overweight and obesity. Several studies were conducted with contradicting results regarding snack frequency and body weight effect. For instance, in a large cross-sectional study with Swedish volunteers for an obesity intervention, high snack frequency was more prevalent in the obese group compared to a normal weight control-group (Bertéus Forslund et al., 2005). In contrast, in a weight loss trial with nutrition counselling and two groups of different eating frequencies (three versus six), no significant differences between groups in weight loss after one year were observed (Bertéus Forslund et al., 2007). Others found a negative effect of eating frequency on body weight (Howarth et al., 2007; Yiannakouris et al., 2007), inverse associations (Kant et al., 1995; Ruidavets et al., 2002) or no associations at all (Duval et al., 2008; Keast et al., 2010; Mills et al., 2011). Differences in

the ‘snack’ term definition, confounders based on differences in PA levels, underreporting of true food consumption and different demographic subgroups, might be responsible for the different results observed.

In scientifically studying snack frequency, metabolic and behavioural consequences are of great interest. A lot of research has investigated how snacking affects the appetite and the hunger state, and whether energy consumed as a snack is compensated by lower energy intakes at the subsequent meals. Leidy and Campbell (2011) concluded, in their review on appetite control, that low eating frequency of fewer than three meal occasions per day has a negative effect on appetite control, while increased eating frequency above the typical three meals per day pattern has no effect (Leidy & Campbell, 2011; Smeets & Westerterp-Plantenga, 2008; Stote et al., 2007). Other studies postulate that the time of consumption, the nutrient composition of the snack (Leidy et al., 2010), the habitual eating frequency and the frequency of the main meals (Leidy & Campbell, 2011; Whybrow et al., 2007) as well as the compensation strategies at the main meal (Rolls et al., 1991) are the determining factors for the behavioural and metabolic consequences of snacking. In an outstanding study from Marmonier et al. (1999), the authors differentiated between snacks consumed in a hungry versus a non-hungry state, and showed that snacks consumed in a non-hungry state had no beneficial effects on prolonged satiety, and are not compensated for in the subsequent meal (Marmonier et al., 2002; Marmonier et al., 1999). Nevertheless, the ‘obesogenic’ environment permanently enables and stimulates food intake. Situational cues (e.g. the presence of family, seated or not) and food cues (e.g. portion size, perceived healthfulness) determine how often people eat and whether people classify an eating occasion as a meal or a snack. This impacts on how much is eaten at the subsequent ‘real’ meal (Pliner & Zec, 2007; Shimizu et al., 2010; Wansink et al., 2010). Food consumed on the run might be perceived as a snack even though it is calorie dense, and subsequently, people eat another ‘real’ meal afterwards.

Various studies from different theoretical perspectives and research fields were conducted to reveal the association between eating frequency and body weight. Scientifically, the evidence is inconclusive and other factors, apart from the eating frequency itself, seem to be influential. Thus, it seems worth considering an overall approach to snacking, including eating patterns and lifestyle factors, instead of solely focusing on eating frequency. Therefore, we conducted a study focusing on dietary patterns in high-frequency snack consumers and discussed its meaning in the ongoing debate about the weight effect of high-frequency snacking and body weight (Chapter 10).

2.3.2 Life events

A person's food choice system and eating behaviour changes over their lifetime, shaped by varying life contexts, experienced situations and major life events. Major events lead to transitions from one life stage to another accompanied by new life circumstances. Such life events are, for example, retirement, the death of a spouse, the birth of a child, marriage or loss of a job.

It was previously assumed that life events initiate stress that is attributable to the need for changes in habitual patterns and social readjustment. There is now evidence that perceived positive and negative life events have a different effect on physiological and behavioural mediating pathways. Clinical and epidemiological research has found enhanced risks for morbidity and even mortality associated with negative life events (Cohen & Williamson, 1991; Stroebe, 2011). This leads to the assumption that major life events, such as the death of a spouse, divorce or loss of a job, result in psychosocial distress. Psychosocial distress can impact health not only through changes in the body's physiology (e.g. increased cortisol level) but also through changes in individual behaviour (Stroebe, 2011). Stressed individuals are more likely to engage in unhealthy coping behaviour, such as increased cigarette and alcohol consumption, poor eating habits and less PA (Ng & Jeffery, 2003). In contrast, positive life events, such as a new job, marriage or the birth of a child, were suggested to result in health-promoting behaviour triggered by changes in personal relationships, social roles and responsibilities, or family status and structure (Elder, 1987; Wethington & Johnson-Askew, 2009). For instance, new parents might be motivated to start paying more attention to their diet than they did prior to the birth event (Devine et al., 2000; Szwajcer et al., 2005). Furthermore, people who are married might profit from social support and guidance from a health-conscious spouse, which is linked with better health behaviour (Eng et al., 2005; Lee et al., 2005; Umberson, 1992). In studying changes in health behaviour and food choices over time, potential timeframes associated with change are negative and positive life events. A clear distinction between positive and negative life events, however, might not always be possible, because people might perceive the pleasantness of life events differently. Some might regard a specific major event as an opportunity to implement changes, while others might feel pressured and stressed to change routines.

Transition to cohabitation and parenthood. Life events that are associated with early family formation are particularly interesting because it seems to be a crucial time period that constitutes the basis for the family's future eating habits (Anderson et al., 2004). A lot of

studies have showed that social factors have an impact on eating behaviour: from the presence of others that have a clear impact on how much is eaten (Herman et al., 2003) to complex family interactions pervasively affecting what is eaten. Therefore, it is reasonable to assume that moving in with a partner leads to changes in their eating behaviour. However, the management of eating relationships requires food negotiations and compromises (Kemmer et al., 1998; Sobal, 2005). In common sharing of both meals and resources, it is suggested that partners tend to converge their diets to a more similar eating pattern (Bove et al., 2003; Marshall & Anderson, 2002).

The transition to parenthood might also impact people's health behaviour and lifestyle. With social roles being redefined, new caretaking responsibilities occur and parents want to create a health-promoting environment for their new-born (Edvardsson et al., 2011). This might be accompanied by food-related changes in attitudes, values and strategies, which lead to an implementation of healthier eating habits (Devine, et al., 2000). For example, women were reported to consume more fruit and vegetables and eat breakfast regularly two years post-partum (Olson, 2005). On the other hand, early parenthood might also be a risky period for developing unhealthy eating habits due to the excessive demands of family roles and domestic tasks. Parents experience increasing time scarcity (Jabs & Devine, 2006), and compromises in food choices are made, for instance, by obtaining more ready meals and fast food. Coping strategies, such as missing meals or eating away from home, might further negatively impact dietary quality (Bava, et al., 2008; Devine, et al., 2009).

Life events may not only force people to make behavioural adjustments, but also might enhance their motivation to implement positive changes. While cross-sectional studies only indicate differences in eating behaviours associated with different life stages, transition studies more precisely reveal dynamic adaptations attributable to a specific event. Therefore, we conducted a cross-sectional comparison of different household types to uncover whether food choices differ between people in different life stages; that is, single living, living with a partner and living with a partner and children. In a second step, a longitudinal analysis was performed that aimed to investigate whether life stage transitions are associated with changes in food choices (Chapter 11).

3 The Swiss Food Panel

3.1 Outline

The Swiss Food Panel is a longitudinal study about eating behaviour and PA behaviour in a Swiss adult sample. The Panel was initiated to gain insights into influences on food choices and PA behaviour, and to identify factors associated with behavioural changes over time. Moreover, potential target groups for further prevention campaigns and healthy lifestyle promotion should be identified. Data collection started in February 2010 with yearly follow-up periods for about five years. Participants filled in an annual paper-and-pencil questionnaire suitable for optical reading that gathers information about the consumption frequency of different core food items (e.g. meat, vegetables, high-fat foods). Alcohol consumption, PA level and socio-demographic variables were also assessed. The questionnaire covered a wide range of different topics related, but not restricted, to eating styles, healthy body weight motivation and food neophobia. Some questions and scales were included every year; others changed over time.

3.2 Sample characteristics and development

Recruitment. In spring 2010, a mail survey was sent out to 20,912 randomly selected household addresses from the telephone book in the German-speaking and French-speaking parts of Switzerland. One reminder was sent with another copy of the questionnaire after five weeks to people that had not yet responded. The response rate was 30.1% (N = 6290, Figure 3.1). The initial response rate was relatively low, which is not unusual for surveys conducted in Switzerland, and is partially attributable to over-surveying (Budowski & Scherpenzeel, 2005; Lipps, 2007). Participants with missing values on the ID variable or both key variables – age and gender – (n = 101) were deleted from the sample, which resulted in a sample size of 6189 participants (29.6%).

Non-response analysis. A random sample of 200 non-responders living in the German part of Switzerland was selected. A telephone survey was conducted to examine the demographic background variables. A maximum of five telephone calls were conducted at different times during the day to reach the non-responders. Out of the 200 non-responders, 55 could not be reached, and from 15 an invalid telephone number was registered. This resulted in 72% (n = 144) of the non-responders being reached. Compared to the food panel participants (Food

Panel vs. non-responders), the non-responders were more likely to be male (47.6% vs. 56.3%) and had a lower educational level (primary or lower secondary school, 6.9% vs. 22.0%). The nationality (Swiss 82.7% vs. 83.8%) and mean age (55.4 vs. 51.4) were comparable between responders and non-responders.

Sample characteristics. The basic characteristics of the sample over all four waves are depicted in Table 3.1. Compared to the general Swiss population in 2010 (Swiss Federal Statistical Office, 2010), fewer males participated in the study (census = 49.3%) and more participants had a higher secondary or college/university degree. The age range of participants included in the study was between 20 and 99 years. A lower percentage of young adults (20–39 years old) and a lower percentage of older people (>65 years) participated in the study (18.1% vs 27.0% census; 28.8% vs 17.1% census). It is very likely that young adults are less often registered in the telephone book and were therefore unreachable for this study.

Switzerland has four national languages: German, French, Italian and Rumantsch; 64% of the population live in Switzerland's 17 German-speaking cantons and 20% of the population live in the French speaking cantons (Western Switzerland). Of the participants in 2010, 70.1% (*N* = 4336) lived in the German-speaking part of Switzerland, and 29.9% (*N* = 1853) lived in the French-speaking part of Switzerland.

Table 3.1 Sample characteristics and development of the Swiss Food Panel

Characteristics	2010	2011	2012	2013
Participants	6'189	4'436	3'723	3'151
Response rate (%)	30.1	77.9	87.4	88.6
Men (%)	47.6	47.2	46.5	46.6
Age (years)	54.4	55.5	56.6	57.5
Education (%)[1]				
Low	6.9	6.0	5.5	5.0
Middle	29.8	37.5	37.5	37.1
High	53.8	52.1	54.2	55.4
Region West (%)	29.9	28.8	28.7	28.0

[1] Educational level was categorized into three categories: (low) no education, primary and lower secondary school, (middle) vocational school, (high) higher secondary school, college and university, ETH. Between 1-2% of the respondents did not report der educational level.

Of all people in the basis sample, 50.9% remained in the panel until 2013 (Figure 3.1). The dropout rate declined over time, which is typical for panel surveys (Lipps, 2007). Men, lower-educated people and people living in the French-speaking part of Switzerland were slightly more likely to drop out.

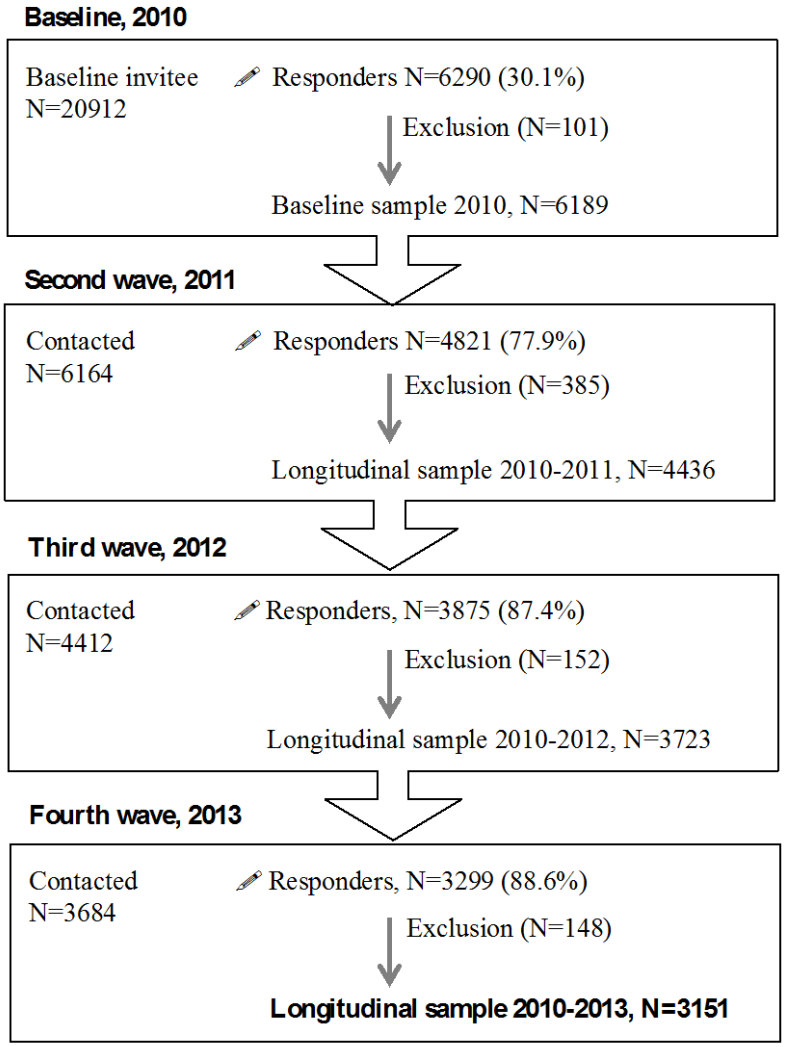

Figure 3.1 The flow chart depicts the study sample from the Swiss Food Panel. Excluded were those participants with missing gender, age or address details, those who died, those unwilling to participate in the next wave and those who filled in less than 50% of the questionnaire. Participants with inconsistent indicator variables (gender, birth date) between waves were also excluded.

4 Research questions

The central research questions in this thesis are dedicated to factors that influence food choices and determine changes in food choices over time. These factors are attributable to psychological conditions, food skills and eating context. Although it is not the focus of this thesis, PA will play a substantial role in two studies either as a moderator or an outcome variable. All studies are based on data from the Swiss Food Panel waves from 2010 to 2013.

Both cross-sectional and longitudinal analyses were conducted. Food choices in the following studies were evaluated with regard to their nutritional contribution to a balanced diet. Therefore, healthy choices were defined by high fruit and vegetable consumption and low consumption of high-fat, energy-dense food groups, while unhealthy food choices were defined by the high consumption of food groups that reflect a Westernized eating pattern, such as meat, processed meat, sugar-sweetened beverages and sweets. Nutrition-related lifestyle was characterized by variables, such as alcohol consumption, PA, family meals and front-of-TV main meal consumption.

Table 4.1 supplies an overview of all studies and corresponding research questions that are included in this thesis, followed by Part II in which new studies from the Swiss Food Panel are presented.

Table 4.1 Chapter overview and central research questions

Chapter	Topic	Central research questions
Chapter 1-4	General Introduction	
Chapter 5	Food neophobia in adults and food choices	Is there an association between food neophobia in adults, socio-demographic characteristics and food choices?
Chapter 6	Emotional eating and physical activity	Is there an association between emotional eating and BMI? Is there an interaction effect between recreational PA and BMI in emotional eaters?
Chapter 7	Body weight motivation, food choices and physical activity	Are different types of healthy body weight motivations associated with food choices and PA in the long term?
Chapter 8	Cooking skills and balanced food choices	What are the most important predictors for the presents of high cooking skills? Do people who are able to cook make better food choices?
Chapter 9	Nutrition information use and food choices	Do people differ in their nutrition information usage and interest? Do consumer segments differ in nutrition information usage and demographics?
Chapter 10	Snack frequency and dietary pattern	Is there an association between BMI and snack frequency? Are there different underlying eating patterns associated with a high snack frequency?
Chapter 11	Life events and changes in food choices	Are there within-individual changes in food choices and eating behaviour following the life event birth of the first child or moving in with a partner?
Chapter 12-14	General discussion	

BMI = body mass index; PA = physical activity.

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Part II

New Studies from the Swiss Food Panel

Chapter 5

Food neophobia in adults and food choices

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Manuscript published
Siegrist, M., Hartmann, C., & Keller, C. (2013). Antecedents of food neophobia and its association with eating behavior and food choices. *Food Quality and Preferences 30*, 293-298

Abstract

Antecedents and associations of food neophobia were measured. Data came from a large mail survey (N=4436) conducted in the German- and French-speaking parts of Switzerland. Results of a multiple regression analysis showed that age was positively, and income and education were negatively associated with food neophobia. Men had higher values compared to women, and participants from the German-speaking part had higher values compared with participants from the French-speaking part of Switzerland. Food neophobia also decreased with urbanization. Food consumption and liking of foods were correlated with food neophobia. Persons with higher food neophobia scores consumed smaller amounts of vegetables, salad, poultry, and fish compared with persons with lower food neophobia scores. Food neophobia was also positively related to the importance of the Swiss origin of foods. Food neophobia has a negative impact on people's food variety and on the consumption of recommended foods such as vegetables or fish.

5.1 Introduction

Humans are omnivores, and they can eat and digest a broad range of foods. This big advantage enables our species to easily adapt to a new food environment. Being an omnivore poses risks, however, because humans may consume toxic plants or animals, for example. Thus, humans, similar to other mammalian omnivores, demonstrate an ambivalent reaction to new foods, a mixture of interest and fear (neophobia) (Rozin & Vollmecke, 1986). These opposing motives are captured in the Food Choice Motive questionnaire (de Boer, Hoogland, & Boersema, 2007; de Boer, Schosler, & Boersema, 2013), which distinguishes between a promotion orientation (e.g., eating nourishing food) and a prevention orientation (e.g., avoiding dangerous plants). The goal of the prevention orientation is to avoid negative outcomes by avoiding novel foods. Humans differ considerably in their willingness to eat novel foods and in their level of food neophobia, however. Pliner and Hobden (1992) proposed the food neophobia scale, a reliable and valid instrument that measures food neophobia. Much research has examined the impact of food neophobia on people's willingness to eat or to try unfamiliar food products. This body of research suggests that food-neophobic persons are hesitant to try or to buy novel foods (Arvola, Lahteenmaki, & Tuorila, 1999; Backstrom, Pirttila-Backman, & Tuorila, 2004; Chung et al., 2012; Henriques, King, & Meiselman, 2009; Schickenberg, van Assema, Brug, & de Vries, 2008; Tuorila, Lahteenmaki, Pohjalainen, & Lotti, 2001). In the present paper, we examine the associations of various variables with food neophobia. We are especially interested in how neophobia is related to people's daily eating and food purchasing behavior and in the socio-demographic variables that are correlated with food neophobia.

The food neophobia scale has been shown to correlate not only with people's willingness to eat or to try unfamiliar foods (Tuorila, et al., 2001) but also with people's liking of unfamiliar foods (Arvola, et al., 1999). Study results suggest that people with a higher level of food neophobia rated the taste pleasantness of unfamiliar foods lower compared with people with a lower level of food neophobia. Raudenbush and Frank (1999) measured participants' willingness to try, expected liking of, actual liking of, and willingness to retry familiar and unfamiliar foods. The study results suggested that neophobics and neophilics do not differ regarding familiar foods, but in the case of unfamiliar foods, neophobics' ratings were more negative compared with neophilics'. Food neophobia was a significant predictor of people's willingness to try such exotic foods as snails or passion fruit (Backstrom, et al., 2004). People's willingness to try healthful alternatives (e.g., a meat

substitute based on soybeans instead of meat) was also negatively associated with food neophobia (Schickenberg, et al., 2008).

Food neophobia is an important predictor of people's willingness to try non-traditional ethnic foods (Choe & Cho, 2011; D'antuono & Bignami, 2012). Neophobics are less likely to be interested in ethnic foods compared with neophilics. The two groups did not differ, however, in acceptance of familiar non-ethnic foods. Acceptance of new food products also seems to be influenced by food neophobia. For functional food products, which provide additional health benefits, food neophobia had a negative impact on people's willingness to use and buy functional foods (Siegrist, Stampfli, & Kastenholz, 2008; Urala & Lahteenmaki, 2007). However, food neophobia seems unimportant for new products in general. For example, food neophobia was not a significant predictor of people's willingness to try genetically modified foods or organic foods (Backstrom, et al., 2004).

Only a few studies have examined how food neophobia influences everyday food choices. Associations between food neophobia and food intake were observed in an undergraduate student sample (Eertmans, Victoir, Vansant, & Van den Bergh, 2005). Another study showed that adults and children with higher levels of food neophobia had eaten fewer foods listed on a food frequency questionnaire compared with adults and children with lower levels of food neophobia (Koivisto & Sjoden, 1996). This suggests that people with a lower level of food neophobia consume a broader variety of foods compared with people with a higher level of food neophobia. Results of a study that examined a group of Scottish adolescents suggested that consumption of healthy foods is associated with a lower level of food neophobia (MacNicol, Murray, & Austin, 2003). Similar findings were observed in a Finnish study. Children with low neophobia gave higher pleasantness ratings for fruits and vegetables compared to children with high neophobia (Mustonen, Oerlemans, & Tuorila, 2012). In addition, neophobic children seem to have less variety in their diet compared with neophilic children (Falciglia, Couch, Gribble, Pabst, & Frank, 2000). To the best of our knowledge, the impact of food neophobia on the consumption of recommended foods such as vegetables, fruits, and fish in an adult population has not been examined.

What factors influence food neophobia? Food exposure seems to decrease people's food neophobia. Exposure to novel foods reduces food neophobia (Pliner, Pelchat, & Grabski, 1993). Based on this observation, associations between food neophobia and socio-demographic variables seem likely. There is a much broader food selection today than several decades ago. Therefore, in general, younger people have been exposed at early age to exotic foods compared to older people. Based on this reasoning, a positive relationship between age

and food neophobia is expected. In several studies, this association has been observed (Fernández-Ruiz, Claret, & Chaya, 2013; Meiselman, King, & Gillette, 2010; Pliner & Hobden, 1992). In cities, food availability is much broader compared to rural areas. People in rural areas may be less exposed to exotic foods and may have a higher level of food neophobia. Results in line with this hypothesis have been observed (Flight, Leppard, & Cox, 2003; Tuorila, et al., 2001). Culture may also have an impact on food neophobia. Results suggest that Lebanese college students have higher food neophobia scores compared with American college students (Olabi, Najm, Baghdadi, & Morton, 2009), and that Swedes are more willing to try novel foods compared to Americans or Finns (Ritchey, Frank, Hursti, & Tuorila, 2003).

Neophobia decreases as education increases (Hursti & Sjoden, 1997; Meiselman, et al., 2010; Tuorila, et al., 2001) and as income increases (Meiselman, et al., 2010). However, the effect of gender on food neophobia is still unclear (Meiselman, et al., 2010). Some studies reported significant gender differences, indicating that men are more neophobic than women (Hursti & Sjoden, 1997; Tuorila, et al., 2001). In other studies, no significant gender differences were observed (Fernández-Ruiz, et al., 2013; Nordin, Broman, Garvill, & Nyroos, 2004; Pliner & Hobden, 1992).

One goal of the present research was to examine the impact of socio-demographic variables on food neophobia. Published studies that examined associations between food neophobia and socio-demographic variables tested only bivariate associations. Some of the explanatory variables are correlated, however. Thus, it is important to control for these effects. Instead of bivariate correlations, multiple regression analyses were computed in this study. A second research goal was to examine possible relationships between food neophobia and food behavior. We expected that food neophobia is negatively correlated with liking and consuming foods such as vegetables or fish. In other words, food neophobia may influence people's food behavior by restricting the variety of food consumed, which may result in a less balanced diet. To consider correlations between food neophobia and food behavior with socio-demographic variables, it is important to control for the latter variables.

It has been suggested that for high-neophobic people a sense of cultural identification and social belonging is important (Barrena & Sánchez, 2012). Perceived familiarity with foods could be increased through communication, and as a result, product acceptance among consumers with a food neophobia tendency could be augmented. Based on this reasoning, we expected that food neophobia is positively correlated with the quality perception of Swiss, and therefore familiar, products and with the importance of the Swiss origin of foods.

5.2 Methods

Participants

This study analyzed data from the Swiss Food Panel, a population-based longitudinal study of the eating behavior of the Swiss population. The Swiss Food Panel started in 2010. Mail surveys were sent out to 20,912 randomly selected household addresses from the telephone book in the German-speaking and French-speaking parts of Switzerland. Altogether, 6189 persons were included in the baseline sample in 2010 (a response rate of 30%). All respondents in 2010 were contacted for the second survey period in 2011, except for 75 participants who were excluded from the survey because of missing addresses, death, or unwillingness to participate in the second survey. The 2011 response rate was 78%. After data cleaning, 4726 participants remained in 2011; their data were paired with the data from 2010. Data from respondents for whom gender and date of birth were different across the two surveys were deleted (n=290). Finally, 4436 participants remained in the final longitudinal sample 2010-2011. In the final sample, 47.2% of the participants were male, and the mean age was 56 years (SD=15, range 21–99). For the present study, data from 2011 were analyzed, because food neophobia was measured in the 2011 survey for the first time.

Questionnaire

The Swiss Food Panel is a paper-and-pencil questionnaire. It includes a short food frequency questionnaire (FFQ), and questions related to liking of various foods, importance of Swiss origin for foods, socio-demographic variables, and other constructs that are not relevant for the present research.

Food Neophobia Scale. The 10 items from the food neophobia scale (Pliner & Hobden, 1992) were translated into German and French (see Table 5.1). The wording of some items had to be changed a bit, to have the same meaning as the original items. Other studies using food neophobia also slightly changed some of the items so that they were meaningful to study participants (Flight, et al., 2003; Henriques, et al., 2009). The term ethnic restaurant is not used in German or in French, for example. Therefore, “ethnic restaurants” was replaced by “places, where foods from other cultures are served.” As in the original scale, a 7-point response scale was used, but the responses ranged from -3 (“do not agree at all”) to 3 (“fully agree”). The other response categories were only numerically anchored. The items indicated with R in Table 5.1 were recoded. Cronbach’s alpha for the total sample was .80. The item-

total correlations ranged between .30 and .62. This suggests that all items should be included in the scale. For the German-speaking sample, the Cronbach's alpha was .79, and for the French-speaking sample, the value was .82. For the individual scores, the mean value across the ten items was calculated.

Table 5.1 Original English items of the food neophobia scale, and German and French translations of the items.

English Items	German Items	French Items
1. I am constantly sampling new and different foods. (R)	1. Ich probiere ständig neue und verschiedene Lebensmittel aus. (R)	1. Je goûte constamment des aliments différents ou nouveaux. (R)
2. I don't trust new foods.	2. Ich traue neuen Lebensmitteln nicht.	2. Je ne fais pas confiance aux aliments nouveaux.
3. If I don't know what is in a food, I won't try it.	3. Wenn ich nicht weiss, was in einem Lebensmittel enthalten ist, probiere ich es nicht aus.	3. Quand j'ignore ce que contient un aliment, je ne le goûte pas.
4. I like foods from different countries. (R)	4. Ich mag Essen aus unterschiedlichen Kulturen. (R)	4. J'aime manger des plats de différentes cultures. (R)
5. Ethnic food looks too weird to eat.	5. Das Essen aus anderen Kulturen sieht eigenartig aus, so dass ich es nicht esse.	5. Les plats d'autres cultures me semblent bizarres, donc je ne les mange pas.
6. At dinner parties, I will try a new food. (R)	6. An sozialen Anlässen probiere ich neue Speisen aus. (R)	6. Je goûte de nouveaux plats lorsque je sors. (R)
7. I am afraid to eat things I have never had before.	7. Ich fürchte mich davor, Speisen zu essen, die ich nie vorher gegessen habe.	7. Je redoute toujours de manger des plats que je n'ai jamais mangés auparavant.
8. I am very particular about the foods I will eat.	8. Ich bin sehr wählerisch in Bezug auf Essen.	8. Je suis très difficile en matière d'alimentation.
9. I will eat almost anything. (R)	9. Ich esse fast alles. (R)	9. Je mange presque de tout. (R)
10. I like to try new ethnic restaurants. (R)	10. Ich gehe gerne an Orte, wo Essen aus anderen Kulturen serviert wird. (R)	10. Je vais volontiers dans les établissements qui servent des plats d'autres cultures. (R)

(R) Reversed items

Dietary Behavior Assessment. The FFQ was specially designed for the Swiss Food Panel and was used to estimate the frequency of the habitual consumption of various food products. FFQ scales were considered reliable by conducting a two-week test-retest analysis in a separate study (for further information, see (Hartmann, Siegrist, & van der Horst, in press).
In the Swiss Food panel, a comprehensive FFQ is not used, but foods that can be viewed as indicators of a balanced or not balanced diet were selected. These food groups were chosen because the consumption is encouraged by dietary guidelines (Keller et al., 2012) or because their high frequency of consumption has been shown to have negative health effects (Faramawi, Johnson, Fry, Sall, & Yi, 2007). Furthermore, the Swiss population consumes less fruits, vegetables and fish as recommended, but more sweet and salty snacks and red meat as recommended (Keller, et al., 2012). The questionnaire did not collect information on portion size or number of portions, except for fruit and vegetable consumption.

Items relating to meat (beef or veal, pork, chicken, sausages, and cold cuts) and fish consumption frequency were assessed on a 6-point scale. Response possibilities were “several times per day” (was assumed to be two times per day, coded as 14 times per week), “daily” (was assumed to be one time per day, coded as seven times per week), “several times per week” (was assumed to be three times per week, coded as three times per week), “several times per month” (was assumed to be three times per month, coded as 0.75 times per week), “several times per year”, and “less or never” were considered as negligible (coded as zero). Calculated mean values for consumption frequencies per week were for beef or veal 1.20 (*SD* = 1.29), for pork 1.00 (*SD* = 1.26), for poultry 1.26 (*SD* = 1.32), for sausages and cold cuts 1.26 (*SD* = 1.63), and for fish 0.85 (*SD* = 1.06).

Fruit, vegetable (cooked or steamed), and salad consumption was assessed with consumption frequency and portion number. For statistical calculations, a 5-point response scale for consumption frequencies was recoded: daily (coded as seven times per week), four to six times per week (coded as five times per week), one to three times per week (coded as two times per week), one to three times per month (coded as 0.5 times per week), and less or never (coded as zero). The respondents were asked how many portions of vegetables (cooked, steamed) and salad (one portion = a handful or 50 g) as well as fruits (one piece or one handful) they usually eat. The items relating to portion number and consumption frequency were combined to reflect “servings” of vegetables and salad as well as “pieces” of fruits consumed per week. The mean value for vegetable consumption was 8.76 (*SD* = 6.22), for salad consumption 11.00 (*SD* = 7.42), and for fruit consumption 9.59 (*SD* = 7.97).

Liking of various foods. Participants indicated how much they liked the following foods: vegetables (e.g., cooked or steamed) (*M* = 5.37, *SD* = 1.0); fruits (*M* = 5.23, *SD* = 1.12); chocolate, candies, and candy bars (e.g., Mars, Snickers, and Twix) (*M* = 4.41, *SD* = 1.49); chips, salty nuts, and salty snacks (*M* = 3.88, *SD* = 1.44); whole grain bread (*M* = 4.89, *SD* = 1.35); and cookies (*M* = 4.25, *SD* = 1.34). A 6-point response scale was used, and the response categories ranged from "do not like at all" (1) to "like very much" (6). The two extreme categories were verbally and numerically anchored; the other response categories were only numerically anchored.

Importance of Swiss origin. Participants answered the question "How important is it for you that the following foods originate from Switzerland?" The foods were poultry, beef, pork, fruits, and vegetables. A 6-point response scale was used, and response categories ranged from "not important at all" (1) to "very important" (6). The two extreme categories were verbally and numerically anchored; the other response categories were only numerically anchored. Responses to the items were highly correlated. The five items were combined to a scale (Cronbach's □.89) with a mean value of 24.02 (*SD* = 5.65).

Perception of food quality and safety of Swiss products. Three items measured whether participants perceived Swiss foods to be of higher quality and safety compared with foods from the European Union (EU; e.g., "The product quality of Swiss foods is better than that of EU foods," "The product safety/hygiene of Swiss foods is better than that of EU foods," "The taste of Swiss foods is better than the one of EU foods."). A 6-point response scale was used, and response categories ranged from "do not agree at all" (1) to "fully agree" (6). The two extreme categories were verbally and numerically anchored; the other response categories were only numerically anchored. Responses to the items were highly correlated. The three items were combined to a scale (Cronbach's □.84) with a mean value of 4.11 (*SD* = 1.16).

Socio-demographic characteristics. Age, gender, and region (German- or French-speaking part of Switzerland) were measured. Educational level was measured with five different levels, and household income was measured with six levels. Participants indicated whether they lived in a city, a suburb, or a rural area. This variable was dummy coded for further analyses with rural area as a reference category.

5.3 Results

Antecedents of neophobia

The impact of various socio-demographic variables on food neophobia was examined using multiple linear regression analysis. The predictors were age, income, gender, education, and indicators of the region in which the person lives. The model was significant ($F(7,4075)=103.03$, $p<.001$) and explained 15% of the variance. Results of the regression analysis are shown in Table 5.2. Age was significantly positively associated with food neophobia. Older people have higher food neophobia values compared with younger people. The effect for gender was also significant. Men have higher food neophobia values compared with women. Income and education were both negatively correlated with food neophobia. People with higher income and a higher level of education have lower food neophobia scores compared with people with lower income and a lower level of education. There was also a cultural effect. Participants in the German-speaking part are significantly more food neophobic compared with participants in the French-speaking part. Results further suggest that food neophobia decreases with urbanization.

Table 5.2 Results of a linear regression analysis with the neophobia scale as dependent variable, and various socio-demographic variables as independent variables

Variable	*B*	*SE B*	β
Constant	-1.08**	.09	
Age	.02**	.001	.23
Gender	-.16**	.03	-.08
Region	-.28**	.03	-.12
Income	-.09**	.01	-.13
Education	-.10**	.01	-.12
City (vs rural)	-.09*	.04	-.04
Suburbs (vs rural)	-.02	.02	-.01

Note. $R^2=.15$. * < .05, ** < .001; Gender, 0=males and 1=females; Region, 0=German-speaking part, 1=French-speaking part. The variable urban-rural was dummy coded with the reference category rural=0, and city=1 and suburbs=1.

Food neophobia and food consumption

Correlations between food neophobia and consumption of selected foods measured utilizing a food frequency questionnaire are shown in Table 5.3. People with higher food neophobia scores consume significantly less fish, poultry, vegetables, and salad compared with people with lower food neophobia. Women tend to consume more vegetables and have lower food neophobia scores compared with men. To rule out such alternative explanations of the observed effects, partial correlations were computed. The effects of region, income, education, age, and gender were controlled for. Results in Table 5.3 show that the bivariate correlations and the partial correlations were similar. This result suggests that food neophobia explains additional variance in people's food behavior besides socio-demographic variables.

Table 5.3 Correlations between neophobia scores and several food frequency measures

Variables	Correlation	Partial correlation[1]
Vegetable consumption (in portions)	-.07**	-.05*
Salad consumption (in portions)	-.07**	-.05*
Fruit consumption (in portions)	.02	<.01
Beef or veal consumption	-.02	<.01
Pork consumption	.05*	.04*
Poultry consumption	-.11**	-.05*
Sausages and cold cuts consumption	.03	.04
Fish consumption	-.10**	-.07**

Note. * < .01, ** < .001; [1]Controlled for the variables region, income, education, age and gender; N varies between 4043 and 4270, differences due to missing values

Food neophobia and liking of foods

The association between food neophobia and liking of various foods is shown in Table 5.4. Controlling for socio-demographic variables, food neophobia was significantly negatively correlated with vegetables, whole grain bread, and chips, salty nuts and salty snacks. Results suggest that food neophobia influences liking of foods from various food categories.

Table 5.4 Correlations between neophobia scores and much various foods are liked

Variables	Correlation	Partial correlation[1]
Vegetables cooked or steamed	-.09**	-.11**
Fruits	-.03	-.03
Chocolate, candies, candy bars (e.g., Mars, Snickers, Twix)	-.07**	-.02
Chips, salty nuts and salty snacks	-.13**	-.06**
Whole grain bread	-.15**	-.12**
Cookies	-.03	.01

Note. * = .001, ** < .001; [1] Controlled for the variables region, income, education, age and gender; N varies between 4075 and 4275, differences due to missing values

Food neophobia and preferred origin

Past research shows that people with higher food neophobia scores are more reluctant to buy new food products. As shown in Table 5.5, both the importance of Swiss origin and the perception that Swiss food is of higher quality and has better safety standards compared with food from abroad is associated with higher levels of food neophobia. Food-neophobic persons prefer not only familiar foods but also foods produced in a familiar country.

Table 5.5 Correlations between neophobia scores and various variables

Variables	Correlation	Partial correlation[1]
Importance of Swiss origin for foods	.11**	.08**
Food quality and safety of Swiss food is perceived better as foods from EU	.19**	.15**

Note. * = .001, ** < .001; [1] Controlled for the variables region, income, education, age and gender; N varies between 4197and 4436, differences due to missing values

5.4 Discussion

There are large inter-individual differences among humans in terms of trying new foods (Pliner & Hobden, 1992). People's reluctance to eat new foods can be a barrier for marketing new foods (Meiselman, et al., 2010), but food neophobia may also be a barrier to a more balanced diet. In many countries, people do not eat the recommended amounts of fruits and

vegetables. Therefore, uncovering factors that may be associated with unhealthy food consumption is important. Furthermore, food neophobia can influence people's hedonic assessment of foods. Fear of new food products must also be considered in commercial food product testing (Henriques, et al., 2009; King, Meiselman, & Henriques, 2008). Only when high-neophobic people participate in product development tests will products be designed that appeal to a broader range of consumers.

Results of the present study suggest that food neophobia influences people's daily eating behavior. Persons with higher food neophobia scores consume smaller amounts of vegetables, salad, and less often poultry, and fish compared with persons with lower food neophobia scores. We found these associations, even when we controlled for the impact of region, income education, age, and gender. Therefore, the results suggest that food neophobia may result in less balanced food consumption, because smaller amounts of vegetables, salad, and fish are consumed than recommended (Keller, et al., 2012). Food neophobia could be one reason that consumption of these products is not more prevalent. Moreover, food-neophobic people are not only reluctant to try new foods (Backstrom, et al., 2004; King, et al., 2008) but also have less variety in their diet compared with non-neophobic people, which might make implementing dietary guidelines in daily eating practice more difficult. Food neophobia also was not correlated with all tested food categories. This construct seems unrelated to the frequency of fruit consumption, for example. The alternative explanation that people with a high level of food neophobia have a generally lower intake of all foods can be ruled out. It seems likely that neophobic persons compensate for lower consumption of foods such as fish, poultry, vegetables, and salad with increased consumption of other food groups such as pork. Accordingly, food neophobia might not only restrict people's food variety but also might promote higher consumption of less beneficial food groups.

Liking of foods plays a dominant role in food choices and frequency of consumption (Woodward et al., 1996). Associations between food neophobia and food consumption might be mediated by disliking foods or anticipating bad taste (Eertmans, et al., 2005). Regarding people's liking of various food categories, underlying results were observed. People with higher food neophobia scores liked cooked or steamed vegetables and whole grain bread less compared with people with lower food neophobia scores. Even when the socio-demographic variables were controlled, food neophobia was associated with the liking scores. These results suggest that food neophobia-related dislike of foods might act as an additional barrier for balanced food choices especially regarding vegetable intake. However, for foods such as fruits and cookies no association with food neophobia was observed.

Food neophobia was correlated with the importance of Swiss origin for foods such as vegetables, fruits, and meat. These results are remarkable, because non-Swiss origin is not related to ethnic foods, which are less often consumed by neophobic persons. Large amounts of vegetables, fruits, and meat are imported, but people with a high level of food neophobia may prefer Swiss tomatoes, strawberries, or chicken breasts because such individuals have more trust in the food quality and safety of Swiss products compared to foods from other European countries. Therefore, promoting the Swiss origin of food products might be a method for signaling familiarity, and may increase food neophobics' willingness to buy or consume these products.

For product development or for campaigns aiming to increase consumption of recommended foods, factors such as food neophobia should be considered. To make new food products attractive to consumers with a higher level of food neophobia, familiarity should be created. An example is meat substitutes that are similar in shape and texture to meat products. Whether such new products are accepted by food neophobics and food neophilics should be tested, of course.

Food neophobia can be decreased through exposure to novel foods (Pliner, et al., 1993). Repeated exposure creates familiarity with a food; therefore, it is more likely accepted. However, there are other ways to increase familiarity with food products and to increase their acceptance among food neophobics. Results of the present study have further strengthened our hypothesis that product origin seems to be more important to people with a higher level of food neophobia compared with people with a lower level of food neophobia. Again, food neophobics perceived the quality and safety of Swiss food products to be better compared with foods from the European Union. When introducing new foods, familiar aspects of the foods such as originating in the consumer's country should be emphasized. This marketing approach could increase the familiarity of novel food.

Results of the present study suggest that people from the German-speaking region of Switzerland have higher food neophobic scores compared with people from the French-speaking region. Food neophobia seems malleable, to a certain degree. The food environment and French cuisine may have resulted in exposure to a broader set of foods. Other socio-demographic variables such as income, education, or urban living may also result in more exposure to various foods, and thus affect food neophobia (Meiselman, et al., 2010). Results from the multiple regression analysis suggest that income, education, and urban living had a negative impact on food neophobia. In line with other studies (Fernández-Ruiz, et al., 2013; Meiselman, et al., 2010; Pliner & Hobden, 1992), we found age was positively correlated with

food neophobia. One would expect that with increasing age people have been exposed to more foods. It seems plausible, therefore, that a cohort effect has been observed. The food environment today is much more influenced by various ethnic foods, and a much broader set of foods is available compared to forty or fifty years ago. It could be that food habits developed in an environment with broad food exposure result in less food neophobia compared with habits developed in a more food-deprived environment. It is not possible to test this explanation in a cross-sectional design, and longitudinal studies over a long period of time are needed.

The effect of gender on food neophobia is less clear. Meiselmann and colleagues (2010) concluded that gender has little or no effect on neophobia. Results of the present study showed that men are significantly more neophobic compared to women. Thus, we replicated the findings observed in Finnish (Tuorila, et al., 2001) and Swedish (Hursti & Sjoden, 1997) studies. One possible explanation for the observed gender differences is that women are still more often responsible for food preparation compared with men (Hartmann, Dohle, & Siegrist, 2013), and thus, women may be more exposed to and more familiar with a broader set of foods than men.

Past research has found mixed results regarding associations between socio-demographic variables and food neophobia. There are several possible explanations for these mixed results. In most studies, convenience samples were examined, and bivariate analyses instead of multivariate analyses were conducted. In many studies, participants were arbitrarily classified as neophobics and non-neophobics (Meiselman, et al., 2010) or in three groups, low, medium, and high neophobia (Tuorila, et al., 2001). Such classification reduces the variance and makes it less likely to find associations with other variables. In our view, it makes sense to conceptualize food neophobia as a continuous variable and not as a discrete variable, because food neophobia occurs in a different form than as an existing or non-existing trait.

In the present study, a heterogeneous sample from the German- and French-speaking regions of Switzerland was examined. Our sample was a bit older and better educated compared to the general Swiss population. Another limitation is that self-reported eating behavior was analyzed and people's actual food behavior was not measured. Therefore, consumption frequency scores might be biased by conscious or unconscious under- or over-reporting of people's true food consumption. Furthermore, only small or medium effects were observed. Research that has examined the impact of personality traits on people's food behavior also found only small to modest associations, however (Mottus et al., 2012).

Past research has mainly focused on the sociodemographic variables as possible antecedents of food neophobia. Results of the present study suggest that these variables explain about 15% of the variance. This implies, however, that there are most likely other variables that may have an impact on food neophobia. For example, in samples of children, shyness and food neophobia were correlated (Pliner & Loewen, 1997). Future research might examine whether personality factors such as the Big Five are correlated with food neophobia (Mottus, et al., 2012). Another avenue of research is to examine how prevention motivation and promotion motivation are related to food neophobia (de Boer, et al., 2007; de Boer, et al., 2013).

To summarize, the findings of the present study indicate that food neophobia has a negative impact on people's food variety and on the consumption of recommended foods such as vegetables or fish. With the number of obese and overweight people increasing, it becomes important to identify factors that influence people's eating behavior, and food neophobia might be one important barrier for balanced food choices. Therefore, people should be exposed at an early age to a variety of foods, and that they become familiar with a broad range of foods. Moreover, we have outlined that other aspects of food products such as its origin may create some kind of familiarity for food neophobic persons, and thus may increase their willingness to consume these products.

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Chapter 6

Emotional eating and physical activity

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ETH Zurich

Manuscript published

Dohle, S., Hartmann, C., & Keller, C. (2014). Physical activity as a moderator of the association between emotional eating and BMI: evidence from the Swiss Food Panel. *Psychology & Health*

Abstract

Objective: Research has demonstrated that emotional eating (eating induced by negative affect or distress) is associated with overconsumption and weight gain. This study tests whether physical activity attenuates the relationship between emotional eating and body weight.

Design: Analyses are based on the second (2011) and third (2012) wave of the Swiss Food Panel, an on-going longitudinal survey of the eating and activity behaviour of the Swiss population. Data from 3,425 participants (47% males) with a mean age of 56 years (*SD* = 14) were analysed.

Main Outcome Measures: Body mass index, health consciousness, food consumption (vegetables/fruits and sweet, high-fat foods).

Results: Analyses revealed an independent interaction effect of emotional eating and recreational physical activity, over and above other predictors of BMI. Compared to their low-active counterparts, highly active emotional eaters had a lower BMI and consumed more vegetables and fruits. No difference was found for sweet, high-fat foods consumption.

Conclusion: The results suggest that emotional eaters who are also highly active may still feel the urge to eat when under emotional distress; however, they also choose more healthy foods to cope with this distress. Thus, increasing physical activity could be a promising intervention strategy in preventing weight gain in emotional eaters.

6.1 Introduction

Worldwide, obesity levels have reached epidemic proportions. Obesity is considered a major risk factor for chronic diseases such as high blood pressure, high cholesterol, type 2 diabetes, coronary heart disease, and cancer (Hill, Wyatt, Reed, & Peters, 2003). In addition, the economic burden of obesity in developed countries accounts for approximately 2–7% of total health-care costs, which indicates that obesity represents one of the largest items in health care expenditure (World Health Organization, 2000). Preventing individuals from becoming overweight[1] or obese is therefore a public health priority in many countries.

The development of overweight and obesity is a multifactorial condition based on a complex interaction of genetic susceptibility, physiological conditions, and an obesogenic environment, which encourages food consumption and discourages physical activity. In addition, psychological factors also play an important role as they determine how individuals respond to this environment (Adriaanse, de Ridder, & Evers, 2011; Snoek, Van Strien, Janssens, & Engels, 2007). In particular, emotional eating, defined as eating in response to positive or negative emotions (van Strien, Frijters, Bergers, & Defares, 1986), has been found to be associated with excessive food intake and, consequentially, with weight gain (Koenders & van Strien, 2011; van Strien, Herman, & Verheijden, 2012; but see also Adriaanse et al., 2011). Psychosomatic theory (Bruch, 1973) suggested at least two mechanisms that may be responsible for the emotional eating response. First, emotional eating may result from individual's inability to recognize hunger as different from other irritating or arousing internal states. Second, emotional eaters may eat food to alleviate emotional distress, due to learning experiences in childhood. In line with this notion, research found that emotional eating was influenced by depression and the individuals' difficulties to identify their own feelings (Ouwens, van Strien, & van Leeuwe, 2009). In addition, negative affect influenced emotional eating through emotion-oriented coping (Spoor, Bekker, Van Strien, & van Heck, 2007). According to this latter line of research, eating food is used as a means to cope with negative affect.

It has been proposed that emotional eaters particularly consume sweet, high-fat foods in particular to regulate their emotions (Macht, 2008). A number of studies support this assumption (Konttinen, Mannisto, Sarlio-Lahteenkorva, Silventoinen, & Haukkala, 2010; Macht & Simons, 2000; Oliver, Wardle, & Gibson, 2000). In an experimental study, it was

[1] The World Health Organization (WHO) defines being overweight as having a Body Mass Index (BMI) equal to or more than 25 kg/m^2 and defines obesity as having a BMI equal to or more than 30 kg/m^2. BMI is computed via the ratio of weight in kilograms to squared height in meters.

found that emotional eaters consume more sweet, high-fat foods in response to emotional stress than non-emotional eaters (Oliver et al., 2000). In a similar vein, Konttinen and colleagues (2010) demonstrated that higher emotional eating was related to the consumption of sweet foods, while it was unrelated to the consumption of vegetables and fruits.

The present study thus focuses on the association between emotional eating, food choices, and weight gain. In addition, it examines the role of physical activity in the relationship between emotional eating and body weight.

Physical activity, emotional eating and weight gain

The long-term health benefits of physical activity are widely established (Bouchard, Blair, & Haskell, 2012; Dohle & Wansink, 2013; Hardman & Stensel, 2009; Lee et al., 2012). In addition, research suggests that physical activity could be a way of preventing weight gain (Vuori, 2001). The inverse association between physical activity and Body Mass Index (BMI) has been reported in many observational studies (DiPietro, 1999). Experimental studies, in contrast, have been less conclusive and indicate that an increase in physical activity or exercise does not necessarily lead to weight loss in overweight or obese individuals, which could be due to an increase in in energy intake (Dohle, Wansink, & Zehnder, in press; King et al., 2007). Physical activity has also been linked to improved mood (Fox, 1999; Yeung, 1996), and active individuals often report feeling less tense, anxious, and depressed than inactive individuals (Dunn, Trivedi, Kampert, Clark, & Chambliss, 2005; Sarafino, 2006). Thus, it stands to reason that physical activity may reduce the negative affect and distress typically found in emotional eaters. In fact, evidence suggests that physical activity is negatively associated with emotional eating (van Strien & Koenders, 2010). In addition, Oaten and Cheng (2006) provided experimental evidence that the beginning an exercise programme and maintaining it over a 2-month period resulted in significant improvements in a wide range of regulatory behaviours and in the reduction of emotional distress over time.

Because of its positive effects in regard to emotion regulation, physical activity may also attenuate the relationship between emotional eating and BMI. A test of this hypothesis has been provided by Koenders and van Strien (2011). The authors examined the influence of physical activity and emotional eating among office workers in in a large Dutch banking corporation. In the study, employees received a questionnaire that measured lifestyle factors (physical activity, smoking, and alcohol consumption), as well as emotional eating and BMI. After answering the questionnaire, the employees received an individual intervention and were offered individual feedback and lifestyle advice. The authors revealed that intensive

physical activity and emotional eating had a significant main effect on two-year changes in BMI. In addition, physical activity was found to have a significant interaction effect on emotional eating: the association between emotional eating and increases in body weight was less strong for employees with high levels of activity. These results are in line with the notion that physical activity could be a successful way of attenuating the relationship between emotional eating and BMI. However, these findings are limited to a population of healthy office workers who participated in a lifestyle intervention, and it is not clear whether similar results would be found for other populations (Koenders & van Strien, 2011). In addition, research suggests that physical activity might act as keystone habit that provokes changes in eating habits and other health-related behaviors (Blair, Jacobs, & Powell, 1985; Duhigg, 2012; van Rensburg, Taylor, & Hodgson, 2009). Thus, it is also crucial to investigate if physical activity leads to more advantageous food choices and a change in health consciousness in emotional eaters. Health consciousness is an indicator of a person's intrinsic motivation to maintain good health (Dutta-Bergman, 2005), and has been connected to various health-related behaviors such as dietary choices (van der Horst & Siegrist, 2011), nutrition label use (Visschers, Hartmann, Leins-Hess, Dohle, & Siegrist, 2013), and eating styles (Keller & van der Horst, 2013). Thus, analyzing food choices and diet-related health consciousness in physically active and inactive emotional eaters would allow drawing more detailed conclusions about the role of physical activity in emotional eating.

The present study

This research investigates the role of recreational physical activity on the association between emotional eating and BMI. By using an established self-report measure of physical activity, i.e., the Global Physical Activity Questionnaire (Armstrong & Bull, 2006; Bull, Maslin, & Armstrong, 2009), we focused on moderate and intensive recreational physical activities but not on work-related physical activities. We concentrated on recreational physically activity because research indicates that adherence to an exercise programme is beneficial to a number of self-regulatory operations, including emotion regulation (Oaten & Cheng, 2006). In addition, while work-related physical activities are often performed out of economic necessity, recreational physical activity is typically voluntary and self-initiated. Thus, if it is confirmed that recreational physical activity is an important determinant of BMI, it could be a leverage point for population-based interventions aimed at preventing weight gain. Moreover, in contrast to the study by Koenders and van Strien (2011), this study examines the effect of recreational physical activity on BMI by using a demographically diverse sample that is

various in regard to education, age, and gender. We also investigate differences in diet-related health consciousness and food choices in order to fully understand the moderating effect of recreational physical activity on the relationship of emotional eating and BMI.

We propose three hypotheses. First, we expect that emotional eating and recreational physical activity will have a main effect on BMI. Emotional eating is hypothesised to be positively related to BMI, while physical activity is expected to be negatively related to BMI. Second, recreational physical activity should attenuate the relationship between emotional eating and BMI; thus, we hypothesize an interaction effect of emotional eating and recreational physical activity. Last, we expect that the attenuation effect of physical activity on BMI is accompanied by different food choices. In line with research by Konttinen (2010) and Macht (2008), we assume that non-active emotional eaters have a higher consumption of sweet, high-fat foods than highly-active emotional eaters. Because of their engagement in recreational physical activity, it is also possible that highly-active emotional eaters are more health-conscious in regard to their diet than their less-active counterparts. Thus, it is also possible that they consume more healthy foods, such as vegetables and fruits.

We examine these hypotheses controlling for further eating styles that could promote overeating such as restrained eating (the cognitive restriction of energy intake) and external eating (eating in response to external food stimuli, i.e., the smell or sight of food) (van Strien et al., 1986). Restrained eating and external eating were found to be correlated with emotional eating (Keller & van der Horst, 2013; van Strien et al., 2012).

6.2 Method

Participants and Procedure

Data for this study were obtained from the Swiss Food Panel, an on-going longitudinal survey of the eating and activity behaviour of the Swiss population. The study began in 2010 (first wave) and was designed to help explain the underlying factors related to behavioural changes over time. Households were randomly selected from the telephone book in the German-speaking and French-speaking parts of Switzerland. The first wave included a final sample of N = 6,290, with a response rate of 30.1%. Except for those persons who had to be excluded (see Figure 3.1, p23), all respondents from 2010 were contacted for the second wave in 2011, and all respondents from 2011 were contacted for the third wave in 2012. The longitudinal sample (2010 - 2012) consisted of 3,559 participants.

Because we were interested in psychological and lifestyle predictors of BMI, we additionally excluded the data of women who indicated that they were pregnant during the study period (*n* = 92), as well as respondents with extreme weight gain/loss (+/- 30kg; *n* = 42), because this might be indicative of serious medical conditions. The final sample size was *N* = 3,425. Forty-seven percent (*n* = 1,623) of the respondents were men, and 53% (*n* = 1,802) were women. The self-reported education level was categorized into no education (2.0%, *n* = 70), primary and lower secondary school (5.3%, *n* = 183), vocational school (33.1%, *n* = 1,132), higher secondary school (28.5%, *n* = 976), and college and university (29.4%, *n* = 1,008). Overall, 56 respondents (1.6%) did not indicate their education level. The mean age in 2011 was 56 years (*SD* = 14).

Questionnaire

The Swiss Food Panel questionnaire covers a broad range of constructs. For this paper, only a selection of the constructs was included: eating styles (restrained eating, emotional eating, and external eating, measured via the Dutch Eating Behavior Questionnaire), recreational physical activity (measured via the Global Physical Activity Questionnaire), diet-related health consciousness, and the frequency of food consumption (Food Frequency Questionnaire). The questionnaire also included sociodemographic information, as well as anthropometric (weight and height) questions used to calculate BMI. The Global Physical Activity Questionnaire was not used in the first wave (2010). Thus, this paper focuses on the second (2011) and third waves (2012) of the Swiss Food Panel. Data from 2011 are considered as the baseline (T1), while T2 refers to the 1-year follow-up in 2012.

Dutch Eating Behaviour Questionnaire

A short version of the Dutch Eating Behaviour Questionnaire (DEBQ; van Strien et al., 1986) was used to measure restrained eating, emotional eating, and external eating. Based on a representative Dutch sample (van Strien, Herman, & Verheijden, 2009), the short version was especially developed for the present study by including those items with the highest factor loadings on the scale (T. van Strien, personal communication, August 17, 2009). The restrained eating scale indicates how much an individual restrains or limits his or her eating (four items, e.g., “When you have put on weight, do you eat less than you usually do?”, “Do you take into account your weight with what you eat?”). The emotional eating scale refers to eating in response to arousal states, such as anger, fear, or anxiety (five items, e.g., “Do you get the desire to eat when you are anxious, worried, or tense?”, “Do you have a desire to eat

when you are depressed or discouraged?"). The external eating scale measures eating in response to external food-related cues, regardless of the individual's internal state of hunger or satiety (five items, e.g., "If food tastes good to you, do you eat more than usual?", "If you see others eating, do you also have the desire to eat?"). Answers were given on a 5-point scale ranging from *never* (1) to *very often* (5). In this study, the reliabilities (Cronbach's alpha) at T1 were $\alpha = .82$, $\alpha = .94$, and $\alpha = .77$ for restrained eating, emotional eating, and external eating, respectively.

Recreational Physical Activity

To assess recreational physical activity, the second version of the Global Physical Activity Questionnaire (GPAQ; Armstrong & Bull, 2006; Bull et al., 2009) was used in the survey. The GPAQ was developed by the World Health Organization (WHO) for physical activity surveillance in various countries. It collects information on physical activity participation in three domains: work, recreation, and transportation. Information on the frequency (days) and duration (minutes) of moderate-intensity and vigorous-intensity physical activities are recorded separately (for the work and recreation domains only).

Analyses were conducted in accordance with the GPAQ analysis guide (WHO, 2012), which includes information on how to clean GPAQ data. Because we used a paper-and-pencil version of the GPAQ, some modifications to the guide were necessary. According to the analysis guide, participants with inconsistent answers on filter questions (e.g., someone who reports never being active at work, but reports values > 0 in the corresponding frequency and duration variables) should be excluded and coded as missing. This approach is reasonable for an interview version of the GPAQ because the interviewer would usually skip the frequency and duration variables, but it makes less sense for a paper-and-pencil version of the GPAQ. Therefore, we kept the data of participants who gave valid answers for the frequency and duration variables, which resulted in less missing data.

The GPAQ analysis guide allows for calculating metabolic equivalents (METs). One MET is defined as the energy cost of sitting quietly, and is equivalent to a caloric consumption of 1 kcal/kg/hour (WHO, 2012). For the analysis of GPAQ data, moderate and vigorous intensities are defined as 4 METs and 8 METs, respectively. The number of minutes spent performing recreational activity per week was multiplied by the assigned MET value (MET-minutes). At T1, respondents reported a median of 960 MET-minutes/week of recreational physical activity, 0 MET-minutes/week of work-related physical activity, and 420 MET-minutes/week of transportation physical activity.

Diet-Related Health Consciousness

The Diet-Related Health Consciousness Scale comprised four items (e.g. “My health is dependent on how and what I eat”, “I am prepared to leave a lot, to eat as healthy as possible”) which were based on the Health Consciousness Scale proposed by Schifferstein and Oude Ophuis (1998). In former studies, these four items were shown to have good internal consistency, typically yielding a Cronbach’s alpha higher than 0.79 (van der Horst & Siegrist, 2011; Visschers et al., 2013). Answers were given on a 6-point scale ranging from *don’t agree at all* (1) to *fully agree* (6). Scale scores represent the average for all items in the scale (Cronbach’s $\alpha = .81$ at T1).

Food Frequency Questionnaire

On the Food Frequency Questionnaire (FFQ), participants reported their average consumption frequency of various food products. The FFQ was specially developed for the Swiss Food Panel; detailed descriptions of the test-retest reliability have been published previously (Hartmann, Siegrist, & van der Horst, 2012). To reduce the respondent burden, the questionnaire did not collect information on portion size or the number of portions, except for fruit and vegetable consumption. For the purposes of the present study and in line with Konttinen et al.’s study (2010) on emotional eating and food consumption, we analysed vegetable/fruit and sweet, high-fat food consumption.

Three items were used to assess the consumption of vegetables/fruits: vegetables (cooked or steamed), salad (e.g., lettuce, tomatoes, or raw vegetables), and fruits. Answers to the three items were given on a 5-point scale: *daily* (coded as 7 times per week), *4 – 6 times per week* (coded as 5 times per week), *1 – 3 times per week* (coded as 2 times per week), *1 – 3 times per month* (coded as 0.5 times per week), and *less or never* (coded as 0). In addition, participants were asked how many portions of vegetables (one portion = a handful) and fruits (one piece or one handful) they usually eat. The consumption frequency was then multiplied by the portion in order to reflect the servings (pieces) of vegetables and fruits consumed per week. A summative score was calculated for the consumption of vegetables/fruits.

The consumption frequency of three sweet, high-fat food items (cookies, chocolate, and sweet pastries) was assessed on a 6-point scale: *several times per day* (coded as 14 times per week), *daily* (coded as seven times per week), *several times per week* (coded as three times per week), or *several times per month* (coded as 0.75 times per week); *several times per year* and *less or never* were considered to be negligible (coded as zero). Total sweet, high-fat food consumption was calculated as the sum of these three items per week.

Data analysis

First, descriptive statistics were calculated to gather information about the means, standard deviations, and intercorrelations of the scales. Second, a hierarchical regression analysis was conducted to test the possible moderator effect of recreational physical activity (T1) on the relationship between emotional eating (T1) and BMI (T2). Three additional hierarchical regression models were calculated for diet-related health consciousness, vegetable/fruit consumption, and sweet, high-fat food consumption as outcome measures (all measured at T2). For all hierarchical regression analyses, age, gender, and education were entered in the first step. In the second step, the simple effects of restrained eating, emotional eating, external eating, and recreational activity were entered. To examine the increment to R^2 due to the interaction term of emotional eating and recreational activity over and above the other predictors (Cohen, Cohen, West, & Aiken, 2003), we included the interaction term in a third step.[2] All continuous variables were mean-centred to avoid problems with multicollinearity (Aiken & West, 1991). For the same reason, gender was dummy-coded (with "0" corresponding to females and "1" corresponding to males). To test whether the regression slopes were significant, we conducted simple slope analyses (Aiken & West, 1991). SPSS Version 19 for Macintosh (SPSS, Inc, Chicago, Illinois) was used to perform all analyses.

6.3 Results

Descriptives

The means and standard deviations of all variables are displayed in Table 6.1. For both time points, women scored higher on restrained eating, emotional eating, and external eating (all $p < .05$). Women had also higher scores on diet-related health consciousness ($p < .001$) and higher consumption of vegetables/fruits ($p < .001$). Men had higher BMIs than women at both time points ($p < .001$). At T1, men showed also higher scores on recreational activity ($p < .05$).

Table 6.2 presents the correlation coefficients between all variables in the present study. T1 measures of restrained, emotional, and external eating were positively related to BMI at T2. In contrast, recreational physical activity (measured at T1) was negatively associated with BMI at T2. Quite unexpectedly, the consumption of sweet, high-fat foods was

[2] Compared to experimental research, interactions in observational research are often of small magnitude and account for only a few percentage points of the total variance (Cohen et al., 2003; McClelland & Judd, 1993). Therefore, to test the contribution of the interaction, a hierarchical regression approach (as outlined by Cohen et al., 2003) was chosen.

negatively related to BMI at T2, indicating that individuals who regularly consumed sweet, high-fat foods had lower BMIs one year later. T1 measures of restrained eating and recreational activity were positively related to the T2 measure of diet-related health consciousness, while external eating (T1) was negatively associated with diet-related health consciousness (T2). In terms of food consumption, positive associations for restrained eating, emotional eating, and recreational activity at T1 and fruit/vegetable intake at T2 were revealed. In addition, the T1 measure of diet-related health consciousness was negatively associated with sweet, high-fat food intake (T2). Positive associations were found for emotional eating and external eating (both measured at T1) and sweet, high-fat food intake (T2).

Hierarchical Regression Analyses

Table 6.3 presents the results of the hierarchical regression analysis predicting BMI at T2. Overall, 20.5% of the variance in BMI was explained one year after the baseline assessment. In addition to the demographic variables of age (β = .108, p < .001), gender (β = .355, p < .001) and education (β = -.176, p < .001), emotional eating was a strong predictor of BMI (β = .270, p < .001). Higher emotional eating scores were associated with higher BMIs one year later. Restrained eating (β = .101, p < .001) and recreational activity levels (β = -.126, p < .001) also significantly predicted BMI; participants who had higher scores on restrained eating and those who were less active had higher body weights at T2. External eating was not a significant predictor. As indicted in Table 3, the interaction effect between emotional eating and recreational activity significantly explained the variance in BMI at T2 over and above the other predictors (β = -.072, p < .001). Simple slope analyses (Aiken & West, 1991) revealed that emotional eating strongly positively predicted BMI (β = .343, p < .001) when recreational activity was lower (-1 SD). However, as activity increased (+1 SD), the predictive power of emotional eating regarding BMI decreased (β = .193, p < .001). Thus, emotional eating was more predictive of BMI when recreational activity was lower.

Table 6.1 Descriptive statistics for all scales (presented for males and females, N = 3425)

	All		Males		Females		
	Mean (SD)						*p*
Time 1							
1. Restrained Eating [a]	3.03	(.84)	2.88	(.85)	3.16	(.82)	<.001
2. Emotional Eating [a]	2.06	(.87)	1.81	(.75)	2.28	(.92)	<.001
3. External Eating [a]	2.85	(.61)	2.82	(.60)	2.87	(.61)	.018
4. Recreational	960	(240-2320)	1140	(160-	960	(240-2160)	.012[a]
5. Health Consciousness [a]	4.68	(.97)	4.50	(1.00)	4.85	(.90)	<.001
6. Vegetables/Fruits [a]	29.37	(15.81)	25.94	(14.79)	32.45	(16.06)	<.001
7. Sweet, High-fat Foods [a]	4.06	(3.93)	3.99	(3.75)	4.12	(4.08)	.345
8. BMI [a]	24.56	(4.01)	25.74	(3.46)	23.50	(4.17)	<.001
Time 2							
9. Restrained Eating [a]	3.01	(.85)	2.86	(.85)	3.15	(.82)	<.001
10. Emotional Eating	2.03	(.87)	1.80	(.75)	2.25	(.91)	<.001
11. External Eating [a]	2.85	(.61)	2.81	(.61)	2.88	(.60)	<.001
12. Recreational	960	(180-2160)	1080	(80-2400)	960	(240-2160)	.081[a]
13. Health Consciousness [a]	4.66	(.98)	4.47	(1.02)	4.83	(.90)	<.001
14. Vegetables/Fruits [a]	29.42	(15.71)	26.06	(14.65)	32.45	(16.03)	<.001
15. Sweet, High-fat Foods [a]	4.00	(3.97)	3.95	(3.88)	4.04	(4.05)	.538
16. BMI [a]	24.67	(4.06)	25.76	(3.49)	23.68	(4.29)	<.001

Note. Results are given as [a] mean and standard deviation (Student's t-test) or as [b] median and interquartile range (Mann-Whitney test).

Table 6.2 Correlations Among Time 1 and Time 2 Variables (N = 3425)

	Correlations															
Scale	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*
Time 1																
1. Restrained Eating	1															
2. Emotional Eating	.202*	1														
3. External Eating	.056	.467*	1													
4. Recreational Activity	.125*	-	-.057	1												
5. Health Consciousness	.232*	.012	-	.076*	1											
6. Vegetables/Fruits	.154*	.069*	-.028	.130*	.295*	1										
7. Sweet, High-fat Foods	-.048	.127*	.185*	.013	-	.026	1									
8. BMI	.096*	.114*	.066*	-	-	-	-	1								
Time 2																
9. Restrained Eating	.768*	.205*	.071*	.106*	.189*	.125*	-.040	.085*	1							
10. Emotional Eating	.174*	.802*	.414*	-	.022	.082*	.114*	.111*	.218*	1						
11. External Eating	.057	.431*	.745*	-.051	-	.003	.163*	.072*	.113*	.484*	1					
12. Recreational Activity	.121*	-	-.044	.608*	.080*	.115*	.027	-	.131*	-	-.026	1				
13. Health Consciousness	.226*	.008	-	.080*	.704*	.291*	-	-	.222*	-.005	-	.107*	1			
14. Vegetables/Fruits	.158*	.067*	-.031	.135*	.276*	.697*	.024	-	.152*	.086*	.012	.131*	.287*	1		
15. Sweet, High-fat Foods	-.056	.122*	.187*	.000	-	.029	.762*	-	-	.138*	.185*	.021	-	.032	1	
16. BMI	.094*	.125*	.076*	-	-	-	-	.965*	.083*	.128*	.085*	-	-	-	-	1

Note. Pairwise deletion of missing values and the Spearman rank correlation coefficient was used. Underlined correlations represent test-retest reliabilities of measures. * Significant at Bonferroni corrected level of significance, 0.00042 (0.05/120).

Table 6.3 Hierarchical Regression Analysis Predicting BMI at T2 (N = 3425)

Step	*B*	*SE B*	*β*	*p*
Step 1				
Constant	23.66551	.076		<.001
Age	.02329	.005	.080	<.001
Gender (male)	2.11058	.135	.260	<.001
Education	-.63510	.068	-.155	<.001
Step 2				
Constant	23.30537	.074		<.001
Age	.03222	.005	.110	<.001
Gender (male)	2.87045	.134	.353	<.001
Education	-.73026	.064	-.178	<.001
Restrained Eating	.47330	.077	.098	<.001
External Eating	.07005	.122	.010	.565
Emotional Eating	1.27899	.086	.275	<.001
Recreational Activity	-.00015	.000	-.102	<.001
Step 3				
Constant	23.27364	.074		<.001
Age	.03141	.005	.108	<.001
Gender (male)	2.88303	.134	.355	<.001
Education	-.72317	.064	-.176	<.001
Restrained Eating	.48433	.077	.101	<.001
External Eating	.06054	.121	.009	.618
Emotional Eating	1.25144	.086	.270	<.001
Recreational Activity	-.00018	.000	-.126	<.001
Emotional Eating x Recreational Activity	-.00012	.000	-.072	<.001

Note: Missing values were <1% of all actual values and were replaced using mean substitution. R^2 =9.8% for Step 1, ΔR^2 =10.2% for Step 2, ΔR^2 =0.5% for Step 3 (*p*s<.001).

The results of the hierarchical regression analysis performed to predict diet-related health consciousness at T2 are presented in Table 6.4. The regression explained 10.4% of the variance. Gender (male) and external eating were negatively related to diet-related health consciousness measured one year later (gender: β = -.179, p < .001; external eating: β = -.080, p < .001). In contrast, older people (β = .104, p < .001), respondents with higher scores on the restrained eating scale (β = .190, p < .001), and more active respondents (β = .061, p < .001) showed higher diet-related health consciousness scores at T2. No interaction effect between emotional eating and recreational activity was found, p = .926.

The hierarchical regression analysis for vegetable/fruit consumption explained 7.4% of the variance (see Table 6.5). The strongest predictor of vegetable/fruit consumption was gender: males consumed fewer vegetables/fruits at T2 than females (β = -.211, p < .001). Age (β = .085, p < .001), education (β = .066, p < .001), restrained eating (β = .077, p < .001), and recreational activity (β = .116, p < .001) positively predicted vegetable/fruit consumption. The results further indicated that the interaction of emotional eating and recreational activity made a significant, unique contribution to the prediction of vegetable/fruit consumption.
This contribution was over and above that of the other predictors (β = .056, p = .001). The simple slope analysis showed that emotional eating significantly predicted vegetable/fruit consumption at high levels of recreational activity (+1 SD), β = .082, p = .003, but not at low levels of recreational activity (-1 SD), β = -.035, p = .184.

Table 6.6 demonstrates the results of the hierarchical regression analysis predicting sweet, high-fat food consumption at T2. Only a small portion of the variance (3.5%) in sweet, high-fat food consumption was explained. The largest predictor was external eating (β = .125, p < .001), but education (β = .063, p < .001) and emotional eating (β = .056, p = .006) also positively predicted the consumption of sweet, high-fat food. Restrained eating, in contrast, was negatively related to sweet, high-fat food consumption (β = -.090, p < .001). No interaction effect between emotional eating and recreational activity was found, p = .934.

Table 6.4 Hierarchical regression analysis predicting diet-related health consciousness at T2 (N = 3425)

Step	*B*	*SE B*	*β*	*p*
Step 1				
Constant	4.85394	.019		<.001
Age	.01098	.001	.157	<.001
Gender (male)	-.40539	.033	-.208	<.001
Education	-.00614	.017	-.006	.710
Step 2				
Constant	4.82725	.019		<.001
Age	.00730	.001	.104	<.001
Gender (male)	-.34905	.034	-.179	<.001
Education	-.02079	.016	-.021	.201
Restrained Eating	.21910	.020	.190	<.001
External Eating	-.12816	.031	-.080	<.001
Emotional Eating	-.02294	.022	-.021	.295
Recreational Activity	.00002	.000	.060	<.001
Step 3				
Constant	4.82741	.019		<.001
Age	.00731	.001	.104	<.001
Gender (male)	-.34912	.034	-.179	<.001
Education	-.02083	.016	-.021	.200
Restrained Eating	.21904	.020	.190	<.001
External Eating	-.12811	.031	-.080	<.001
Emotional Eating	-.02279	.022	-.021	.299
Recreational Activity	.00002	.000	.061	<.001
Emotional Eating x Recreational Activity	.00000	.000	.002	.926

Note: Missing values were <1% of all actual values and were replaced using mean substitution. R^2 =5.8% for Step 1 (p<.001), ΔR^2 =4.5% for Step 2 (p<.001), ΔR^2 =0% for Step 3 (p=.926).

Table 6.5 Hierarchical Regression Analysis Predicting Vegetables/Fruits Consumption at T2 (N = 3425)

Step	*B*	*SE B*	*β*	*p*
Step 1				
Constant	32.75674	.298		<.001
Age	.11321	.019	.101	<.001
Gender (male)	-7.04238	.530	-.226	<.001
Education	1.19473	.266	.076	<.001
Step 2				
Constant	32.52393	.307		<.001
Age	.09291	.020	.083	<.001
Gender (male)	-6.55118	.554	-.210	<.001
Education	1.05485	.265	.067	<.001
Restrained Eating	1.44881	.319	.079	<.001
External Eating	-.50871	.504	-.020	.312
Emotional Eating	.35041	.357	.020	.327
Recreational Activity	.00053	.000	.097	<.001
Step 3				
Constant	32.61928	.308		<.001
Age	.09536	.020	.085	<.001
Gender (male)	-6.58898	.553	-.211	<.001
Education	1.03355	.265	.066	<.001
Restrained Eating	1.41566	.319	.077	<.001
External Eating	-.48013	.503	-.019	.340
Emotional Eating	.43323	.358	.024	.226
Recreational Activity	.00064	.000	.116	<.001
Emotional Eating x Recreational Activity	.00037	.000	.056	.001

Note: Missing values were <1% of all actual values and were replaced using mean substitution. R^2 =5.3% for Step 1 (p< .001), ΔR^2 =1.7% for Step 2 (p<.001), ΔR^2 =0.3% for Step 3 (p=.001).

Table 6.6 Multiple Linear Regression Predicting Sweet, High-fat Food Consumption at T2 (N = 3425)

Step	*B*	*SE B*	*β*	*p*
Step 1				
Constant	4.03555	.077		<.001
Age	-.01307	.005	-.046	.008
Gender (male)	-.08375	.138	-.011	.543
Education	.25165	.069	.063	<.001
Step 2				
Constant	4.04446	.079		<.001
Age	.00205	.005	.007	.668
Gender (male)	-.10262	.143	-.013	.473
Education	.25152	.069	.063	<.001
Restrained Eating	-.42250	.082	-.090	<.001
External Eating	.81302	.130	.125	<.001
Emotional Eating	.25287	.092	.056	.006
Recreational Activity	-.00002	.000	-.012	.478
Step 3				
Constant	4.04510	.080		<.001
Age	.00207	.005	.007	.686
Gender (male)	-.10287	.143	-.013	.472
Education	.25138	.069	.063	<.001
Restrained Eating	-.42272	.083	-.090	<.001
External Eating	.81321	.130	.125	<.001
Emotional Eating	.25342	.093	.056	.006
Recreational Activity	-.00002	.000	-.012	.521
Emotional Eating x Recreational Activity	.00000	.000	.001	.934

Note: Missing values were <1% of all actual values and were replaced using mean substitution. R^2 =0.6% for Step 1 (p<.001), ΔR^2 =2.9% for Step 2 (p<.001), ΔR^2 =0% for Step 3 (p=.934).

6.4 Discussion

This study investigated the role of emotional eating and recreational physical activity on BMI. In line with the results of other studies (Koenders & van Strien, 2011; van Strien et al., 2012), we found that emotional eating was associated with BMI measured one year later. The regression analyses revealed that emotional eating was particularly related to the consumption of sweet, high-fat foods, such as chocolate, pastries, and cookies, while it was not related to the consumption of fruits and vegetables. These results are consistent with research by Macht (2008), who suggested that sweet, high-fat foods are often used to regulate emotions. Moreover, this study demonstrated that physical activity is inversely related to BMI. Thus, it adds to the evidence provided by many observational, population-based studies that consistently report lower BMIs with higher levels of self-reported physical activity (DiPietro, 1999). It should be noted, however, that the present research focused on voluntary and self-initiated recreational physical activity, not on work-related activity or on an intervention designed to increase physical activity.

In line with our hypotheses and with Koenders and van Strien's study (2011), we also found an independent interaction effect of recreational physical activity and emotional eating, over and above other predictors of BMI. Contrary to our hypotheses, however, we found no indication that this effect was related to the lower consumption frequency of sweet, high-fat foods. Highly active emotional eaters did not have higher scores on diet-related health consciousness than their less-active counterparts. Instead, we found that high levels of physical activity combined with high levels of emotional eating resulted in the higher consumption of healthy foods, such as vegetables and fruits. These results suggest that emotional eaters who are also highly active may still feel the urge to eat under emotional distress, but that they choose healthier foods as a way to cope with this distress. This tentative conclusion warrants further investigation because in this population-based survey, we did not measure negative affect, distress, or food choices in particular situations. Additionally, it is also possible that the lower BMIs of active emotional eaters simply reflects the higher energy expenditure of active individuals, which is not compensated for by the higher consumption of unhealthy foods. Thus, the results of the present study also indicate that highly emotional, highly active individuals do not reward themselves with sweet, high-fat foods for being physically active; to put it differently, they do not exercise to indulge. Therefore, we believe that physical activity could be a viable approach to preventing weight gain in emotional eaters.

External eating was not related to BMI measured one year later. The absence of support for external eating as a risk factor for being overweight or obese is, however, consistent with the results of other recently conducted studies (Koenders & van Strien, 2011; Sung, Lee, & Song, 2009; van Strien et al., 2009). The univariate analyses revealed that emotional and external eating were correlated, which could be an indication that emotional eaters might be particularly prone to eating in response to external cues when they feel anger, fear, or anxiety. In fact, Koenders and van Strien (2011) have argued that emotional eating might be a better predictor of overeating and BMI than external eating because emotional eating might act as a trigger for external eating; or, to put it differently, craving for food when being emotional seem to make emotional eaters to be susceptible for food cues in the environment.

In the present study, restrained eating was positively associated with BMI, indicating that dietary restraint may be acting as a marker for overeating tendencies (Johnson, Pratt, & Wardle, 2012). Furthermore, in the present study, restrained eating was associated with higher consumption of fruits and vegetables. This is also in line with the results of a recent study (Keller & van der Horst, 2013). Compared with normal eaters, restrained eaters had a higher level of health consciousness, consumed more fruits and vegetables, and more frequently spontaneously associated eating not only with dieting but also with health, suggesting that restrained eating is also driven by health considerations. However, further research needs to examine under which circumstances restrained eating in fact has beneficial effects. Recent research suggests that restrained eating only bears the risk of overeating in case of coexisting impulsivity (Jansen et al., 2009) and that at high dispositional self-control facilitates successful restrained eating (Keller & Siegrist, 2014). It might be that especially restrained eaters with high self-control or low impulsivity adhere to healthier dietary patterns.

Several limitations regarding this study need to be acknowledged. In this study, we found no association between sweet, high-fat foods and BMI in the univariate analyses (Pearson correlation coefficients); instead, the association was actually negative. This unexpected result might be due to the fact that we did not ask for information regarding the portion sizes of sweet, high-fat foods; thus, this variable only reflects the consumption frequency and not the number of servings. In addition, we cannot rule out that the dietary assessment is subject to social desirability in some participants. Any conscious or unconscious under/over-reporting of people’s real food consumption might, therefore, bias the consumption frequency scores (Voss, Kroke, Klipstein-Grobusch, & Boeing, 1997). Further research using more extensive measures of food consumption is warranted. Moreover, our study is limited to using a questionnaire to capture information regarding emotional

eating. Because individuals may be limited in their abilities to assess the degree to which they eat in response to emotions, some authors have questioned the used of self-report scales in assessing emotional eating (Adriaanse et al., 2011; Brogan & Hevey, 2013; Evers, de Ridder, & Adriaanse, 2009). It has been argued that an emotional eating questionnaire may not capture the tendency to eat under emotional conditions, but rather reflects beliefs about the relationship between emotions and eating. Promising implicit measures of emotional eating have been developed recently, and they could also be used to replicate the findings of the current study (Ayres, Prestwich, Conner, & Smith, 2011; Bongers, Jansen, Houben, & Roefs, 2013).

Additionally, future studies need to consider more contextual issues related to food consumption and physical activity, also in interaction with personality traits. A better understanding of the determinants for engaging in physical activity among emotional eaters is also important, and it might be related to differences in the access to sport facilities or other environmental factors. Notwithstanding these limitations, the results of this study indicate that physical activity also has the potential to attenuate the relationship between emotional eating and BMI. Thus, increasing physical activity could be a promising intervention and a starting point for individuals who are prone to eating when emotionally distressed.

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Chapter 7

A Self-Determination theory approach to adults' healthy body weight motivation: a longitudinal study focussing on food choices and recreational physical activity

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Manuscript submitted for publication
Hartmann, C., Dohle, S., & Siegrist, M. (resubmitted). A Self-Determination theory approach to adults' healthy body weight motivation: a longitudinal study focussing on food choices and recreational physical activity

Abstract

This study focuses on body weight motivation based on Self-Determination Theory. The impact of body weight motivation on longitudinal changes in food choices, recreational physical activity, and body mass index was explored. A sample of adults (N = 2917, 46% men), randomly selected from the telephone book, completed a questionnaire in two consecutive years (2012, 2013), self-reporting food choices, recreational physical activity, and body weight motivation. Types of body weight motivation at T1 (autonomous regulation, introjected regulation, external regulation) were tested with regard to their predictive potential for changes in food choices, recreational physical activity, and body mass index. Autonomous motivation predicted improvements in food choices and long-term adherence to vigorous recreational physical activity in both genders. Introjected motivation predicted long-term adherence to vigorous recreational physical activity only in women. External motivation predicted negative changes in food choices; however, the type of body weight motivation had no impact on body mass index in overweight adults in the long-term. Autonomous goal-setting regarding body weight seems to be substantial for healthy food choices and adherence to recreational physical activity.

Introduction

Adequate food choices, flexible control over eating behaviour, and sufficient activity levels are considered to be the main approaches to positively influencing weight development (Dohle, Hartmann, & Keller, 2014; Fogelholm & Kukkonen-Harjula, 2000; Polivy, 1996); however, a large portion of the population experiences difficulties managing its weight (James et al., 2004), evoked by unhealthy food choices and inactive lifestyles. Western diets are typically energy-dense—dominated by red meat and high-fat, palatable foods that facilitate an oversupply of energy (Swinburn et al., 2011; Wang & Beydoun, 2009). In contrast, consumption of vegetables and fruits, relatively low in energy density and rich in vitamins, minerals, and other bioactive compounds, are subject to insufficient intake rates (Lock, Pomerleau, Causer, & McKee, 2004). A physically active lifestyle helps to maintain energy balance and has beneficial effects on health parameters such as insulin sensitivity, physical fitness, and well-being (Foreyt, Brunner, Goodrick, Jeor, & Miller, 1995; Fox, 1999). However, a large portion of the population is insufficient in its physical activity levels (Sjöström, Oja, Hagströmer, Smith, & Bauman, 2006), which is considered as another major risk factor for becoming overweight and obese (World Health Organisation, 2013).

Identifying drivers for positive changes in food choices and physical activity behaviour is crucial in explaining why some people are successful at regulating their body weight while others are at risk of weight gain or unhealthy weight cycling. One approach to identifying drivers for positive changes in weight-related behaviours is studying individual psychological factors such as people's underlying motives for striving for a healthy body weight. Rather than the intensity of the motivation itself, the type of motivation is considered to be the determinant for successful weight management and engagement in weight-related health behaviours; this was the object of examination in the present study.

Motivation from the Perspective of the Self-Determination Theory

The Self-Determination Theory (SDT) introduced by Deci and Ryan (1985) is an extension of the classical categorisation of intrinsic and extrinsic motivation. The SDT focuses on the concept of autonomy in regulatory processes of motivation. More specifically, SDT distinguishes between autonomous and controlled forms of motivation regulation, which refer to the extent to which a person's regulatory processes of motivation are self-determined (Ryan & Connell, 1989). The natural underlying process that describes an individual's

tendency to internalise external regulations into self-regulation is referred to as internalisation. Internalisation results in more self-determined action and is based on an assimilation of values into the inner sense of self (Deci & Ryan, 2002). Accordingly, SDT proposes different types of motivation regulation that differ in terms of the degree to which the regulation has been internalised and integrate; they fall along a continuum from least to most self-determined: amotivation, external, introjected, identified, integrated, and intrinsic. Amotivation describes the state of lacking the intention to engage in the behaviour at all. External and introjected regulation are two forms of extrinsic motivation that are considered to be controlled, as a person's intention to act is evoked by an interpersonal or intra-psychic force (Williams et al., 2002). Moreover, behaviour is performed either in response to external contingencies, such as expected punishment or incentives (external), or a need to maintain self-esteem or prevent a feeling of guilt (introjected) (Ryan & Deci, 2000; Williams et al., 2002). Identified and integrated regulations are the basis for a more self-determined (autonomous) yet extrinsically motivated behaviour. Behaviour that is based on identified regulation is accepted as personally important, but does not necessarily reflect one's beliefs and overarching values (Deci & Ryan, 2002). Integrated regulation is associated with volitional engagement in a specific behaviour—people act in congruence with their deeply held values. Nevertheless, the behaviour is still instrumentally oriented to achieve personally important goals (Deci & Ryan, 2002). The most autonomous and self-determined form of motivation is based on intrinsic regulation; it compromises engagement in an activity for its own sake and inherent enjoyment. People who act self-determined are more likely to engage in activities that reflect their own interests, their own values, and their own goals, which results in more need satisfaction and psychological well-being. Being more autonomously motivated is also associated with volitionally consistent behaviour (Koestner, Bernieri, & Zuckerman, 1992) and effective performance (Deci & Ryan, 2002; Thøgersen-Ntoumani & Fox, 2007). In contrast, individuals who strive for goals that are not personally endorsed (e.g. pressure by significant others, feelings of guilt) mostly lack self-determined action and are prone to discouragement after failures or negative experiences, resulting in less persistence in establishing the desired behaviour (Deci & Ryan, 1987).

SDT in the context of Health Behaviours

The SDT approach is attracting increasing attention in health behaviour studies and psychology-based interventions (e.g. Chatzisarantis & Hagger, 2009; Ingledew & Markland,

2008). Recent reviews about motivational dynamics based on SDT have emphasised the importance of autonomous regulation in physical activity (Teixeira, Carraça, Markland, Silva, & Ryan, 2012); eating regulation (Verstuyf, Patrick, Vansteenkiste, & Teixeira, 2012); and weight control programmes (Teixeira, Silva, Mata, Palmeira, & Markland, 2012). In particular, in a study about exercise behaviour, autonomous motivation toward exercise (e.g. exercising is personally important) emerged as a significant predictor for exercise participation, whereas externally regulated exercise behaviour (e.g. pressure by others to exercise) was not associated with exercise engagement (Standage, Sebire, & Loney, 2008). Another study revealed that autonomous regulation of eating behaviour (e.g. "eating healthy is an integral part of my life") was linked to eating a more healthy diet (e.g. eating vegetables), whereas controlled regulation of eating behaviour (e.g. "I would be humiliated if I was not in control of my eating behaviours") was linked to bulimic and depression symptoms, lower life satisfaction, and lower self-esteem (Pelletier, Dion, Slovinec-D'Angelo, & Reid, 2004). Accordingly, an autonomous, self-motivated cognitive style is not only associated with better and sustainable health behaviour, but has also been reported as the most consistent outcome predictor for weight loss maintenance in obesity treatment (Williams, Grow, Freedman, Ryan, & Deci, 1996).

Notwithstanding exercise behaviour, eating behaviour and weight development are the results of a complex interplay of a broad range of psychological, physiological, genetic, and environmental factors; this leads to a high variability in people's behaviours and body weights. In only focusing on one determinant (i.e. type of motivation), the authors only expect a limited amount of variance to be explained.

Treatment Self-Regulation Questionnaire

The Treatment Self-Regulation Questionnaire (TSRQ) is based on the SDT approach. The first versions of the questionnaire in the health domain were used in the 1990s to assess patients' autonomous and controlled reasons for participating in an alcohol treatment, weight loss programme (Ryan, Plant, & O'Malley, 1995; Williams et al., 1996) or for following a diabetic diet and exercising regularly (Williams, Freedman, & Deci, 1998). In the following years, the TSRQ was modified and adapted to study various health behaviours, such as tobacco use, exercise, and diet (Levesque et al., 2007). Levesque et al. (2007) recommended a version of the TSRQ to assess motivation across a variety of health behaviours that distinguishes among three sub-scales of motivation (autonomous, introjected, and external)

and amotivation (Levesque et al., 2007). The TSRQ does not further distinguish autonomous regulation in the three sub-scales—intrinsic, identified, and integrated regulation—provided by the SDT approach. This is because within the health domain, intrinsic motivation, by Ryan and Deci's (2000) definition, is only rarely assessed, as only a few people perceive health behaviour (e.g. quitting smoking) as interesting, satisfying, or intrinsically enjoyable (Levesque et al., 2007). Moreover, according to Levesque et al. (2007), identified and integrated regulations regarding health behaviours are usually not measured separately because they were found to cluster well together (Levesque et al., 2007).

The present study

In this study, the authors examined the underlying motives for the desire to achieve or maintain a healthy body weight. Instead of focusing on self-determination toward physical activity (e.g. Behavioural Regulation in Exercise Questionnaire, Mullan et al., 1997) or eating behaviour (e.g. Regulation of Eating Behaviour Scale, Pelletier et al., 2004), a different approach was chosen: focusing on body weight. A scale was applied that enabled the authors to identify whether body weight motivation is a driver for both changes in food choices and changes in recreational physical activity (PA). Additionally, motivation regulation toward eating or physical activity does not necessarily reflect motivation regulation toward body weight. For example, people might report that they feel humiliated when they are not in control of their eating behaviours; however, this does not necessarily indicate that they try to regulate their weight for introjected reasons. Thus, the present study seeks to address different types of motivation toward body weight and whether they predict changes in food choices and recreational PA in the long term. Based on the literature described above, the authors hypothesised that autonomous regulation for a healthy body weight is more positively associated with healthy food choices and adherence to recreational PA in the long term than more controlled forms of regulation.

The existing knowledge of the motivational tendencies underlying health-related behaviours is mostly based on sub-groups such as students or patients (e.g. Duncan, Hall, Wilson, & Jenny, 2010; Pelletier et al., 2004; Williams et al., 1998). The present study, however, was conducted with a large population-based sample of adults that is more diverse in terms of age and socioeconomic factors. Even though the observed effects among such a heterogeneous sample can be small, it permits more generalisability among different socio-demographic groups (e.g. education). Additionally, a whole range of interventions has been

conducted that focused on patients' autonomous motivation with small to moderate effect sizes (e.g. Levy & Cardinal, 2004; Silva et al., 2011; Williams et al., 1998; Williams et al., 1996). The present study's approach enables us to study real-life behaviour independent of intervention studies or guided programmes.

The study was designed to analyse the longitudinal relationship between types of motivation regulation and one-year changes in people's food choices and recreational PA. It is worth mentioning that the authors expected changes in people's behaviour within one year and without interventions to be small, and longitudinal studies investigating changes in health-related behaviours typically explain a small amount of variance (Jessor, Vandenbos, Vanderryn, Costa, & Turbin, 1995; van Strien, Herman, & Verheijden, 2014). Nevertheless, by taking advantage of the more sophisticated approach regarding motivation regulation offered by SDT—its application in a demographically diverse sample—a new, thorough understanding can be gained regarding body weight management at the population level. To the authors' knowledge, no previous research has documented such evidence using longitudinal data.

Methods

The Swiss Food Panel

The present study examined data from the third (2012) and fourth (2013) wave of the Swiss Food Panel, a population-based longitudinal study conducted in Switzerland on eating behaviour and physical activity behaviour. The Swiss Food Panel started in February 2010, and the same individuals completed a paper-and-pencil questionnaire for each subsequent year. The questionnaire consists of, among others, a Food-Frequency Questionnaire (FFQ), the Global Physical Activity Questionnaire version two (GPAQv2) and questions related to sociodemographic characteristics, as well as self-reported anthropometric measurements (height and weight) used to calculate body mass index (BMI). In addition, an adapted version of the Treatment Self-Regulation Questionnaire (TSRQ) was included in the two waves investigated in this study.

Sampling and participants

In 2010, a mail survey was sent to 20,912 randomly selected household addresses from the phone book in the German-speaking and French-speaking parts of Switzerland. In an accompanying letter, respondents were asked to participate in a longitudinal study. In case of

multi-person households, the person who was registered in the telephone book completed the questionnaire, and the authors explained that the same person should fill in the questionnaire yearly for a longer period of time. No compensation for participating was offered. In the first wave in 2010, 6,290 of all invited participants filled in the questionnaire (a response rate of 30%). Participating persons received a questionnaire every consecutive year.

For the longitudinal data file (including all waves), participants with missing gender, age, or address details; participants who died; participants unwilling to participate in the next survey; participants who completed less than 50% of the questionnaire; and participants who had inconsistencies in their indicator variables (gender, birth date) between waves were excluded, limiting the sample size to N = 3151 (Figure 1). For the present study, the longitudinal data file was additionally checked for inconsistencies in reported body heights at baseline and follow-up. All persons with body height differences greater than a 5 cm difference were excluded from the sample, as it was assumed that another person had completed the questionnaire on their behalf (N = 162). Because weight measures were analysed in the present study, women who indicated the birth of a child during the study period under consideration (2012 and 2013) were also excluded (N = 72). Thus, the final sample for the present study consisted of 2,917 persons (47% males) with a mean age of 58 years (range 23–94 years) in 2013. Compared to the general Swiss population,[1] the final sample consisted of fewer males (census = 49%), more participants who had a higher secondary or college/university degree, and a lower percentage of young adults (20–39 years old) (12% vs. 34%). The lower proportion of young adults typically occurs when the sampling is based on telephone book entries, because younger people are less likely to be registered in the telephone book. Of the participants, 70% live in the German-speaking cantons of Switzerland and 30% live in the French-speaking cantons of Switzerland.[2]

Over the four-year study period, response rates varied between 78% and 89% (Figure 1). Men, respondents with lower levels of education, and participants living in the French-speaking part of Switzerland were slightly more likely to drop out over time. However,

[1] Swiss Federal Statistical Office (2010).

[2] Switzerland has four national languages (German, French, Italian, Rumantsch). Of Switzerland's population, about 65% are German-speaking, 23% are French-speaking, 8% are Italian-speaking, and are 0.5% Rumantsch-speaking (Swiss Federal Statistical Office, 2012). German-speaking and French-speaking people represent the majority of Switzerland's population, and thus were the only ones included in the study.

changes (2010 vs. 2013) in the sample's composition related to gender (men 49% vs. 47%), education (low 10% vs. 7%), and region (French-speaking 30% vs. 28%) were small.

Measures

Healthy body weight motivation

An adapted version of the TSRQ was used for the measurement of autonomous, introjected, and external regulation toward a healthy body weight.[3] Thus, items were specified by the way they focused on participants' reasons for maintaining or reaching a healthy body weight (Table 7.1). Instead of assessing amotivation with the items from the questionnaire by Levesque et al. (2007), amotivated people were identified by answering the following filter question before answering the TSRQ: "Would you like to have or maintain a healthy body weight?" This could be answered with "yes," "no," or "it does not matter to me." Participants who answered the filter question with "no" or "does not matter to me" were asked to skip the TSRQ because they were considered as amotivated. Data from amotivated individuals were excluded from further data analyses (N = 254, 8.7%). Excluded participants were more likely to be male (67.3%), were slightly older than the average (M = 60, range 26–92), and had a mean BMI of 25.71 (SD = 4.48). Of the excluded participants, 11% had a low level of education, 42.9% had a middle educational level, and 45.3% had a high level of education.

[3] The aim was to assess motives for why people try to regulate weight, and the authors are aware that a subjective perception of a healthy weight is not necessarily equal to an objective perception of a healthy weight.

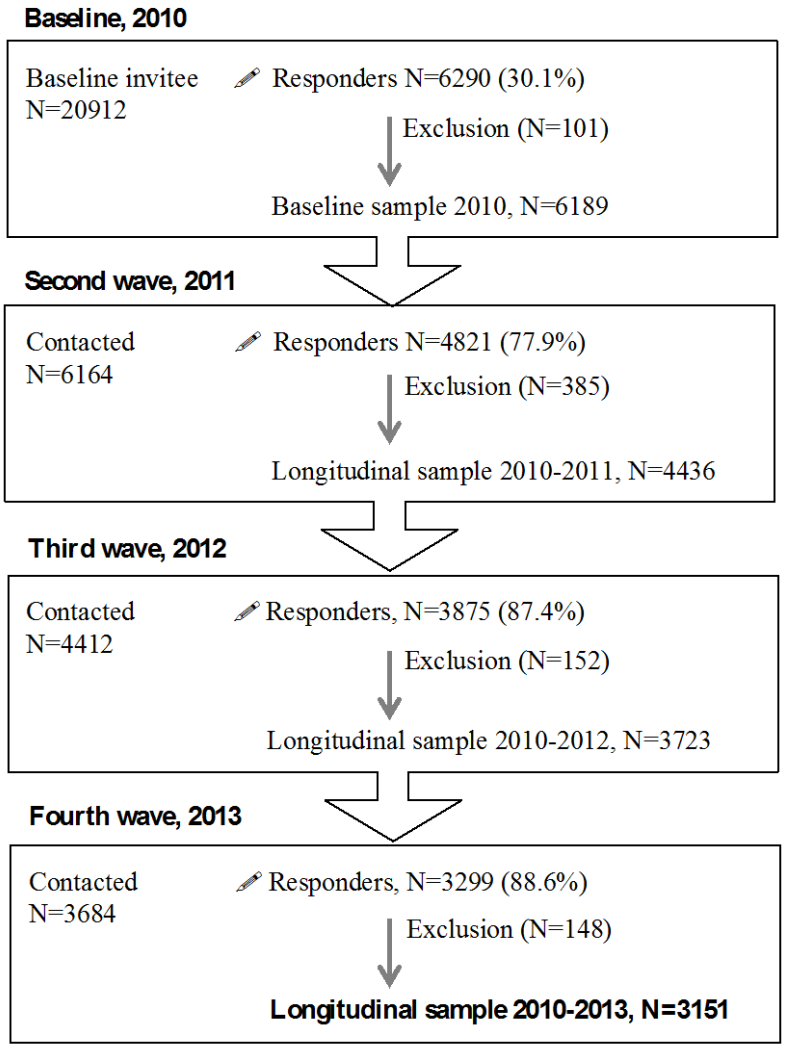

Figure 7.1 - Flow chart of the study sample development

The flow chart depicts the study sample from the Swiss Food Panel. Excluded were those participants with missing gender, age or address details, those who died, those unwilling to participate in the next wave and those who filled in less than 50% of the questionnaire. Participants with inconsistent indicator variables (gender, birth date) between waves were also excluded.

Table 7.1. Mean scores and standard deviations for the different reasons to regulate body weight (based on the Treatment-Self-Regulation Questionnaire)

	The reason I would like to have a healthy body weight is because…	M	SD
Autonomous regulation (α=.90)			
1	...it is very important to be as healthy as possible.	5.92	1.20
2	...I personally believe that it is the best for my health.	6.01	1.07
3	...I would like to take responsibility for my own health.	6.05	1.13
4	...It is an important decision I really want to make.	5.65	1.39
5	...I thought about it carefully and think that this is important for many aspects of my life.	5.39	1.55
6	...It fits my life goals.	5.37	1.53
Introjected regulation (α=.91)			
7	...I would be embarrassed if I did not have a healthy body weight.	4.03	2.07
8	...I would feel bad about myself if I do not have a healthy body weight.	4.40	2.05
9	...I would have a guilt conscience if I do not have a healthy body weight.	3.88	2.00
10	...I feel undisciplined when I do not have a healthy body weight.	4.33	1.98
External regulation (α=.80)			
11	...I permanently feel pressure by others to have a healthy body weight.	2.13	1.48
12	...Others would be upset with me if I do not have a healthy body weight.	1.69	1.12
13	...I want others to see that I can do it.	2.81	1.93
14	...I want others to accept me.	2.86	1.96

Note. M: mean; SD: standard deviation;. Listwise deletion of missing values was used, resulting in N=2324. Mean scores reflect the following response choices: 1=*do not agree at all* to 7=*totally agree.*

Food and alcohol consumption

The FFQ was specially designed for the Swiss Food Panel and used to estimate the frequency of habitual consumption of various foods. A detailed description of the test–retest study and the FFQ items was published previously (Hartmann, Siegrist, & van der Horst, 2012). The following food items were included in the present study: salad (lettuce, tomatoes) or raw vegetables; vegetables (cooked/steamed); fruit; pork; beef or veal; poultry (e.g. turkey, chicken); processed meats (e.g. cold cuts, sausages, ham); cookies; sweet pastries; chocolate; savouries (e.g. chips, nuts, salty snacks); wine; and beer.

Fruit, salad, and vegetable frequency was measured using five response options (coding): daily (7 times/week), 4–6 times/week (5 times/week), 1–3 times/week (2

times/week), 1–3 times/month (0.5 times/week), and less or never (0). Participants were also asked how many portions of vegetables and salad (one portion = a handful), as well as fruits (one piece or one handful), they usually ate when they consumed these foods. Consumption frequencies and portion numbers were multiplied to indicate portions of fruit, vegetables, and salad consumed per week. The consumption frequency of all meat-related and sweets-related items as well as savouries, wine, and beer were measured using six response options: several times/day (14 times/week), daily (7 times/week), several times/week (3 times/week), several times/month (0.75 times/week), several times/year (0), and less or never (0). Composite variables were created by adding up single items for sweets and savouries (sweet/savouries, $\alpha = .69$); vegetables and salad (vegetables/salad, $\alpha = .50$); meat ($\alpha = .72$); and alcohol ($\alpha = .52$). The composite variables indicate consumption frequencies (e.g. meat consumption frequency per week), except for vegetables and fruit, which indicate portions per week.

Recreational physical activity

Recreational PA was measured using the Global Physical Activity Questionnaire version two (GPAQv2). The GPAQ was originally designed by the World Health Organisation (WHO) to assess PA patterns in developing countries (Armstrong & Bull, 2006; World Health Organisation, 2014). GPAQ data in this study was cleaned and analysed according to the Global Physical Activity Questionnaire Analysis Guide, provided by the WHO (2014). The GPAQ distinguishes among different activity settings or domains: activity at work, travel to and from places, and recreational activity. Within the recreational domain, information on frequency (days per week), duration (minutes), and level of intensity (vigorous, moderate) of PA in a typical week is self-reported. Vigorous-intensity PA denotes PA that is exhausting and causes a great increase in breathing and heart rate (e.g. running, soccer). Moderate-intensity PA denotes PA that is moderately exhausting and causes a small increase in breathing and heart rate (e.g. cycling, brisk walking). To express levels of PA participation, metabolic equivalents (METs) are calculated based on the self-reports in the GPAQ. One MET is defined as the energy expenditure of sitting quietly (resting metabolic rate) and is equivalent to a caloric consumption of 1 kcal/kg/hour. To take the relative energy expenditure of each activity into account, four METs are multiplied with reported minutes spent in moderate activities (MET-minutes/week) and eight METs are multiplied with minutes spent in vigorous activities (MET-minutes/week).

Anthropometry

Body mass index (BMI) was calculated from self-reported weight and height (body weight (kg)/body height (m^2)). According to the international classification system of the WHO (World Health Organisation, 2006), persons with BMI values of o 25 kg/m^2 were classified as overweight (37.8%) and persons with BMI values < 25 kg/m^2 were classified as normal weight (60.7%). Further, 9.5% of the participants had BMI values of < 20, 51.2% between ≥ 20 and < 25, 28.9% between ≥ 25 and <30, and 8.9% ≥ 30.

Data analysis

To explore changes in food choices and BMI between waves associated with different types of motivation regulation, hierarchical multiple regressions were conducted. The analysis of covariance is the analysis of choices for longitudinal continuous data with two measurement points (Twisk, 2013). This approach takes into account that participants' consumption values at Time 2 (T2) depend on their initial consumption values at Time 1 (T1) by including T1 values as independent variables in the regression model. This enables the removal of the potential influence of the initial consumption value at T1 so that the estimated effects of the other variables are independent of it (Cohen, Cohen, West, & Aiken, 2003). Separate regression equations were calculated for every food group variable (i.e. vegetables/salad, fruit, meat, sweets/savouries) and the alcohol variable. Because weight developments predicted by body weight motivation might differ depending on weight status, separate regression models were conducted for normal weight (BMI < 25) and overweight (BMI ≥ 25) participants. All regression models were carried out separately for males and females.

To explore the longitudinal relationship between types of motivation and changes in moderate and vigorous PA, various logistic regressions were conducted. Because the values for moderate PA and vigorous PA were positively skewed, each PA variable was dichotomised into active and inactive.[4]

[4] According to the GPAQ analysis guide, values of less than 10 minutes of vigorous or moderate PA are considered as negligible and respondents are categorised as inactive. Therefore, 10 minutes per week of moderate PA (4 METs * 10 minutes = 40 METs-min) and 10 minutes per week of vigorous PA (8 METs * 10 minutes = 80 METs-min) are considered as cut-off values for moderate PA and vigorous PA, respectively.

PA change variables were defined as follows: participants who were physically inactive at both time points (T1, T2) were termed “inactive”; participants who increased their activity were termed “adopters” (inactive T1, but active T2); participants who quit PA were termed “quitters” (active T1, but inactive T2); and participants who were active at both time points were termed “maintainers” (active at T1 and T2). Six different models (three predicting moderate PA, three predicting vigorous PA) were tested, separated for gender: maintainer versus inactive, beginner versus inactive, and quitter versus maintainer. Beside the models’ χ^2-Statistic, contingency tables were checked for the prediction accuracy of the cases.

All analyses were performed with the longitudinal data set from 2012–2013 (N = 2665) using the SPSS statistics software package version 20 (SPPS Inc., Chicago, IL).

Results

Table 7.2 depicts descriptives for both genders and waves. The mean values for autonomous and introjected regulation were higher in women compared to men, while no differences in external regulation were observed between the genders. Women reported a higher vegetables/salad and fruit intake and a lower meat and alcohol consumption frequency compared to men; however, women were less physically active than men. In general, not even half of the participants in this study, neither men nor women, reached the recommended 600 METs per week (Haskell et al., 2007), indicated by the low median values.

Table 7.3 displays the Pearson’s correlations among all of the investigated variables and between the T1 and T2 values. The SDT-based sub-scales closer to each other on the self-determined continuum (e.g. autonomous and introjected) were more highly correlated than the sub-scales that were farther apart (autonomous and external). The highest correlation between the sub-scales occurred between introjected and external regulation, which might be due to the fact that both are controlled forms of regulation. Of special interest, BMI was positively correlated with the controlled forms of regulation and negatively correlated with autonomous regulation. Further analysis for normal weight and overweight participants showed that external regulation was more highly correlated with BMI in overweight participants (r = .18, $p < .001$) than in normal weight participants (r = .06, $p < .05$).

Table 7.2. Characteristics of the study population (N=2663)

		T1					T2				
		WOMEN		MEN			WOMEN		MEN		
	Range	*M*	*SD*	*M*	*SD*	*t(df)*	*M*	*SD*	*M*	*SD*	*t(df)*
Age (years)	23-93	54.40	13.24	58.68	13.76	8.16(2661)**	55.40	13.24	59.68	13.76	8.16(2661)**
BMI (kg/m^2)	17-64	23.62	4.37	25.69	3.45	13.31(2642)**	23.62	4.38	25.75	3.53	13.51(2628)**
Education (%)[a]											
Low		9.7		4.7			9.2		4.6		
Middle		39.0		32.4			40.0		32.2		
High		50.2		62.4		χ^2(2)=387.65***	50.0		63.0		χ^2(2)=398.17***
SDT-based measures[b]											
Autonomous regulation	1-7	5.82	1.06	5.57	1.08	-5.84(2610)**	5.84	1.11	5.62	1.08	-5.04(5270)**
Introjected regulation	1-7	4.16	1.86	4.02	1.69	-2.00(2598)*	4.24	1.89	4.06	1.71	-2.48(2455)**
External regulation	1-7	2.47	1.39	2.56	1.32	1.57(2574)^{ns}	2.30	1.35	2.47	1.27	3.17(2482)**
Food Variables											
Vegetables /salad (portions per week)	0-84	21.66	11.23	18.02	10.23	-8.62(2631)**	21.42	11.03	17.54	10.30	-9.26(2628)***
Fruits (portions per week)	0-42	11.00	7.92	8.28	7.45	-9.01(2630)**	11.04	7.89	8.32	7.65	-8.91(2620)***
Sweets (incl. savouries) (frequency per week)	0-35.75	4.44	4.15	4.53	4.13	.55(2626)^{ns}	4.37	4.14	4.36	4.00	-.10(2622)^{ns}
Meat (frequency per week)	0-42	3.89	3.11	5.26	3.61	10.46(2628)**	3.74	3.37	5.19	3.69	10.51(2615)***
Alcohol (frequency per week)	0-14.75	1.72	2.31	3.24	3.46	13.52(2641)**	1.72	2.31	3.21	3.46	13.52(2641)***
Recreational PA[c]											
Moderate (METs per week)	0-3000	839.17	1354.33	798.47	1216.41	.78(2496)^{ns}	812.41	1237.28	757.31	1168.74	-1.13(2491)^{ns}
Vigorous (METs per week)	0-3000	832.91	1864.53	1154.06	2506.58	3.67(2497)**	865.58	2027.88	1131.42	2374.01	3.03(8.89)**

Note. M: mean; SD: standard deviation; df: degrees of freedom; ns: not significant; METs: metabolic equivalents; PA: recreational physical activity. *p<.05, **p<.01, ***p<.001.[a] Education level was categorized into three categories: (low) primary and lower secondary school, (middle) vocational school, (high) higher secondary school, college and university. [b] Participants rated on a 7-point Likert scale that was numerically and verbally anchored (1=*do not agree at all*, 7=*fully agree*). [c] PA values were positively skewed, therefore median values are additionally reported in the following. Men: moderate PA = 480 METs per week, vigorous PA = 40 METs per week; women: moderate PA = 480 METs per week, vigorous PA = <1 MET per week.

Table 7.3. Pearson Correlations among all variables (N=2663).

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
	Time 1																						
1	Autonomous	1																					
2	Introjected	,32**	1**																				
3	External	,15**	,43**	1**																			
4	BMI	-,09**	,10**	,24**	1																		
5	Vegetables/salad (portions a week)	,13**	.03	-.01	-,08**	1																	
6	Fruits (portions a week)	,16**	.03	-.02	-.01	,36**	1																
7	Sweets/savouries (frequency a week)	-,07**	.02	.03	-,08**	-.03	.02	1															
8	Meat (frequency a week)	-,07**	<-.01	,10**	,13**	-,07**	-,15**	,12**	1														
9	Alcohol (frequency a week)	-.02	<-.01	,06**	.01	-.02	-,07**	.02	,20**	1													
10	Moderate PA (METs)	,08**	.03	.03	-,08**	,07**	,08**	-.01	-.04	,05*	1												
11	Vigorous PA (METs)	,08**	.02	<.01	-,07**	,05*	,08**	-.03	.02	.03	,31**	1											
	Time 2																						
12	Autonomous	,60**	,23**	,11**	-,05*	,09**	,14**	-,08**	-,07**	-.01	,08**	,07**	1										
13	Introjected	,23**	,65**	,35**	,08**	.01	.03	.03	.01	-.02	.02	,05*	,32**	1**									
14	External	,07**	,27**	,62**	,29**	-.04	-.01	.01	,14**	,06**	<.01	-.03	,09**	,34**	1**								
15	BMI	-,07**	,10**	,23**	,91**	-,09**	-.01	-,07**	,14**	.01	-,08**	-,06**	-,05*	,10**	,28**	1							
16	Vegetables/salad (portions a week)	,14**	.03	-,04*	-,11**	,64**	,28**	-.02	-,05**	-.03	,06**	,07**	,10**	-.02	-,05*	-,12**	1						
17	Fruits (portions a week)	,16**	.03	-.01	-.03	,31**	,73**	.02	-,15**	-,05**	,07**	,08**	,13**	.02	-.01	-.04	,33**	1					
18	Sweets/savouries (frequency a week)	-,05*	.02	.01	-,09**	<.01	.01	,69**	,08**	.01	-.02	-.02	-,06**	<.01	.02	-,07**	-.01	.01	1				
19	Meat (frequency a week)	-,08**	-.01	,09**	,13**	-,09**	-,12**	,08**	,65**	,19**	-,06**	<.01	-,10**	<.01	,13**	,15**	-,06**	-,11**	,11**	1			
20	Alcohol (frequency a week)	-.02	.01	,07**	,05*	-.02	-,07**	-.03	,18**	,83**	.04	.02	-.02	-.02	,07**	,05*	-,04*	-,06**	.01	,21**	1		
21	Moderate PA (METs)	,12**	,06**	.02	-,06**	,06**	,08**	-.04	-,05*	,05*	,42**	,22**	,11**	,08**	.03	-,05*	.03	,06**	-.02	-,06**	.04	1	
22	Vigorous PA (MET)	,12**	,07**	.02	-,06**	.04	,09**	-.03	.02	.04	,18**	,39**	,11**	,09**	.03	-,05*	,04*	,08**	-.02	<.01	.04	,36**	1

Note. BMI: body mass index; PA: recreational physical activity; MET: metabolic equivalents. **p<.001, *p<.01. Pairwise deletion of missing values was used. Underlined correlations represent correlations between Time 1 and Time 2. Because of the high skewness of the PA variables, Spearman's correlation coefficients for PA variables between T1 and T2 were also conducted (moderate PA: r_s=.53, p<.001; vigorous PA: r_s=.64, p<0.001.

Table 7.4 shows the correlations between the SDT-based measures, the food, and the alcohol consumption variables as well as the PA levels according to gender. Autonomous regulation was positively correlated with intake of fruits (r = .15, p < .001) and vegetables (r = .13 for men, r = .11 for women, p < .001) and negatively correlated with consumption frequency of sweets/savouries in both genders (r = -.07, p < .05) and meat in men (r = -.07, p < .05). Introjected regulation was not associated with any of the food groups. External regulation was positively correlated with consumption frequency of meat in both genders and alcohol intake in men (r = .09, p < .01). Table 4 also depicts Spearman's correlations between the SDT-based measures and PA levels. In men, autonomous regulation and recreational PA were positively correlated (moderate r_s = .11, p < .001; vigorous r_s = .09, p < .01). In women, autonomous regulation was positively associated with moderate PA (r_s = .10, p < .001), but not with vigorous PA. Both vigorous and moderate PA were correlated with introjected regulation in women (r_s = .06, p < .05 and r_s = .08, p < .01, respectively), but not in men. Lastly, the higher the external regulation in women, the lower their moderate PA level (r_s = -.06, p < .05).

Table 7.4. Pearson correlations among SDT-based measures, food choices, alcohol frequency and recreational PA (N=2663; T1)

	Autonomous		Introjected		External	
	MEN	WOMEN	MEN	WOMEN	MEN	WOMEN
Vegetables/salad	.13***	.11***	ns	ns	ns	ns
Fruit	.15***	.15***	ns	ns	ns	ns
Sweets/savouries	-.07*	-.07**	ns	ns	ns	ns
Meat	-.07*	ns	ns	ns	.09**	.10***
Alcohol	ns	ns	ns	ns	.09**	ns
Moderate PA[a]	.11***	.10***	ns	.08**	ns	-.06*
Vigorous PA[a]	.09**	ns	ns	.06*	ns	ns

SDT: Self-Determination Theory; PA: recreational physical activity. ***p<.001; **p<.01; *p<.05; pairwise deletion of missing values was used. [a] PA values were positively skewed, therefore, Spearman's correlation coefficients are depicted for the PA variables.

SDT-Based Measures as Predictors of Change in Food and Alcohol Consumption, Recreational PA, and BMI

Table 7.5 (women) and Table 7.6 (men) display the results of the hierarchical multiple regression analyses examining longitudinal relationships between the SDT-based measures and changes in food choices. Autonomous regulation at T1 was the only significant predictor for positive changes in food choices in both genders. More precisely, women reported higher vegetables/salad intake (β = .08, p = .001) at T2, while men reported lower meat consumption at T2 (β = -.06, p = .027). In contrast, external regulation was associated with negative changes in food choices. Externally regulated women tended to increase their alcohol consumption frequency (β = .05, p = .006) and externally regulated men increased their meat frequency (β = .06, p = .025). Introjected regulation was not a significant predictor of change in food choices. No significant results were observed for sweet/savouries consumption in either men or women.

Table 7.5. Longitudinal regressions with SDT-based measures (T1) as predictors for change in food choices (T2) in women, controlled for age and initial food choice (T1).

		Y=vegetables/salad intake T2 (N=1381)					Y=fruit intake T2 (N=1379)				
		B	SE B	ß	p-value	$R^2/\Delta R^2$	B	SE B	ß	p-value	$R^2/\Delta R^2$
Model 1	*Constant*	9.65	1.07		<.001		1.48	.67		.026	
	Y T1	.62	.02	.64	<.001		.68	.02	.68	<.001	
	Age T1	-.03	.02	-.04	.070	.407***	.04	.01	.06	.002	.479
Model 2	*Constant*	6.38	1.51		<.001		-.18	1.00		.859	
	Y T1	.61	.02	.63	<.001		.68	.02	.67	<.001	
	Age T1	-.04	.02	-.05	.019		.03	.01	.06	.006	
	Autonomous T1	.79	.23	**.08**	**.001**		.34	.16	.05	.031	
	Introjected T1	.04	.14	.01	.773		.06	.10	.01	.554	
	External T1	-.31	.18	-.04	.091	.006**	-.09	.12	-.02	.465	.002

		Y=sweets/savouries intake T2 (N=1368)					Y=meat intake T2 (N=1367)					Y=alcohol frequency T2 (N=1387)				
		B	SE B	ß	p-value	$R^2/\Delta R^2$	B	SE B	ß	p-value	$R^2/\Delta R^2$	B	SE B	ß	p-value	$R^2/\Delta R^2$
Model 1	*Constant*	1.19	.35		.001		1.33	.33		<.001		-.12	.15		.425	
	Y T1	.69	.02	.71	<.001		.68	.02	.63	<.001		.83	.02	.81	<.001	
	Age T1	<.01	.01	.01	.747	.503***	<-.01	.01	-.02	.450	.395***	.01	.01	.04	.008	.669
Model 2	*Constant*	1.09	.52		.036		1.26	.48		.009		-.26	.24		.262	
	Y T1	.69	.02	.71	<.001		.68	.02	.62	<.001		.83	.02	.81	<.001	
	Age T1	<.01	.01	.01	.763		<-.01	.01	-.02	.428		.01	<.01	.04	.014	
	Autonomous T1	.01	.08	<.01	.866		<.01	.07	<.01	.993		<.01	.04	<.01	.990	
	Introjected T1	.04	.05	.02	.359		<-.01	.04	<-.01	.944		-.01	.02	-.01	.732	
	External T1	-.06	.06	-.02	.300	.001	.04	.06	.02	.493	<.001	.08	.03	**.05**	**.006**	.002*

Note. Y corresponds to the food variable either at Time 1 (Y T1) or Time 2 (Y T2). There were no significant motivational predictors of changes for sweets/savouries and meat consumption in women. *p<.05, **p<.01, ***p<.001

Table 7.6. Longitudinal regressions with SDT-based measures (T1) as predictors for change in food choices (T2) in men, controlled for age and initial food choice (T1).

		Y=vegetables/salad intake T2 (N=1131)					Y=fruit intake T2 (N=1129)				
		B	SE B	ß	p-value	$R^2/\Delta R^2$	B	SE B	ß	p-value	$R^2/\Delta R^2$
Model 1	*Constant*	6.62	1.11		<.001		.52	.64		.416	
	Y T1	.64	.02	.63	<.001		.79	.02	.77	.000	
	Age T1	-.01	.02	-.01	.610	.398***	.02	.01	.04	.034	.567***
Model 2	*Constant*	5.11	1.53		.001		.66	.92		.476	
	Y T1	.63	.02	.63	<.001		.79	.02	.77	<.001	
	Age T1	-.01	.02	-.01	.561		.02	.01	.04	.052	
	Autonomous T1	.38	.24	.04	.122		-.01	.15	<-.01	.963	
	Introjected T1	.16	.17	.03	.355		-.15	.10	-.03	.142	
	External T1	-.41	.20	-.05	.043	.004	.23	.12	.04	.062	.001

		Y=sweets/savouries intake T2 (N=1131)					Y=meat frequency T2 (N=1134)					Y=alcohol frequency T2 (N=1142)				
		B	SE B	ß	p-value	$R^2/\Delta R^2$	B	SE B	ß	p-value	$R^2/\Delta R^2$	B	SE B	ß	p-value	$R^2/\Delta R^2$
Model 1	*Constant*	.52	.64		.416		2.28	.42		<.001		.51	.25		.042	
	Y T1	.79	.02	.77	<.001		.66	.02	.64	<.001		.81	.02	.82	<.001	
	Age T1	.02	.01	.04	.034	.485***	-.01	.01	-.03	.172	.417***	.01	<.01	.01	.613	.676***
Model 2	*Constant*	.66	.92		.476		3.01	.57		<.001		.41	.37		.262	
	Y T1	.79	.02	.77	<.001		.65	.02	.63	<.001		.81	.02	.82	<.001	
	Age T1	.02	.01	.04	.052		-.01	.01	-.03	.195		<.01	<.01	.01	.608	
	Autonomous T1	-.01	.15	<-.01	.963		-.19	.09	**-.06**	**.027**		.02	.06	.01	.680	
	Introjected T1	-.15	.10	-.03	.142		-.02	.06	-.01	.785		.03	.04	.01	.543	
	External T1	.23	.12	.04	.062	.001	.16	.07	**.06**	**.025**	.005*	-.06	.05	-.02	.266	<.001

Note. SDT: Self-Determination Theory. Y corresponds to the food variable either at Time 1 (Y T1) or at Time 2 (Y T2). *p<.05, **p<.01, ***p<.001

Table 7.7 displays the results of the various logistic regressions on changes in vigorous PA as outcomes and the types of regulation as predictors. First, the models predicting the likelihood of being a maintainer (vs. inactive) between T1 and T2 given the different types of regulation was significant for both genders (female model: $\chi^2(4) = 47.84$, $p \leq .001$; male model: $\chi^2(4) = 101.91$, $p \leq .001$). Autonomous regulation significantly predicted maintenance in vigorous PA between waves for women (b = .21, Wald $\chi^2(1) = 9.64$, $p < .01$) and men (b = .26, Wald $\chi^2(1) = 11.80$, $p = .001$). The odds ration (OR) of 1.24 for women and of 1.29 for men indicates an increased likelihood of long-term PA maintenance. Introjected regulation predicted PA maintenance only in women (b = .10, Wald $\chi^2(1) = 5.52$, $p < .05$) and was associated with an odds ratio of 1.10 for being a PA maintainer. Thus, introjected regulation distinguishes between women who maintain physical activity and those who are inactive. Second, the full models predicting group membership for inactive versus adopter were statistically significant in both genders (female model: $\chi^2(4) = 22.04$, $p \leq .001$; male model: $\chi^2(4) = 11.45$, $p \leq .02$). However, contingency tables indicated that no participant was correctly predicted as an adopter by the models. The same was true for the models predicting group membership for maintainer versus quitter. The model's prediction accuracy for quitting vigorous PA was 0%. Thus, the models were not considered as good models to predict changes in vigorous PA related to different types of regulation. Third, the same models as described above were tested for moderate PA (Appendix 1). Based on the contingency tables, none of the tested models resulted in an improved prediction.

Table 7.8 displays the results of the hierarchical multiple regression analyses examining motivational predictors of change in BMI for normal weight (BMI < 25) and overweight (BMI ≥ 25) participants and for men and women separately. The only significant predictor for change in BMI was introjected regulation in normal weight women ($\beta = -.04$, $p = .007$), indicating a lower BMI one year later. None of the other types of regulation predicted changes in BMI in normal weight or overweight participants.

Table 7.7. Summary of logistic regression analysis with SDT-based measures (T1) as predictors for change in ***vigorous PA***

	WOMEN						MEN					
	B	SE	OR	95% CI	Wald statistic	p	B	SE	OR	95% CI	Wald statistic	p
	Inactive (N= 560) vs. Maintainer (N=420)						**Inactive (N=420) vs. Maintainer (N=430)**					
Constant	1.02	.45	2.76		5.18	.023	.30	.46	1.35		.42	.516
Age T1	-.05	.01	.95	[.94, .96]	79.50	**<.001**	-.03	.01	.97	[.96, .98]	32.02	**<.001**
Autonomous T1	.21	.07	1.24	[1.08, 1.41]	9.64	**.002**	.26	.08	1.29	[1.12, 1.50]	11.80	**.001**
Introjected T1	.10	.04	1.10	[1.02, 1.20]	5.52	**.019**	.07	.05	1.07	[.97, 1.18]	1.84	.175
External T1	-.09	.05	.92	[.82, 1.02]	2.66	.103	-.08	.06	.93	[.82, 1.04]	1.60	.206
Model $\chi^2(4)=47.84$, p=<.001; Pseudo-R^2=.06 (Cox & Snell), .07 (Nagelkerke)							Model $\chi^2(4)=101.91$, p≤.001; Pseudo-R^2=.10 (Cox & Snell), .13 (Nagelkerke)					
	Inactive (N=560) vs. Adopter (N=136)						**Inactive (N=420) vs. Adopter (N=97)**					
Constant	-1.16	.66	.31		3.16	.075	-1.3	.74	.28		3.02	.082
Age T1	-.03	.01	.97	[.95, .98]	16.47	<.001	-.02	.01	.98	[.96, 1.0]	6.43	.011
Autonomous T1	.25	.10	1.28	[1.05, 1.55]	6.14	.013	.23	.12	1.26	[1.0, 1.6]	3.73	.054
Introjected T1	.04	.06	1.04	[.93, 1.17]	.47	.495	.05	.08	1.05	[.90, 1.22]	.39	.533
External T1	-.04	.08	.96	[.83, 1.12]	.25	.616	-.14	.10	.87	[.73, 1.05]	2.02	.155
Model $\chi^2(4)=22.04$, p≤.001; Pseudo-R^2=.03 (Cox & Snell), .05 (Nagelkerke)							Model $\chi^2(4)=11.45$, p≤.02; Pseudo-R^2=.02 (Cox & Snell), .04 (Nagelkerke)					
	Maintainer (N=420) vs. Quitter (N=134)						**Maintainer (N=430) vs. Quitter (N=97)**					
Constant	.99	.99	.75		.20	.651	-1.60	.72	.20		4.97	.026
Age T1	.01	.01	1.01	[.99, 1.03]	.95	.330	.03	.01	1.03	[1.02, 1.05]	14.04	<.001
Autonomous T1	-.22	.10	.80	[.65, .98]	4.53	.033	-.35	.11	.71	[.57, .88]	9.27	.002
Introjected T1	.01	.06	1.01	[.89, 1.14]	.02	.881	.03	.08	1.03	[.88, 1.21]	.12	.734
External T1	-.01	.08	.99	[.84, 1.16]	.03	.875	-.01	.10	.99	[.81, 1.21]	.02	.898
Model $\chi^2(4)=5.22$, p>.05; Pseudo-R^2=.01 (Cox & Snell), .01 (Nagelkerke)							Model $\chi^2(4)=47.84$, p≤.001; Pseudo-R^2=.06 (Cox & Snell), .07 (Nagelkerke)					

Note. SDT: Self-Determination Theory; OR: odds ratio; CI: confidence interval; PA: recreational physical activity. Inactive was defined by <80 MET-min pro week of vigorous PA at T1 (baseline) and T2 (follow up). Maintainer was defined by ≥80 MET-min pro week of vigorous PA at T1 and T2. Adopter was defined by <80METs-min pro week at T1, and ≥80 METs-min pro week of vigorous PA at T2. Quitter was defined by ≥80 METs-min pro week of vigorous PA at T1 and <80METs-min at T2.

Table 7.8. Longitudinal regression with SDT-based measures (T1) predicting **changes** in BMI (T2), controlled for age and initial BMI (T1). Different regression models were conducted for normal weight and overweight participants, and for men and women.

		WOMEN (N=1005)					MEN (N=537)				
		B	SE B	ß	p-value	$R^2/\Delta R^2$	B	SE B	ß	p-value	$R^2/\Delta R^2$
Normal weight (BMI <25)											
Model 1	*Constant*	.82	.31		.01		1.79	.69		.010	
	BMI T1	.96	.01	.91	<.001		.93	.03	.81	<.001	
	Age T1	<.01	<.01	.01	.485	.826***	<-.01	<.01	-.01	.736	.648
Model 2	*Constant*	.67	.34		.045		1.51	.72		.037	
	BMI T1	.97	.01	.91	<.001		.93	.03	.80	<.001	
	Age T1	<.01	<.01	.01	.659		<-.01	<.01	-.02	.493	
	Autonomous T1	.04	.03	.02	.110		.05	.04	.04	.217	
	Introjected T1	-.04	.02	**-.04**	**.007**		.02	.03	.02	.596	
	External T1	.01	.02	.01	.706	.002*	.02	.04	.02	.548	.003
Overweight (BMI ≥25)											
Model 1	*Constant*	4.40	1.31		.001		5.89	.89		<.001	
	BMI T1	.82	.04	.77	<.001		.81	.03	.76	<.001	
	Age T1	.01	.01	.03	.335	.590	-.01	.01	-.04	.160	.582
Model 2	*Constant*	3.56	1.55		.022		6.21	1.00		<.001	
	BMI T1	.82	.04	.77	<.001		.80	.03	.75	<.001	
	Age T1	.01	.01	.03	.360		-.01	<.01	-.04	.112	
	Autonomous T1	.04	.16	.01	.780		-.05	.09	-.02	.542	
	Introjected T1	.17	.11	.06	.145		-.03	.07	-.01	.677	
	External T1	<-.01	.13	<-.01	.981	.004	.16	.07	.06	.034	.004

Note. SDT: Self-Determination Theory; T1: Time 1; T2: Time 2. ***p<.001, **p<.01, *p<.05

Table 7.9. (Additional file) Summary of logistic regression analysis with SDT-based measures (T1) as predictors for change in ***moderate PA***

	WOMEN						MEN					
	B	SE	OR	95% CI	Wald-statistic	p	B	SE	OR	95% CI	Wald-statistic	p
	Inactive (N= 197) vs. Maintainer (N=810)						**Inactive (N=187) vs. Maintainer (N=602)**					
Constant	1.49	.51	4.42		8.43	.004	-.25	.54	.78		.22	.640
Age T1	-.02	.01	.98	[.97, .99]	8.38	.004	.02	.01	1.02	[1.00, 1.03]	7.12	.008
Autonomous T1	.17	.08	1.18	[1.02, 1.37]	4.67	.031	.10	.09	1.11	[.94, 1.31]	1.45	.228
Introjected T1	.12	.05	1.13	[1.02, 1.25]	5.78	.016	.04	.06	1.04	[.92, 1.17]	.39	.535
External T1	-.21	.06	.81	[.72, .92]	11.02	.001	-.10	.07	.90	[.78, 1.04]	1.97	.161
Model $\chi^2(4)=24.98$, p=<.001; Pseudo-R^2=.02 (Cox & Snell), .04 (Nagelkerke)							Model $\chi^2(4)=11.49$, p=<.05; Pseudo-R^2=.01 (Cox & Snell), .02 (Nagelkerke)					
	Inactive (N=560) vs. Adopter (N=121)						**Inactive (N=560) vs. Adopter (N=130)**					
Constant	.66	.73	1.93		.82	.365	-.52	.69	.60		.75	.451
Age T1	-.03	.01	.97	[.96, .99]	10.79	.001	.01	.01	1.01	[.99, 1.03]	.75	.386
Autonomous T1	.06	.11	1.06	[.86, 1.32]	.30	.586	.01	.11	1.01	[.81, 1.26]	.01	.910
Introjected T1	.05	.07	1.05	[.91, 1.21]	.46	.499	-.02	.08	.98	[.85, 1.14]	.06	.814
External T1	-.06	.10	.94	[.78, 1.14]	.39	.532	-.10	.10	.90	[.74, 1.09]	1.12	.291
Model $\chi^2(4)=13.22$, p=.01; Pseudo-R^2=.01 (Cox & Snell), .04 (Nagelkerke)							Model $\chi^2(4)=2.29$, p>.05; Pseudo-R^2=.007 (Cox & Snell), .010 (Nagelkerke)					
	Maintainer (N=810) vs. Quitter (N=121)						**Maintainer (N=602) vs. Quitter (N=119)**					
Constant	-1.04	.62	.35		2.84	.092	-.46	.65	.63		.51	.476
Age T1	<.01	.01	1.00	[.99, 1.02]	.27	.605	-.01	.01	1.00	[.98, 1.01]	.38	.536
Autonomous T1	-.23	.10	.80	[.66, .96]	5.72	.017	-.19	.10	.83	[.68, 1.01]	3.54	.060
Introjected T1	-.02	.06	.98	[.87, 1.12]	.07	.792	.03	.08	1.03	[.89, 1.19]	.12	.730
External T1	.12	.08	1.13	[.97, 1.32]	2.51	.113	.03	.09	1.03	[.86, 1.22]	.08	.772
Model $\chi^2(4)=8.33$, p>.05; Pseudo-R^2=.01 (Cox & Snell), .02 (Nagelkerke)							Model $\chi^2(4)=4.34$, p>.05; Pseudo-R^2=.01 (Cox & Snell), .01 (Nagelkerke)					

Note. SDT: Self-Determination Theory; OR: odds ratio; CI: confidence interval; PA: recreational physical activity. Inactive was defined by <40 MET-min pro week of moderate PA at T1 (baseline) and T2 (follow up). Maintainer was defined by ≥40 MET-min pro week of moderate PA at T1 and T2. Adopter was defined by <40METs-min pro week at T1, and ≥40 METs-min pro week of moderate PA at T2. Quitter was defined by ≥40 METs-min pro week of moderate PA at T1 and <40METs-min at T2.

Discussion

The main goal of this study was to assess motivation regulation within SDT for the desire to achieve or maintain a healthy body weight in a large, random sampling-based panel of adults. We further examined whether different types of regulation (autonomous, introjected, external) were associated with one-year changes in food choices, recreational PA, and BMI.

As hypothesised, autonomous regulation was the only type of motivation that predicted healthier food choices in the long term (i.e. increased vegetable intake in women and decreased meat intake in men). Autonomous regulation was also a significant predictor for long-term engagement in vigorous PA in both genders. These results support the contention of SDT that autonomous goal-setting is associated with more advantageous health behaviours in the long term. Our results further suggest that autonomous regulation does not predict BMI changes in overweight and obese people. Even though they reported a healthy body weight as an important health goal and their high BMI suggests the necessity of weight loss, their BMI did not change within one year. As suggested previously, health concerns seem not to predict a significant amount of weight loss, and individuals reporting greater concern about their health are not any more successful in their weight loss attempts (Heinberg, Haythornthwaite, Rosofsky, McCarron, & Clarke, 2000). Concerns about the health effect of body weight might not be motivating enough to lose weight initially and overcome the barriers associated with weight loss efforts without any interventions or guided weight-loss programmes. This is also substantiated by the result that autonomous regulation did not predict the adoption of moderate or vigorous PA. Perceived barriers (e.g. illness, lack of time) might hinder individuals in changing their PA behaviour permanently (Brinthaupt, Kang, & Anshel, 2010). Reasons for quitting PA might be diverse as well (e.g. bad health status, relocation into an activity-unfriendly environment), and apart from people's motivation to regulate their weight, other factors might be necessary to consider when predicting peoples' likelihood of quitting recreational PA. Overall, on a population basis, the adoption or quitting of recreational PA cannot be explained by people's self-determination toward body weight.

The results regarding introjected regulation were threefold. First, no associations between introjected regulation and food choices were observed. One might speculate that rather than focusing on the quality of foods chosen (e.g. vegetables) to regulate their weight, persons experiencing an introjected type of regulation are more concerned about the quantity of foods eaten. This thought is underpinned by the study by Pelletier et al. (2004), who

identified introjected regulation of eating behaviour as positively linked with quantity rather than quality concerns regarding food. Consequently, perceived social expectations related to body image, striving for social approval, and thus feelings of shame accompanying weight gain do not serve an important motivating function in the decision to engage in a healthy eating behaviour based on a high intake of favourable foods (e.g. vegetables) and a low intake of unfavourable foods (e.g. sweet, high-fat foods). In contrast, people might be at a higher risk of participating in dysfunctional eating behaviours (e.g. intense fasting) to regulate their weight (Verstuyf et al., 2012).

Second, introjected regulation predicts long-term adherence to vigorous, but not moderate, recreational PA; however, this was the case for females only. Our results match earlier findings addressing gender differences in the predictive potential of introjected regulation for exercise participation (Duncan et al., 2010; Wilson, Rodgers, Fraser, & Murray, 2004). Duncan et al. (2010) reported introjected regulation toward PA as the only significant predictor of exercise intensity in women, but not in men. Wilson et al. (2004) also found introjected regulation toward PA to be a significant predictor of exercise intention in women, but not in men. Women often exercise for weight and appearance reasons rather than for health reasons (Cash, Now, & Grant, 1994; McDonald & Thompson, 1992; Silberstein, Striegel-Moore, Timko, & Rodin, 1988), and evidence from the present study confirms that also on a population level, introjected regulation toward body weight is a significant predictor for vigorous PA in those women whose weight regulation attempts are appearance-oriented. Thus, self-imposed pressure based on a sense of obligation to successfully manage weight might evoke some kind of beneficial distress to exercise; however, introjected regulation has also been associated with negative psychological conditions such as lower self-worth and lower life satisfaction (Thøgersen-Ntoumani & Fox, 2007).

Third, introjected regulation predicted a lower body weight one year later. This was only the case for women who were classified as normal weight (BMI < 25) and despite the fact that weight reduction was not necessary from a health perspective. No association with weight development was observed in men. Body weight was reported as a central part of some women's sense of identity and social value (Clarke, 2002), and a desire to fit the sociocultural body ideal might be involved in women's concerns about weight gain. Indeed, body image dissatisfaction was reported to be greater in women with low general self-determination following media exposure to the "thin ideal" (Mask & Blanchard, 2011), and introjected regulation seems to be related to a higher likelihood of striving for a socially

prescribed ideal body size. Consequently, introjected regulation toward body weight appears to be an important aspect in the development of body size dissatisfaction. Those somehow externally induced weight management motives presumably act as underlying motivational forces to engage in unhealthy weight control behaviours (Thøgersen-Ntoumani, Ntoumanis, & Nikitaras, 2009). However, the present results also suggest a relationship with healthy weight loss activities such as the observed long-term vigorous exercise participation, which stands in contrast to the SDT theory that suggests that the more controlled forms of motivation are a less stable motivational basis in the long term (Deci & Ryan, 1987). Nevertheless, both a healthy eating pattern and engagement in PA are complementary factors in body weight regulation, and it remains unclear whether these people are more susceptible to weight gain or weight cycling caused by circumstances that temporarily prohibit PA, such as injuries.

Our analysis revealed that external regulation predicted negative changes in food choices. Mostly, externally motivated persons strive for extrinsic goal pursuits, such as acceptance by others or a demonstration of weight management abilities; they try to comply with others' demands and have not internalised a healthy body weight as an important factor for health and physical well-being. As our results indicate, balanced food choices and PA are not part of their strategies to maintain or achieve a healthy body weight. Additionally, external regulation in our study was more highly correlated with BMI in overweight participants than in normal weight participants, but external regulation had no impact on BMI in the long-term in either the normal weight or overweight participants. These observations indicate that external regulation is rather a consequence than a cause of high BMI values. In fact, overweight and obese persons often need to deal with other people's expectations and social pressure, and they often receive more negative feedback from their social environment regarding their body weight than normal weight people do (Puhl & Heuer, 2009). Previous studies have emphasised a negative effect of social pressure on dietary habits (Satia, Kistal, Curry, & Trudeau, 2001), and accordingly, external regulation in our study was linked to an increase in meat consumption (men) and a trend toward increased alcohol consumption (women). This observation might indicate that eating behaviours are used to cope with distress that originates from external pressure to regulate weight; have self-comforting properties (Steptoe, Wardle, Pollard, Canaan, & Davies, 1996; Torres & Nowson, 2007); and might imply a refusal to diet at all (Puhl & Heuer, 2009; Puhl, Moss-Racusin, & Schwartz, 2007). Additionally, "prescribed" weight loss by a spouse or significant other might result in

a perceived loss of self-determination and autonomy, and external forces can even disrupt conceptual engagement with a healthy body weight and its internalisation as one's own health goal (Ryan & Deci, 2000).

When interpreting the effects of the present longitudinal study, three aspects are important to consider. First, food frequencies and PA variables are based on self-reports; however, the FFQ and the GPAQ are sophisticated assessment tools for studies with large sample sizes and are suitable for long-term investigations at the population level (Armstrong & Bull, 2006; Bull, Maslin, & Armstrong, 2009; Cade, Thompson, Burley, & Warm, 2002). Second, data was gathered from a population-based sample. Compared to interventions or experimental studies with homogenous samples (e.g. students), the effects of survey research (real-life study) on population level can be weaker (Taris, 2000). However, these studies might serve as a basis for public health strategies and highlight effects among different socio-demographic groups. Third, the time interval of the present study is limited to one year, and changes in people's behaviour within one year are expected to be small. This is reflected in the fact that the pre-score of the dependent variable in the regressions explains most of the variance, and only a small amount of variance remains to be explained by the predictors. Using the same analysis, effect sizes observed in the present study are comparable with those from other studies explaining food behaviour (van Strien et al., 2014). Additionally, the study period under consideration was limited to one year; it is likely that longer follow-up periods would elicit greater effects (e.g. Jessor et al., 1995). Despite these limitations, by conducting a longitudinal study, spurious correlations could be avoided and the causal ordering of effects could be examined. For example, even though external regulation and BMI were highly correlated in the cross-sectional analysis of the present study, external regulation did not predict BMI changes within one year. The study also highlights that in terms of motivation, even though it turned out to be an important factor for different health behaviours in the cross-sectional analysis, a lot of associations were not significant in the long-term. Thus, cross-sectional studies could lead to an overestimation of the effects.

Conclusions

The results from the present survey provide considerable insights into the relevance of weight management motives for healthy behaviours at the population level. Autonomous goal-setting for a healthy body weight seems to be more supportive in overcoming barriers to carrying out healthy behaviours such as recreational PA and balanced food choices. Weight concerns

regarding health are a motivational source for recreational PA adherence in both genders, whereas concern associated with body appeal and judgement by others was only a motivational source for recreational PA adherence in women.

The social context can catalyse or hinder personal growth and motivational development (Ryan & Deci, 2000), and according to the present results, a controlling social environment accompanied by pressure to change behaviour did not seem to be a beneficial condition for dietary improvements or the adoption of a PA routine. Applying strategies to lose weight requires additional effort, and none of the investigated types of motivation toward a healthy body weight seemed to be related to successful weight-loss efforts in overweight participants without intervention.

The restrictiveness of socially constructed views regarding the body image of men and women, as well as social pressure from attached persons, might hinder some individuals from internalising successful weigh management as their own goal for good health and psychological well-being. Even in the public health domain, common forms of health promotion are based on campaigns of a stimulative nature. Public health campaigns should be designed and evaluated with regard to their potential to initiate internalisation of health goals. Taking the motivational tendencies of the target population into account seems to be more promising than emphasising the “right” way to behave in a healthier manner.

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Chapter 8

Cooking skills and balanced food choices

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Published manuscript

Hartmann C, Dohle S, & Siegrist M. (2013). Importance of cooking skills for balanced food choices. *Appetite* 65, 125-131

Abstract

A cooking skill scale was developed to measure cooking skills in a European adult population, and the relationship between cooking skills and the frequency of consumption of various food groups were examined. Moreover, it was determined which sociodemographic and psychological variables predict cooking skills. The data used in the present study are based on the first (2010) and second (2011) surveys of a yearly paper-and-pencil questionnaire (Swiss Food Panel). Data from 4436 participants (47.2% males) with a mean age of 55.5 years (SD=14.6, range 21–99) were available for analysis. The cooking skills scale was validated using a test-retest analysis, confirming that this new scale is a reliable and consistent instrument. Cooking enjoyment was the most important predictor for cooking skills, especially for men. Women had higher cooking skills in all age groups. Cooking skills correlated positively with weekly vegetable consumption, but negatively with weekly convenience food consumption frequency, even while holding the effect of health consciousness related to eating constant. In summary, cooking skills may help people to meet nutrition guidelines in their daily nutrition supply. They allow people to make healthier food choices. It is, therefore, important to teach children and teenagers how to cook and to encourage them to develop their cooking skills.

8.1 Introduction

Today's cooking practice and its relationship to diet quality and to people's health are not well studied (Caraher et al., 1999; Engler-Stringer, 2010). A fundamental issue and core problem in the study of cooking skills is the lack of a reliable, universally applicable cooking skill measurement.

> In *Cookery for working-men's wives*, Gordon (1890) wrote the following:
>
> …there are very many good, nutritious dishes to be made.… Unhappily, there are comparatively few who will take enough thought or trouble to prepare them. How many homes would be healthier, brighter, and happier if our women could only be brought to see how much depends on them, and bestir themselves in the matter. (p. 8)

This clear position taken by Gordon demonstrates that home-prepared meals are regarded as very important for health affairs as early as the past centuries and that concerns about a lack of cooking skills is not a phenomenon of the modern times. The same issue has been written about since the late 19th century. In earlier years, people suffered from poor health because of bad food practices (Mitchel, 2011). Today, it is assumed that a decline in cooking skills is connected to bad diet quality and obesity (James, 2008). Food guidelines simply inform people about healthy food choices and good eating practices. However, to translate food guidelines into actual daily meal preparation needs more than nutrition knowledge alone. Other important aspects that affect food choices are household characteristics, such as financial resources, available means of transportation, kitchen equipment, and household members' skills in food acquisition, transportation, storage, and preparation (Popkin & Haines, 1981).

Food management skills, especially cooking skills, were compulsorily taught in schools in the past century. In a UK sample, 49% of women and 15% of men mentioned cookery classes in schools as a resource for learning cooking skills (Caraher, et al., 1999; Lang et al., 1999). Today, mothers are reported as the major source of learning about basic cooking skills from an early age (Caraher, et al., 1999; Lang, et al., 1999).

Two core problems are discussed as responsible for todays supposed lack of cooking skills. First, there is a decline in the intergenerational transmission of basic cooking skills at home (Lyon et al., 2011), and cooking classes in schools are no longer formally taught in most countries (Stitt, 1996). Secondly, because people's daily lives are influenced by a chronic feeling of time scarcity, people tend to adopt a more time-saving behaviour even in relation

to daily food consumption (Jabs & Devine, 2006). This is evident in the current speedy food preparations with minimal effort and in the decreased amount of time allotted for eating. Improvements in food technology enabled the food industry to respond to people's demands with an increasing availability of convenience and ready-to-eat food (Jekanowski, 1999). People consider time and effort when making food choices and attach great importance to convenience (Gofton, 1995). Consequently, cooking skills become less frequently practiced on a daily basis because it is no longer necessary to cook to get one's daily nutrition supply. The question arises if the availability of convenience food has resulted in a decline in cooking skills or if these factors have only coincided with each other. Additionally, different employment opportunities and female's participation in the labour market increased in the last century (Lyon, et al., 2011). According to a study from Sayer (2005), women's time routinely spend in daily household tasks including food preparation declined in the last years. More detailed, women invested on average 33 minutes per day more time in daily meal preparation in 1965 compared to 1998, while men's time investment in daily meal preparation slightly increased in this time frame. However, it is still largely the female partner in most households who takes greater responsibility for food preparation (Furey et al., 2000).

In planning interventions to promote healthy dietary patterns, it is important to know whether cooking skills positively contribute to healthy eating. Based on the published literature, it remains unclear how cooking skills influence one's dietary behaviour. One reason for this research gap is the lack of a reliable cooking skill scale. Previous research was focused on cooking habits (Pettinger et al., 2006), general preparation techniques (e.g. steaming or grilling) (Lyon, et al., 2011), and preparation techniques related to a specific food type (e.g. filleting fish) (Caraher, et al., 1999). These measurements are likely subjected to cultural and traditional influences as well as personal preferences and eating habits. To apply a cooking skill scale to most persons, the scale should be constructed as culturally independent as much as possible. Therefore, the first aim of the present study was to design a cooking skill scale that is reliable and applicable to most people. The second objective of this study was to explore the following question: What factors promote cooking skills? It was determined which sociodemographic and psychological variables are predictors of cooking skills. Furthermore, the consequences of the presence or the absence of cooking skills were examined. It was hypothesised that high cooking skills go along with a more balanced diet especially because consumption of various vegetables requires advanced food preparation

skills. Therefore, the third aim was to study the associations between the consumption frequency of various food groups and the presence of cooking skills.

8.2 Methods

Participant.

This study analysed data from the Swiss Food Panel, a population-based longitudinal study of the eating behaviour of the Swiss population. The Swiss Food Panel started in 2010. Mail surveys were sent out to 20,912 randomly selected household addresses from the telephone book in the German-speaking and French-speaking parts of Switzerland. Altogether, 6189 persons responded in 2010 (a response rate of 29.6%). All respondents in 2010 were contacted for the second survey period in 2011, except for 75 participants who were excluded from the survey because of missing addresses, death, or unwillingness to participate in the second survey. The response rate in 2011 was 78.5%. After data cleaning, 4726 participants remained in 2011, whose data were paired with the data from 2010. Data from respondents for whom gender and date of birth were different across the two surveys were deleted (n=290). Finally, 4436 participants remained in the final sample, and only these respondents were included in the cross-sectional and longitudinal analyses of this study. In the 2011 sample, 47.2% of the participants were male, and the mean age was 55.5 years (SD=14.6, range 21–99).

Swiss Food Panel Questionnaire

The Swiss Food Panel is a paper-and-pencil questionnaire. It includes a food frequency questionnaire (FFQ) and questions related to cooking skills, sociodemographic variables, and psychological variables.

Cooking skills. Based on the items from Brunner, et al. (2010) and van der Horst et al., (2010) the following seven items and corresponding cooking skills scale were developed. Respondents were asked to evaluate their own cooking skills on a six-point scale.

1. I consider my cooking skills as sufficient.
2. I am able to prepare a hot meal without a recipe.
3. I am able to prepare gratin.
4. I am able to prepare soup.
5. I am able to prepare sauce.

6. I am able to bake cake.
7. I am able to bake bread.

Based on these seven items, mean values were calculated for each person to reflect his or her cooking skills (α=0.91) (Table 1).

Sociodemographic characteristics. Age, gender, and having children (≤16 years old) were also assessed in the Swiss Food Panel Questionnaire. Educational level was categorised into three groups: (1) low (primary and secondary schools), (2) medium (vocational school), and (3) high (college and university schools). For statistical analysis, education was coded as a binary variable (low versus medium; low versus high). Furthermore, we asked the respondents two questions related to meal preparation responsibilities in their households: 'Which person in your household most often prepares main meals during the week?' 'Which person in your household most often prepares main meals during the weekend?'

Psychological variables. We examined the respondents' health consciousness related to eating as well as four more psychological constructs related to cooking: willingness to invest time, willingness to invest physical effort, willingness to invest mental effort, and cooking enjoyment (Table 8.1). All psychological variables were rated on a six-point scale ranging from 1=do not agree at all to 6=totally agree. The scales from the variables willingness to invest time, willingness to invest physical effort and willingness to invest mental effort were recoded (6=do not agree at all to 1=totally agree) with the result that high values indicate high willingness to invest time or effort. For each person, mean values were calculated based on the items. Additionally, Cronbach's α was explored for the psychological variables (Appendix 8A).

First of all, health consciousness related to eating (α=0.83) was assessed with the following four items: 'I think it is important to eat healthily.' 'My health is dependent on how and what I eat.' 'If one eats healthily, one gets ill less frequently.' 'I am prepared to leave a lot, to eat as healthily as possible' (Schifferstein & Ophuis, 1998). Furthermore, the respondents' willingness to invest time in meal preparation (α=0.82) was analysed with the following three items: 'Since I'm always under time pressure, I try to save time while cooking' (Brunner, et al., 2010). 'Preferable, I spend as little time as possible on meal preparation' (Candel, 2001). 'At home, I preferably eat meals that can be prepared quickly' (Candel, 2001). In addition to that, the respondents rated their willingness to invest physical

effort in meal preparation (α =0.82) with the following three items: ‘After a busy day, I find it physically very exhausting to prepare a meal’ (Brunner, et al., 2010). ‘Cooking means physical effort that I try to avoid if possible’ (Brunner, et al., 2010). ‘The less physical energy I need to prepare a meal, the better’ (Candel, 2001). The respondents’ willingness to invest mental effort in meal preparation (α=0.83) was assessed with the following three items (Brunner, et al., 2010): ‘I don’t want to think about what to cook for a long time.’ ‘I try to minimize the mental effort for preparing meals.’ ‘The less I have to think about preparing a meal, the better.’ Last but not the least, the respondents rated their cooking enjoyment (α=0.95) with the following four items: ‘Cooking is an important type of relaxation for me.’ ‘Preparing a meal brings joy in my life.’ ‘While preparing a meal I can play out my creativity.’ ‘Preparing a meal is a satisfactory activity for me.’

Dietary Behaviour Assessment. The FFQ was specially designed for the Swiss Food Panel and was used to estimate the frequency of the habitual consumption of various food products. FFQ scales were considered to be reliable by conducting a two-week test-retest analysis in a separate study (for further information, see Hartmann, Siegrist, & van der Horst (2012)). FFQ items were grouped into the following categories: convenience food, sweets and savouries, sugar-sweetened beverages, meat and fruit and vegetables (Table 8.2). These food groups were chosen to represent food choices, either because they had been established by dietary guidelines or because their high frequency of consumption had been shown to have unfavourable health effects (Faramawi et al., 2007; Hu & Malik, 2010; van der Horst, et al., 2010). The questionnaire did not collect information on portion size or number of portions, except for fruit and vegetable consumption. Additionally, Cronbach’s α was explored for the convenience food scale, meat scale, and sweets and savoury scale (Table 8.2).

Items relating to sweets and savouries, sugar-sweetened beverages, and meat consumption frequency were assessed on a six-point scale. For statistical calculation, ‘several times per day’ was assumed to be two times per day (coded as 14 times per week); ‘daily’ was assumed to be one time per day (coded as seven times per week); ‘several times per week’ was assumed to be three times per week (coded as three times per week); ‘several times per month’ was assumed to be three times per month (coded as 0.75 times per week); and ‘several times per year’ and ‘less or never’ were considered as negligible (coded as zero). Items falling into each food group were combined to reflect the weekly consumption frequency of these foods.

Convenience food consumption was assessed on a five-point scale: daily (coded as seven times per week), several times per week (coded as three times per week), several times per month (coded as 0.75 times per week), several times per year (coded as zero), and less or never (coded as zero). To reflect the weekly consumption frequency, the items were combined.

Fruit and vegetable consumption was assessed on a five-point scale: daily (coded as seven times per week), four to six times per week (coded as five times per week), one to three times per week (coded as two times per week), one to three times per month (coded as 0.5 times per week), and less or never (coded as zero). Moreover, the respondents were asked how many portions of vegetables (one portion=a handful or 50 g) and fruits (one piece or one handful) they usually eat. The items relating to portion number and consumption frequency were combined to reflect ‘servings’ of vegetables and ‘pieces’ of fruits consumed per week.

Table 8.1 Psychological variables and their underlying items used in the Food Panel questionnaire.

Item	Cronbach's alpha
Health-consciousness[a]	0.83
I think it is important to eat healthily.	
My health is dependent on how and what I eat.	
If one eats healthily, one gets ill less frequently.	
I am prepared to leave a lot, to eat as healthily as possible.	
Willingness to invest time (recoded)	0.82
Since I'm always under time pressure, I try to save time while cooking.[b]	
Preferably, I spend as little time as possible on meal preparation.[c]	
At home, I preferably eat meals that can be prepared quickly.[c]	
Willingness to invest physical effort (recoded)	0.82
After a busy day, I find it physically very exhausting to prepare a meal.[b]	
Cooking means physical effort that I try to avoid if possible.[b]	
The less physical energy I need to prepare a meal, the better.[c]	
Willingness to invest mental effort[b] (recoded)	0.83
I don't want to think about what to cook for a long time.	
I try to minimise the mental effort for preparing meals.	
The less I have to think about preparing a meal, the better.	
Cooking enjoyment	0.95
Cooking is an important type of relaxation for me.	
Preparing a meal brings joy in my life.	
While preparing a meal I can play out my creativity.	
Preparing a meal is a satisfactory activity for me.	

Note: The items were rated on a six-point Likert scale ranging from 1=do not agree at all to 6=totally agree. [a] Schiffstein & Ophuis (1998); [b] Brunner, et al. (2010); [c] Candel (2001).

Table 8.2 Food groups and their underlying items from the FFQ used to characterise dietary behaviour of respondents.

Food group	Items (n)	Items from the FFQ	Cronbach's alpha
Sweets and savouries[a]	4	Cookies, chocolate, sweet pastries, salty snacks	0.69
Sugar-sweetened beverages[a]	1	Beverages sweetened with sugar (e.g. cola, Fanta)	-
Meat[a]	4	Beef or veal, pork, poultry (e.g. turkey, chicken), meat products (e.g. cold cuts, pepperoni, ham, sausages)	0.67
Convenience food[b]	8	Prepacked sandwiches, pizza (chilled/frozen), pizza (take-away/home delivery), a meal in a can, ready meals (frozen/chilled), instant noodles or pasta in a can, instant noodles or pasta with powder sauce in a bag, soup ready to heat	0.74
Fruit[c]	1	Fruit	-
Vegetables[c]	2	Vegetables (cooked/steamed), salad (lettuce, tomatoes) or raw vegetables	-

[a, b, c] Variables were measured using the following response categories in the FFQ: [a] Six response category: several times per day, once a day, several times per week, several times per month, several times per year, less, or never. [b] Five response category: daily, several times per week, several times per month, several times per year, less, or never. [c] Five response category: daily, four to six times per week, one to three times per week, one to three times per month, less, or never. These items were measured with portion number and frequency of consumption.

Data Analysis

Cooking skill scale reliability was tested with the longitudinal data from 2010 and 2011. A test-retest analysis was performed by calculating Pearson's correlation coefficients for single items and for the whole cooking skill scale. Additionally, *t*-values were calculated for every single item and the cooking skill scale from 2010 and 2011. In a further step, data were analysed to investigate which sociodemographic and psychological factors are related to cooking skills. Cross-sectional analyses were performed in the 2011 sample because items related to cooking enjoyment were only included in the 2011 questionnaire. One-way analysis of variance and chi-squared (χ^2) tests were used to evaluate gender differences in cooking skill ratings, cooking responsibility in the household, dietary behaviours, and the psychological variables health consciousness as well as cooking enjoyment. In the next step, multiple regression analysis (forced entry) was performed to examine the relationship between cooking skills as a dependent variable and sociodemographic and psychological variables as explanatory variables. To consider expected gender differences, multiple regression analysis was conducted for males and females separately. Finally, to measure the strength of linear dependence between cooking skills and dietary behaviour, Pearson's correlation coefficients were calculated for cooking skills and consumption frequencies of various food groups. Additionally, partial correlations were calculated to examine the relationships between cooking skills and consumption frequencies while holding the effect of health consciousness constant. All analyses were performed using SPSS statistics software package 19.0 (SPPS Inc., Chicago, IL, USA).

8.3 Results

The constructed cooking skill scale reliability was gauged by conducting a test-retest analysis. The measurement construct is not expected to largely change within the time frame of 1 year. Therefore, we found a very good stability of the cooking skill scale. The test-retest correlation coefficients for the single items varied between r=0.6 and r=0.8, and for the whole scale r=0.8, and are thus very high (Table 8.3).

Table 8.3 Test-retest results from the cooking skills items (2010 and 2011). Descriptive statistics, *t*-values, and Pearson's correlation coefficients are shown.

	2010		2011			
Items	*Mean*	SD	*Mean*	SD	*t*(*df*)	r^a
I am able to bake bread.	4.18	2.06	4.14	2.02	2.23 (4370)	0.82
I consider my cooking skills as sufficient.	4.62	1.54	4.60	1.50	1.28 (4296)	0.59
I am able to bake a cake.	4.84	1.80	4.80	1.74	2.94 (4373)	0.80
I am able to prepare a gratin.	5.01	1.66	4.99	1.61	1.53 (4373)	0.78
I am able to prepare a sauce.	5.10	1.49	5.05	1.48	3.04 (4373)*	0.74
I am able to prepare a hot meal without a recipe.	5.23	1.34	5.23	1.33	–0.36 (4311)	0.65
I am able to prepare a soup.	5.54	1.07	5.46	1.10	5.47 (4372)*	0.60
Cooking skill scale	4.95	1.22	4.91	1.24	3.71 (4248)*	0.84

[a] all $p < 0.001$, * $p < 0.01$

Gender differences in dietary behaviour, health consciousness, cooking skills, cooking enjoyment, and food preparation responsibilities are shown in Table 8.4. Cooking skills were higher for females (M=5.48; SD=0.72) than for males (M=4.24; SD=1.38). Furthermore, the majority of female respondents were responsible for meal preparation during weekdays and weekends. They also reported higher enjoyment in cooking compared to men. Additionally, females were more health conscious and reported higher weekly fruit and vegetable consumption, while men had, on average, higher consumption frequencies for sugar-sweetened beverages, meat, and convenience food.

As mentioned above, females indicated higher cooking skills than men. This is true for all age groups (see Fig. 8.1). The highest cooking skills were reported from respondents in the age group of 50–59 years for women and in the age group of 40–49 years for men. As discussed below, men's cooking skills starkly declined after 40–49 years. Female's cooking skills declined as well. However, this decline started at the age of 70–79 years.

Table 8.4 Characteristics of the study population according to gender (2011). Descriptive statistics and *F*-values are shown.

	Males, n= 2079[a]		Females, n = 2329 [a]		
	Mean or %	SD	*Mean* or %	SD	$F(df_1, df_2)$ or $\chi^2(df)$
Cooking skills	4.24	1.38	5.48	0.72	1415.18 (1, 4351)***
Enjoy cooking	3.76	1.59	4.42	1.34	230.53 (1, 4391)***
Health consciousness	4.47	1.04	4.82	0.93	139.84 (1, 4359)***
Main cook during week	29.4%	-	70.6%	-	1292.82 (1)***
Main cook during weekend	36.0%	-	64.0%	-	717.36 (1)***
Dietary behaviour (consumption frequency per week)					
Convenience food	1.02	2.20	0.50	1.51	54.50 (1, 4336)***
Meat	5.54	4.19	3.98	3.36	187.50 (1, 4336)***
Sugar-sweetened beverages	0.68	1.73	0.27	1.13	86.17 (1, 4378)***
Sweets and savouries	4.48	4.39	4.51	4.32	0.07 (1, 4361)[ns]
Vegetables (servings/week)	17.66	10.83	21.62	11.82	131.44 (1, 4358)***
Fruit (pieces/week)	8.35	7.77	10.70	7.98	96.82 (1, 4374)***

Note. [a] *n* could vary due to missing values. *** $p < 0.001$. [ns] not significant

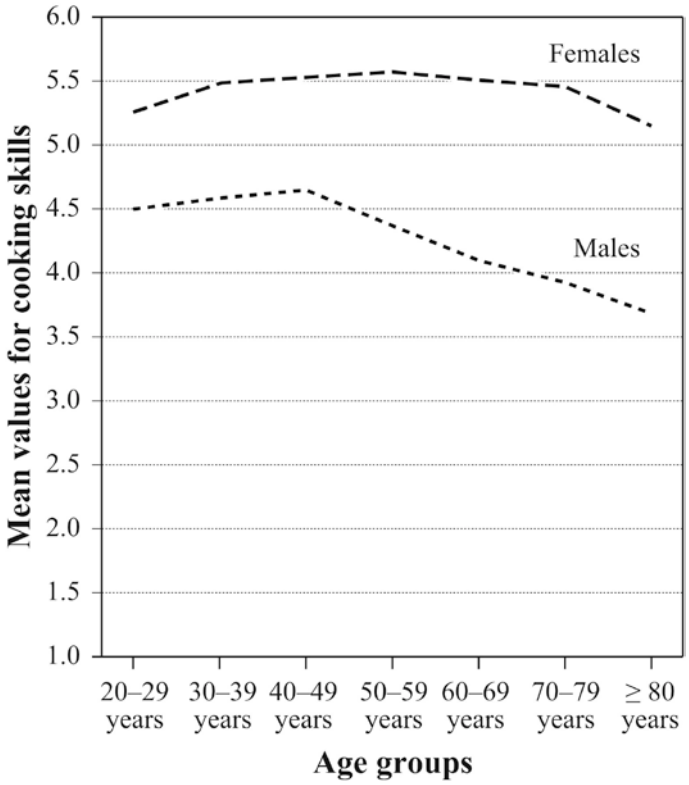

Figure 8.1 Mean values for cooking skills plotted against age groups for males and females separately. Results indicate higher cooking skills in females than in men. Men's cooking skills starkly declined after 40–49 years.

Factors predicting cooking skills were investigated by conducting a multiple regression analysis, with cooking skills as the dependent variable (N=4151) (Table 8.5). Models were constructed separately for males and females. Collinearity diagnostics indicate that the data were suitable for a regression analysis. The most important predictor for cooking skills was enjoyment of cooking in both models (females, r=0.43; males, r=0.70): the higher people's enjoyment of cooking is, the higher are their cooking skills. Cooking skills were not influenced by people's willingness to invest mental effort in cooking, however. Additionally, more significant positive predictors in both models were low versus high education and children in the household under 16 years. As shown in Fig. 8.1, age is negatively related to cooking skills in the male group (for males: cooking skills = - 0.21age; for females: cooking skills = 0.77age – 0.81age^2; for both $p<0.001$).

Table 8.5 Results from the multiple regression analysis with cooking skills as the dependent variable (2011). Analyses were performed for males and females separately.

	Males, n = 1943				Females, n = 2208			
	B	*SE B*	ß	*p-value*	*B*	*SE B*	ß	*p-value*
Constant	2.06	0.16		< 0.001***	3.73	0.11		< 0.001***
Age	–0.01	< 0.01	-0.10	**< 0.001*** **	< 0.01	< 0.01	< 0.01	0.875
Education Low (=0) vs medium (=1)	0.16	0.08	0.05	0.063	0.22	0.05	0.15	**< 0.001*** **
Low (=0) vs high (=1)	0.22	0.08	0.08	**0.006*** **	0.21	0.04	0.15	**< 0.001*** **
Children in household (no=0/yes=1)	0.29	0.06	0.09	**< 0.001*** **	0.19	0.03	0.12	**< 0.001*** **
Willingness to invest time	-0.08	0.02	-0.07	**< 0.001*** **	0.03	0.01	0.04	0.075
Willingness to invest physical effort	0.10	0.02	0.09	**< 0.001*** **	< 0.00	0.02	< 0.01	0.887
Willingness to invest mental effort	0.01	0.02	0.01	0.675	0.02	0.02	0.04	0.119
Enjoy cooking	0.61	0.02	0.70	**< 0.001*** **	0.23	0.01	0.43	**< 0.001*** **
Health consciousness	0.02	0.02	0.01	0.380	0.06	0.02	0.08	**< 0.001*** **

Note. Males adjusted $R^2 = 0.575$; Females adjusted $R^2 = 0.267$

Despite some similarities, there were also differences between males and females. For males, six out of the nine predictors yielded a significant contribution to the model ($p < 0.01$), and the model accounted for 57.5% of variance in cooking skills, $F(5, 1933)=292.89$, $p < 0.001$. A significant variable that positively influenced the model was willingness to invest physical effort in cooking, whereas willingness to invest time was negatively influential. Health consciousness was also an insignificant variable.

For females, only five out of seven predictors yielded a significant contribution to the model ($p < 0.01$), and the model accounted for 26.7% of variance in cooking skills $F(9, 2198) = 90.45$, $p < 0.001$. In contrast to the data for males, health consciousness was positively related to cooking skills for females. Willingness to invest time and effort in cooking was not significant for females.

Table 8.6 (A) Pearson's correlation coefficients for cooking skills and consumption frequency of various food groups (2011), and (B) partial Pearson's correlation coefficients for cooking skills and consumption frequency of various food groups with health consciousness as control variable (2011).

	(A) Cooking skills			**(B) Cooking skills**		
Food groups	Both genders *N*=4151	Males *N*=1943	Females *N*=2208	Both genders *N*=4073	Males N=1921	Females N=2149
Convenience food	-0.15***	-0.05*	-0.25***	-0.13***	-0.05*	-0.24***
Meat	-0.12***	*ns*	*ns*	-0.09***	*ns*	*ns*
Sugar-sweetened beverages	-0.12***	*ns*	-0.10***	-0.08***	*ns*	-0.07**
Sweets (incl. savouries)	-0.03*	-0.05*	*ns*	ns	*ns*	*ns*
Vegetable consumption	0.16***	0.08**	0.15***	0.11***	*ns*	0.09***
Fruit consumption	0.11***	*ns*	0.05*	0.05**	*ns*	*ns*

* $p < 0.05$ (two-tailed). ** $p < 0.01$ (two-tailed). *** $p < 0.001$ (two-tailed). *ns* not significant.

Correlation coefficients were computed to examine the relationship of cooking skills to frequency of consumption of various food groups and diet quality (Table 8.6). As expected, there is a positive correlation between vegetable intake and cooking skills for both genders, whereas a positive relationship between fruit intake and cooking skills was only observed in the female group. Another remarkable result is the negative relationship between cooking skills and convenience food consumption frequency. Furthermore, soft drinks in females and sweet and savouries in males were negatively correlated with cooking skills. The inclusion of health consciousness as control variable diminished some of the correlation coefficients. Nevertheless, vegetable consumption, convenience food consumption, and sugar-sweetened beverages consumption were still correlated with cooking skills in females, and convenience food consumption was still correlated with cooking skills in males.

8.4 Discussion

A cooking skill scale was designed that is applicable to most persons and is stable over a time frame of 1 year. Moreover, it was determined which sociodemographic and psychological variables predict cooking skills. Additionally, the relationships between cooking skills and consumption frequencies of various food groups were examined.

In this study, cooking skills were defined as the ability to prepare different foods. Instead of rating the respondents' ability to prepare special food items (e.g. dark rye bread) or meals (e.g. spaghetti Bolognese), it was rather asked for food groups in general (e.g. bread). This is because the preparation of special food items or meals can be very different depending on cultural contexts and, thus, would influence cooking skill ratings. However, it is most likely impossible to develop a cooking skill scale that is completely culturally independent. This scale's application is not unlimited but suitable for the European cultural region, especially Switzerland.

No other household task seems to be as strongly gendered as cooking (Dixey, 1996). About 71% of the women, but only 29% of their male counterparts, in the present sample are responsible for meal cooking during the week. More importantly, females have on average higher cooking skills then men, especially in higher age groups. One possible explanation for this result may be that in Switzerland cooking

classes for females were obligatory in the earlier years, while obligatory cooking classes for males started only in the 1980s (N. Faller, Swiss Society for Nutrition, personal communication, July 4, 2001). Furthermore, there were differences in cooking skill ratings between different age groups. Females in their 30s reported on average higher cooking skills than females in their 20s. In Switzerland, females, on average, give birth to their first child at the age of 31 years (FSO, 2010). Therefore, differences in cooking skill ratings could be due to skill acquisition with social role change within a familiar setting (Lyon, et al., 2011). This is supported by the present finding indicating that the presence of children is a significant predictor for cooking skills in the regression analysis. It is likely that with the birth of their first child, women start to assume the role as a main food provider for the family and hence are more motivated to acquire cooking skills.

Further analysis shows that the presence of cooking skills is more highly correlated with cooking enjoyment in males than in females. It is possible that men's motivation for domestic cooking may be rather constructed as cooking when they are in the right mood than as an everyday responsibility. Men are more likely to have cooking skills when cooking is constructed as a fun activity, while women's familial role is mostly characterised by their task as the main food provider (Dixey, 1996; Murcott, 1982), and cooking rather occurs as an obligation than as a pleasure. Murcott (1982) showed that around 30% of the interviewed women regarded cooking as something they did not mind doing because they had to. However, around half of the interviewed women in Murcott's study rated cooking as something they enjoyed, and compared to men, female respondents in the present study reported, on average, higher enjoyment in cooking. On the one hand, it is possible that cooking may give women a feeling of self-confidence and self-worth (Dixey, 1996). On the other hand, women like to have control over their family's food consumption pattern (Dixey, 1996; Kemmer et al., 1998). Handing over food preparation to their partner would mean adopting to men's way of eating, which is regarded as less health conscious and less health promoting (Kemmer, et al., 1998). In summary, the results suggest that health-conscious females who enjoy cooking also have higher cooking skills. That is the case regardless of their willingness to invest time as well as mental and physical effort for meal preparation.

Apart from the factors that predict cooking skills, it was examined if the presence of cooking skills is associated with better food choices. There are only a few studies on this. One study showed that adolescents who are more involved in preparing food for their family made healthier dietary food choices (Larson et al., 2006). More specifically, helping to prepare food was positively associated with fruit consumption in male adolescents and with fruit and vegetable consumption in female adolescents (Larson, et al., 2006). This is in line with the results of the present study. Females with higher cooking skills consume more vegetables compared to females with lower cooking skills. This relationship is still present even when controlling for health consciousness related to eating. In fact, cooking skills enable to prepare different food items and dishes, and therefore may increase food choice opportunities as well as food variety. It is well known that food variety is one factor among others that may increase food intake, which is preferable in the case of vegetables consumption (Bucher et al., 2011; Wansink, 2004).

The use of convenience food products is related to fewer cooking skills in this study, which is in line with previous results (Brunner, et al., 2010). Food retailers reacted on people's demand to spend less time in the kitchen by offering a huge variety of fully or partially prepared cheap and tasty foods, which require less or no domestic labour. Convenience foods are omnipresent and simplify meal preparation even if there is no time pressure (Brunner, et al., 2010). The use of convenience foods does not require high cooking skills (Beck, 2007) or additional effort. Unfortunately, a lack of cooking skills reduces the consumers' chance to choose between self-prepared and pre-prepared food. With an increasing amount of convenience foods in the diet, consumers lose control over ingredients and food safety and are dependent on the information given by the food industry. It also restricts food variety and consumers' control of their intake (Lang, et al., 1999). Furthermore, convenience food products are heavily processed and include a lot of sugar, fat, or salt. Therefore, their high consumption frequency is related to obesity (van der Horst, et al., 2010).

It is possible that some limitations may have influenced the results observed in the present study. There is a ceiling effect in cooking skills for women. Moreover, some people may prepare their meals from basic ingredients, while others may use pre-prepared foods. As a result, people with different cooking skills may have responded

similarly to the same questions. Another limitation is that consumption frequency scores from the dietary assessment might be biased by conscious or unconscious under/over-reporting of people's true food consumption (Voss et al., 1997). In addition, cooking enjoyment was assumed as a predictor for cooking skills, but cooking skills may also be a cause of cooking enjoyment.

People tend to have strong views regarding the importance of cooking skills for a healthy diet. However, to the best of our knowledge, the impact of cooking skills on fruit and vegetable consumption in the general population has not been studied. The present study shows that cooking skills are related to food choices. Increasing cooking skills should therefore be part of health promotion activities. For instance, cooking courses provide the opportunity to raise awareness of fresh foods, food ingredients, and health-promoting diets and teach students how to economically and quickly prepare healthy foods. It may help people to transfer the information from nutritional guidelines into daily food practices. It may also increase the likelihood that individuals would choose a more balanced diet. Additionally, children and young adults, especially from low-income families, might benefit most from cooking classes in schools because they have limited access to other resources of information. Nonetheless, to address people's increasing convenience orientation, the use of healthy convenience food and pre-prepared foods should be promoted.

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Chapter 9

Nutrition information use and food choices

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Published manuscript

Visschers, V. H. M., Hartmann, C., Leins-Hess, R., Dohle S., Siegrist, M. (2013). A consumer segmentation of nutrition information use and its relation to food consumption behaviour. *Food Policy, 42,* 71-80

Abstract

Consumers need information such as nutrition tables to assess the nutritional value of a food product. Although a broad range of studies has examined consumers' attention, perception and use of nutrition tables, relatively little is known about what types of consumers use what kind of nutrition information. Therefore, using data from the Swiss Food Panel, we conducted a cluster analysis of nutrition information usage and health and nutrition interest to determine whether consumers could be segmented into specific groups. We identified four segments, which we labelled Official Information Users, Internet Users, Moderate Users and Uninterested. We then determined the segments' demographics, food frequencies and perception of food. Based on our findings, we provide suggestions for targeted interventions that stimulate healthy food choices among these four segments. Our findings imply that nutrition education or the improvement of nutrition labels is unlikely to stimulate nutrition information usage among all consumer types; some consumers may rather benefit more from environmental cues that prime healthy food choices.

9.1 Introduction

As it is difficult for consumers to determine the nutritional value of a food product by just looking at the packaging or tasting the product, explicit nutrition information needs to be provided on food products (Golan et al., 2001). Nutrition tables provide useful information on the healthiness of food, and consumers are encouraged to use them to evaluate and compare food products while purchasing and consuming them. In some countries, such as in the US and in EU member states, nutrition labelling, in the form of nutrition fact tables, is mandatory on prepackaged foods (EU No 1169/2011, 2011; NLEA, 1990). However, consumers appear to find it difficult to interpret the information provided in nutrition tables (see Cowburn & Stockley, 2005; Grunert & Wills, 2007 for reviews).

Besides nutrition tables, there are other sources of information available for consumers to help them choose healthy food products, such as websites on dieting and healthy eating, recommendations made by dieticians and medical doctors or information and recommendations provided by family and friends. However, little is known about the type of nutrition information and sources that consumers use, the type of food consumption patterns related to nutrition information usage and what motivates consumers to use nutrition labels or other information sources. This study aims to shed light on these issues.

Previous studies about nutrition labels and consumers' perception, understanding and usage can be categorised in four formats. First, many studies have investigated psychosocial, external and demographical determinants of nutrition label usage (mostly self-reported use) (e.g., Grunert et al., 2010; Guthrie et al., 1995; Hess et al., 2012). Second, other studies have examined effects of different formats of nutrition labels on consumers' understanding, attitudes and (self-reported) usage (e.g., Goldberg et al., 1999; Levy et al., 1996; Visschers & Siegrist, 2009). Third, a smaller number of studies have looked at the relation between nutrition label usage and dietary behaviour or food consumption, either self-reported or observed food consumption behaviour (e.g., Graham & Laska, 2012; Guthrie, et al., 1995; Ollberding et al., 2010). Fourth, more recently, a number of studies have investigated consumers' visual attention for nutrition labels on products because attention was recognised as a key factor in using this type of information (e.g., Graham & Jeffery, 2012; Graham et al., 2012; van Herpen & van Trijp, 2011; Visschers et al., 2010).

Based on the results of previous studies, the most important determinants of nutrition label usage and the most promising design of nutrition information can be identified and then applied in communication and education campaigns to encourage consumers to use nutrition

labels and make healthy food choices. Such an approach assumes that all consumers are influenced by the same determinants and need to be stimulated to use nutrition labels in the same way. However, consumers mostly do not respond in the same way and need different communication approaches to be informed effectively. An approach in which different communication strategies are targeted at different consumer segments has been found to effectively influence food consumption behaviour (Verbeke, 2008). In a targeted communication approach, the information is made more personally relevant and is therefore more likely to be accepted by the target population (Kreuter & Wray, 2003). For example, consumers who are positive about nutrition labels but report that they are unable to use them may be facilitated by showing these consumers how to interpret this type of nutrition information. Another consumer segment may not like and use nutrition labels but prefer information from dieticians. They should be motivated to contact a dietician and advised how to do so.

Studies on the segmentation of consumers based on their nutrition information usage are still very rare (Grunert & Wills, 2007; Souiden et al., 2013 for a typology of consumers regarding nutrition labels). In developing targeted communication materials to stimulate healthy eating, it would be very helpful to know more about the characteristics of consumers who are already using nutrition table information or other information sources and to know more about those who do not use such information. More interestingly, it would be valuable to determine whether differences exist between consumer groups who do not utilise nutrition information in their food choices and those who do refer to them.

To the best of our knowledge, only one other study has investigated a consumer segmentation of nutrition label use. Souiden et al. (2013) examined a sample of the Canadian population in terms of their usage, understanding, attitudes and ability to use nutrition labels; their health status, health consciousness and nutrition knowledge; and their perceived importance of nutrition, price and taste. The authors identified three clusters: the “Nutrition Savvy” cluster, the “Sceptical and Less Committed” cluster, and the” Nutritionally Perplexed” cluster. The study by Souiden et al. (2013) showed that consumers can be segmented based on their nutrition label usage and attitudes, and that such a segmentation can provide valuable information for a targeted communication approach. The study however has two limitations, which we intended to circumvent in our study. Firstly, Souiden et al. applied a convenience sampling method. This yielded a sample in which women were overrepresented and which contained relatively young respondents and many highly educated respondents.

Secondly, the study by Souiden et al. used respondents' perceived health status as an indicator for the need to use nutrition labels or to improve the respondents' diet and did not include a direct measure to check this, such as a food consumption assessment.

In the present study, we investigated a consumer segmentation of nutrition information usage in a large population sample. We aimed to determine the differences in food consumption between the identified clusters. Nutrition information usage was broadly defined: we assessed not only the use of nutrition tables, but also the use of other sources of nutrition information, such as the Internet and dieticians. In addition, we investigated to what extent the identified segments differed regarding their demographical variables, consumption of a number of food items, and liking and health perception of certain foods. In the remainder of this Introduction, we describe the relation of nutrition information usage with several important psychological variables and with dietary behaviour.

Important variables related to nutrition information usage. To provide meaningful clusters in a segmentation study or a cluster analysis, the selection of the variables should be theory-based (Aldenderfer & Blashfield, 1984). Therefore, we based our cluster analysis on respondents' self-reported nutrition information usage and on two important determinants of nutrition information usage derived from relevant frameworks and previous findings on this topic.

First, nutrition information can only influence consumers when they pay attention to this information (Grunert & Wills, 2007). Their attention can be captured using a top-down approach, i.e., by increasing people's interest in nutrition information or their motivation for paying attention to such information. Alternatively, people's attention can be captured by increasing the salience of the nutrition information, i.e. a bottom-up approach (Visschers, et al., 2010). As we could not directly assess consumers' attention to nutrition information or the saliency of the nutrition information on the products which our respondents consumed, we investigated our respondents' interest in nutrition information. Interest in nutrition information and paying attention to such information have been found to be strongly related (Guthrie, et al., 1995). Second, the awareness of the healthiness of one's diet and lifestyle—or health consciousness—has been found to be an important determinant of nutrition table use. A stronger awareness of the relation between diet and health has been associated with more nutrition label usage (e.g., Hess, et al., 2012; Nayga Jr, 2000). In addition, consumers who consider nutrition as important while shopping are more likely to pay attention to nutrition labels (e.g., Guthrie, et al., 1995; Hess, et al., 2012; Nayga Jr, 2000).

Nutrition information usage and dietary behaviour. Some survey studies have investigated the relation between nutrition label usage and diet quality (Coulson, 2000; Graham & Laska, 2012; Guthrie, et al., 1995; Kristal et al., 2001; Ollberding, et al., 2010). Greater nutrition label usage was found to be related with a healthier diet, e.g. lower energy intake, lower fat intake and higher fruit and vegetables intake. However, the results seem to differ between studies. The study by Coulson (2000), for example, showed that nutrition label usage was related to a lower fat intake and a higher fruit intake, but not to vegetable intake, whereas Kristal et al. (2001) only found a positive relation of nutrition label usage with fat reduction and not with fruit and vegetable consumption. The different dietary assessment methods in these studies may explain these inconsistencies. To the best of our knowledge, our study is the first in which consumer segments on nutrition table usage have been related to food consumption. Both nutrition information usage and food consumption were assessed using self-report measures.

9.2 Method

Procedure and sample

The Swiss Food Panel Questionnaire is a longitudinal study of Swiss consumers' food consumption behaviour and food-related attitudes. In the present paper, the results of only the first wave (collected in Spring 2010) are reported. The questionnaire was sent by postal mail to 20,912 household addresses in the German-speaking and French-speaking parts of Switzerland that were randomly selected from the telephone book. The addressees were asked to return the completed survey using the enclosed stamped and addressed envelope. A reminder containing another copy of the questionnaire was sent five weeks later to those who had not yet returned the questionnaire. The response rate was 30.1% (N = 6,290). Participants with more than 20% missing items relevant for our main research questions were deleted from the sample. This resulted in a final sample size of 6,061 participants.

Our final sample consisted of 52% women (n = 3,152) and 47.7% men (n = 2,892). Seventeen respondents (.3%) had not reported their gender. The mean age of the sample in 2010 was 54 years (SD = 15.22). The highest education level of about one-third of the sample (n = 2,024) was vocational school, 28.4% (n = 1,724) had completed higher secondary school, and 27.8% (n = 1,684) of the respondents held a college or a university diploma. About 9% (n = 558) of our sample had only finished the obligatory school levels, and 1.2% (n = 71) did not report their highest education level. Most of our respondents lived in the German-speaking

part (70.1%, *n* = 4,250) of the country, with the remainder 29.9% (*n* = 1,811) residing in the French-speaking region. The mean BMI of our sample was 24.60 (*SD* = 4.17). Almost 17% (*n* = 973) of the respondents reported having followed a special diet during the last 12 months.

We examined the characteristics of the non-responders in a separate telephone survey. Of the random sample of 200 non-responders in the German-speaking part of Switzerland, 72% (*n* = 144) were reached with a maximum of five telephone calls at different times a day. Compared to the participants, non-responders were more likely to be male (56.3% of non-responders vs. 47.7% of participants) and to have a lower education level (primary or lower secondary school: 22.0% of non-responders vs. 9.2% of participants). The mean ages were similar between non-responders and responders (55 vs. 54yrs). The main reasons for not wanting to complete our survey were a lack of time (13.2%, *n* = 19), not wanting to participate (13.9%, *n* = 20) and not having received our questionnaire (14.6%, *n* = 21). A lack of interest in the topic was mentioned by only 2.1% (*n* = 3) of the non-responders.

Compared with the average Swiss population, our sample was older, included more women and more people with a higher education (Swiss Statistics, 2009, 2010). Probably, young adults are less likely to be registered in the telephone book and could therefore not be reached by our study.

Questionnaire

The Swiss Food Panel Questionnaire 2010 comprises 15 pages and includes a broad range of constructs. Only a selection of the constructs is included in the analyses for this paper, namely: nutrition table usage, nutrition information from other sources, health consciousness, nutrition information interest, food frequencies questionnaire (FFQ), perceived healthiness and liking of a selection of stereotypical healthy and unhealthy products and demographics. Scales were formed based on theory and reliability analyses.

Nutrition table usage – Nutrition table usage was assessed using four items. Participants had to indicate for four situations how often they referred to nutrition tables, namely when they chose food products, when they decided upon an unknown food product, when they had to choose between two or more food products and when they had to determine the healthiness of a food product. The response scale included 6 points, ranging from “very rarely” to “very often”. The internal reliability of the nutrition table usage scale was very good, Cronbach’s α = .93, *N* = 4.

Nutrition information from other sources – Four items were used to assess nutrition information gained from other sources. Respondents had to indicate their frequency of usage of four different information sources (each item started with the same introduction): "When I am looking for information about healthy nutrition,… I perform an Internet search for information" [The Internet], "…I read official homepages, brochures or books to locate the information that interests me" [Official websites and brochures], "…I ask medical doctors or dieticians for information" [Medical doctors or dieticians] and "…I inquire among family members or friends" [Family and friends]. Responses to each item were given on a 6-point scale, ranging from "never" to "very often". As these items covered four distinct sources of information, they were included as four individual items in the cluster analysis.

Health consciousness – Four items assessed our respondents' health consciousness. We based two items on items of the health consciousness scale used by Schifferstein and Oude Ophuis (1998): "My health is dependent on how and what I eat", and "I am prepared to abstain from many things to eat as healthy as possible". Additionally, we included two items to assess the importance of health in food choices ("I think it is important to eat healthily") and the perceived dependence of health on diet ("If one eats healthily, one gets ill less frequently"). The four items were assessed on 6-point Likert scales, ranging from "do not agree at all" to "fully agree". The health consciousness scale had good internal reliability, Cronbach's α = .79, N = 4.

Nutrition information interest – Respondents completed three items to assess their general interest in nutrition information. One of the items was taken from Schifferstein and Oude Ophuis (1998): "I think it is important to know well how to eat healthy". The other two items concerned people's personal expectations in relation to eating healthily ("I expect to know a lot about healthy food and to inform myself accordingly") and in relation to informing oneself about nutrition ("I believe that if one systematically looks for information, one can learn a lot about healthy nutrition"). The three items were assessed on 6-point Likert scales, ranging from "do not agree at all" to "fully agree". The scale's internal reliability was good, Cronbach's α = .76, N = 4.

Food frequency questionnaire (FFQ) – We chose to assess food consumption using a FFQ because the Swiss Food Panel comprises a large sample, and our aim was to compare groups of respondents in terms of their food consumption rather than their exact nutrient intake (Cade et al., 2002). The FFQ was specially developed for the Swiss Food Panel and aimed to estimate habitual or average consumption frequency of various food products per week. The test-retest reliability of our FFQ was examined in a separate study. The dataset included 247 respondents who had responded to two identical questionnaires with two weeks in between. The test-retest correlations of the food frequency items selected for the current study ranged from large to very large (.61 < *r*s < .86).

Table 9.1 shows the food items included in our FFQ. These food groups were chosen to represent extreme food choices, either because they are recommended by dietary guidelines (Walter et al., 2007), or because their high consumption frequency has been shown to have unfavourable health effects (e.g., Faramawi et al., 2007; Hu & Malik, 2010; van der Horst et al., 2011). The FFQ did not assess consumption in terms of portion size or number of portions, except for fruit and vegetable consumption.

The consumption frequency of items relating to *sweets and savouries* (four products), *soft drinks*, *diet soft drinks*, *full-fat milk*, *low-fat milk*, *whole-grain bread* and *cold meat products* was assessed on 6-point response scales (i.e. several times per day, daily, several times per week, several times per month, several times per year, less or never). The consumption of c*onvenience foods* was assessed for eight products on 5-point response scales (i.e. daily, several times per week, several times per month, several times per year, less or never). Consumption of *functional foods* (four products), *low-fat yoghurt* and *full-fat yoghurt* was assessed on 6-point response scales (i.e. daily, several times per week, several times per month, several times per year, less or never, do not know).

To facilitate the statistical calculations, all FFQ answering scales were recoded using the following scale: ‘several times per day’ was assumed to be twice per day (coded as 14 times per week); ‘daily’ was assumed to be once per day (coded as seven times per week); ‘several times per week’ was assumed to be three times per week (coded as three times per week), ‘several times per month’ was assumed to be three times per month (coded as .75 times per week), ‘several times per year’ and ‘less or never’ were considered as negligible (coded as zero times per week), and the ‘do not know’ answer was coded as missing. For each food group, we summed the consumption of the corresponding food products to reflect the consumption frequency of each food group per week (e.g. *convenience foods* was the summed consumption of eight convenient products per week). The four functional food products were

analysed individually as their internal reliability was too low (see Table I).

We measured *fruit* consumption with one item and *vegetable and salad* consumption with two items (vegetables and salad). All three items were assessed on 5-point answering scales: daily (recoded as seven times per week), four to six times per week (recoded as five times per week), one to three times per week (recoded as twice per week), one to three times per month (recoded as .5 times per week) and less or never (recoded as zero times per week). Additionally, respondents were asked how many portions of vegetables and of salad (one portion = a handful or 50g), and fruit (one piece or one handful) they usually eat on days on which they consumed vegetables, salad or fruit, respectively. The portion size was multiplied by the consumption frequency to reflect 'servings' of vegetables and similarly for salad and for fruit consumption per week. Vegetable and salad consumption were then summed to form the total vegetable consumption.

Perceived healthiness of food products – Respondents were also asked to estimate the healthiness of six food products. Three were selected as stereotypical healthy products: cooked vegetables, fruits and whole-grain bread. Three other products were stereotypical unhealthy products: chocolate, cookies and salty snacks. The 6-point Likert scales ranged from "extremely unhealthy" to "very healthy". The items were grouped in two scales: *perception of healthy foods* (three items) and *perception of unhealthy foods* (three items). Both scales had good internal reliability, Cronbach's αs > .75, *N*s = 3.

Liking for particular food products – In addition, we assessed our respondents' liking of the same six food products mentioned under perceived healthiness of food products. The 6-point Likert scales ranged from "do not like at all" to "like very much". The items were grouped in two scales: *liking healthy foods*, Cronbach's $\alpha = .59$, $N = 3$, and *liking unhealthy foods*, Cronbach's $\alpha = .73$, $N = 3$.

Demographics – Last, we assessed the following demographical variables: birth year, gender, education level, height and weight. The latter two were used to calculate the body mass index (BMI) for each respondent. Additionally, we asked whether respondents had been following a diet during the last 12 months, which is a standard period of time in dietary assessments (Colditz et al., 1997; Ocke et al., 1997).

Table 9.1 Food groups and their underlying items from the FFQ used to characterise dietary behaviour of respondents.

Food group	Selected items from the FFQ	Cronbach's α
Sweets and savouries[#]	Cookies, chocolate, sweet pastries, salty snacks	.61
Soft drinks[#]	Beverages sweetened with sugar (e.g. Cola, Fanta)	
Diet soft drinks[#]	Beverages with artificial sweeteners (e.g. diet coke, Red Bull sugar free)	
Cold meat products[#]	Meat products (e.g. cold cuts, pepperoni, ham, sausages)	
Functional foods[§]	Cholesterol-lowering margarine (e.g. Becel-pro-active), cholesterol-lowering yoghurt and dairy products (e.g. Benecol), probiotic yoghurt and dairy products (e.g. LC1) , multivitamin juice or vitamin-enriched juices	.38
Whole-grain bread[#]	Whole-grain bread	
Convenience foods[+]	Pre-packed sandwiches, pizza (chilled/frozen), pizza (take-away), meal in a can, ready meals (frozen/chilled), instant noodles or pasta in a can, instant noodles or pasta with powder sauce in a bag, soup ready to heat	.71
Full-fat dairy[#§]	Full-fat yoghurt, full-fat milk	
Low-fat dairy[#§]	Low-fat yoghurt, low fat milk	
Fish[#]	Fish	
Whole-grain bread[#]	Whole-grain bread	
Fruit[†*]	Fruits	
Vegetable[†*]	Vegetables (cooked/steamed), salad (lettuce, tomatoes) or raw vegetables	

Note. Consumption frequencies were measured using the following response categories: [#]6-response category: several times per day, once a day, several times per week, several times per month, several times per year, less or never; [+]5-response category: daily, several times per week, several times per month, several times per year, less or never; [†]5-response category: daily, four to six times per week, one to three times per week, one to three times per month, less or never. [§]6-response category: daily, several times per week, several times per month, several times per year, less or never, do not know. [*]Items were measured in terms of portion number and frequency of consumption.

Data analysis

Three scales and four individual items were included in the cluster analysis: nutrition table use, health consciousness, nutrition information interest and the four items that assessed nutrition information from other sources. The values of these seven variables were standardised before including them in the cluster analysis. We conducted a hierarchical cluster analysis using Ward's linkage method and the squared Euclidian distance as distance measure. We searched for solutions for two to six clusters. We first looked at the agglomeration schedule and the dendrogram to determine the number of clusters. Both represent the distance between clusters before uniting the two clusters. Large distances indicate that the two clusters are rather heterogeneous. In such cases, it is recommended to stop clustering before the distance increment between the two clusters that can be united becomes too large (Backhaus et al., 2008). We ensured that the sample sizes of the identified clusters were substantial. Finally, we checked that the final cluster centres were pronounced for all four 'input' variables and made sense (i.e. no 'linear' patterns only).

After the cluster analysis, we analysed whether and how the identified clusters of nutrition information users differed in relation to food consumption behaviour, demographics and various food perceptions, such as the perceived healthiness of food products, liking healthy food products and liking unhealthy food products. Many studies have shown that nutrition table usage and health consciousness are different for men and women, with more women reporting using nutrition tables and being more health conscious (Campos et al., 2011; Cowburn & Stockley, 2005). Therefore, we investigated for each dependent variable whether the differences between the clusters were similar among both men and women. More specifically, we conducted Multiple Analyses of Variance (MANOVAs) on the seven nutrition information sources (Table 2), demographics (Table 3), the food frequencies (Table 4 includes familiar food products and Table 5 contains convenience and functional foods) and the determinants of food consumption (Table 6) with cluster as independent variable and mostly for men and women separately. In case of a significant main effect of cluster on one of the dependent variables, we used post-hoc analysis with Bonferroni correction to investigate which clusters differed from each other.

9.3 Results

Descriptives

In general, our respondents' self-reported use of nutrition tables appeared moderate (M = 2.77, SD = 1.64). Type of nutrition table usage significantly affected the likelihood of using them, $F(3, 5974) = 892.51$, $p = .0001$, $\eta^2 = .31$. Post-hoc analyses with Bonferroni correction showed that the means of all four nutrition table usage items differed significantly from each other (ps < .05). Respondents were most likely to use nutrition tables to evaluate the healthiness of a food product (M = 3.07, SD = 1.84) and least likely to use them when they chose food products (M = 2.24, SD = 1.62). Respondents reported to occasionally use nutrition tables to choose between two or more products (M = 2.87, SD = 1.83) and to decide upon an unknown food product (M = 2.91, SD = 1.90).

Respondents were most likely to inform themselves about nutrition through official websites and brochures (M = 3.05, SD = 1.69) and through family members and friends (M = 2.91, SD = 1.56). They searched the Internet occasionally (M = 2.35, SD = 1.62) and were relatively unlikely to ask medical doctors or dieticians for advice (M = 1.84, SD = 1.25). Respondents appeared to be relatively health conscious, as the mean value of this scale was above the midpoint of the 6-point rating scale (M = 4.60, SD = .97). They were also quite interested in nutrition information (M = 4.79, SD = 1.04).

The three scales and four nutrition information items correlated significantly with each other. The highest correlation was between health consciousness and nutrition information interest, r = .63, p = .0001, indicating that greater health consciousness was related to increased nutrition information interest. The other correlations were all small to moderate, .05 < rs <.42. Therefore, a cluster analysis of these three scales and four items was allowed.

Cluster analysis

The agglomeration schedule and dendrogram of the hierarchical cluster analysis indicated that a four-cluster solution best fit the dataset. Moreover, this solution resulted in substantial cluster sizes (see Table 9.2). The four clusters significantly differed on each of the seven variables (see Table 9.2). About 2.4% of the respondents (n = 145) could not be assigned to a cluster because they had one or several missing items on one or several of the seven input variables. We labelled the four clusters as the Official Information Users, Internet Users, Moderate Users and the Uninterested for reasons explained below.

In the following sections, we describe the demographical characteristics, consumption frequencies and additional attitudes of the four clusters in detail.

Table 9.2 Cluster centres and standard deviations for the seven variables included in the cluster analysis for each cluster and the number and the percentage of respondents per cluster.[#]

	Official Info. Users		Internet Users		Moderate Users		Uninterested		
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F (3, 5912)*
Nutrition information interest	5.35[a]	.75	5.04[b]	.84	5.08[b]	.83	3.96[c]	1.06	705.47*
Health consciousness	5.08[a]	.76	4.59[c]	.91	4.90[b]	.76	3.96[d]	1.02	568.81*
Nutrition table usage	3.63[a]	1.65	3.29[b]	1.65	3.04[c]	1.57	1.57[d]	.87	568.81*
Usage of the following information sources:									
The Internet	2.90[b]	1.73	4.56[a]	.98	1.60[c]	.84	1.31[d]	.63	3,197.75*
Official websites & brochures	4.00[a]	1.58	3.97[a]	1.37	3.33[b]	1.58	1.47[c]	.74	1,142.53*
Medical doctors or dieticians	4.19[a]	1.08	1.55[b]	.66	1.45[c]	.65	1.33[d]	.80	3,092.15*
Family and friends	3.83[a]	1.55	3.17[b]	1.48	3.20[b]	1.48	1.87[c]	1.14	472.28*
	%	*n*	%	*n*	%	*n*	%	*n*	
	13.9	844	21.3	1,290	34.7	2,105	27.7	1,677	

Note. 2.4% of the respondents could not be assigned to one of the four clusters. Mean values with different superscripts within the rows differ significantly from each other.* $p < .001$; [#] The same MANOVAs for men and women separately showed similar results: the four segments differed significantly from each other on each of the seven input variables among women (Fs > 190,41, ps < .001) and men (Fs > 241.19, ps < .001) and the patterns of the differences between the segments were the same in each gender group.

The Official Information Users

The Official Information Users (13.9%, *n* = 844, see Table 2) reported using nutrition tables and other information sources about nutrition information (such as official websites and brochures) more often than any of the other groups. This group of consumers was also the most health conscious and the most interested in nutrition information compared with the other four groups (see Table 9.2). The Official Information Users were mainly women, with a

relatively high BMI and were more likely to have followed a special diet during the last 12 months than the other groups (see Table 9.3).

The results in Tables 9.4 and 9.5 show that the Official Information Users had a high consumption frequency of relatively healthy food products compared with the other clusters; such as low-fat dairy, whole-grain bread, fish, fruits, and vegetables and salad. They also had a significantly lower consumption frequency of regular soft drinks and sweets and savouries than some of the other groups. When comparing the four segments on three determinants of food consumption behaviour (Table 9.6), it appears that the Official Information Users liked healthy foods more than the other segments and perceived the unhealthy foods products as not very tasteful.

Table 9.3 Demographic characteristics of the four nutrition information clusters.

	Official Info. Users	Internet Users	Moderate Users	Uninterested	
	M (SD)/%	*M (SD)/%*	*M (SD)/%*	*M (SD)/%*	*Test statistic*
Gender (Men)	37.6%	42.5%	53.8%	63.2%	$\chi^2(3) = 222.89$*
Age	54.20 (13.83)^b	47.54 (13.01)^c	56.12 (15.17)^a	56.20 (15.82)^a	$F(3, 5837) = 108.25$*
Education	2.72 (.99)^b	2.94 (.88)^a	2.74 (.97)^b	2.67 (1.00)^b	$\chi^2(3)=55.79$*
BMI Men	26.74 (3.99)^a	25.58 (3.73)^b	25.65 (3.57)^b	25.76 (3.57)^b	$F(3, 2814)=8.23$*
Women	24.28 (5.09)^a	23.07 (3.86)^b	23.16 (3.68)^b	23.84 (4.94)^a	$F(3, 3020)=11.96$*
Special diet					
Men	23.9%	14.0%	12.0%	7.5%	$\chi^2(3)=62.44$*
Women	31.7%	24.8%	16.6%	16.0%	$\chi^2(3)= 63.51$*

Note. Mean values with different superscripts differ significantly from each other within the rows.

* $p < .001$.

Table 9.4 Means and standard deviations of self-reported food frequencies of familiar food products per nutrition information cluster and gender, including the *F*-values for the main effect of the clusters in each gender (* $p < .05$, ** $p < .01$, *** $p < .001$).

	Men									Women								
	Official Info. Users		Internet Users		Moderate Users		Uninterested			Official Info. Users		Internet Users		Moderate Users		Uninterested		
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*(3, 2321)	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*(3, 2321)
Full-fat dairy[#]	3.73[a,b]	4.45	3.47[b]	3.89	4.04[a,b]	4.49	4.18[a]	4.57	3.28*	3.19[c]	4.19	3.38[b,c]	3.97	3.91[a,b]	4.25	4.03[a]	4.53	5.62**
Low-fat dairy[#]	2.99[a]	3.87	2.91[a]	4.07	3.09[a]	4.12	2.12[b]	3.53	11.07***	3.75[a]	4.56	3.11[a,b]	4.13	3.27[a,b]	4.23	3.03[b]	4.31	2.94*
Cold meat products[+]	1.42[b]	1.92	1.56[b]	1.60	1.47[b]	1.76	1.89[a]	1.97	10.12***	.77[c]	1.27	1.03[a,b]	1.33	1.02[b]	1.41	1.21[a]	1.42	8.61***
Fish[+]	1.16[a]	1.25	.88[b,c]	1.12	.92[b]	1.05	.77[c]	1.02	10.19***	1.09[a]	1.10	.82[b]	.94	.88[b]	1.00	.78[b]	.96	9.66***
Whole-grain bread[+]	3.59[a]	3.65	2.69[b]	2.83	3.52[a]	3.51	2.36[b]	2.97	24.93***	4.11[a]	3.72	3.35[b]	2.99	3.50[b]	3.24	2.85[c]	3.34	12.93***
Fruit[§]	10.30[a]	8.24	8.44[b]	7.65	9.60[a]	8.06	7.25[c]	7.05	19.60***	12.40[a]	7.96	10.80[b]	7.51	11.51[a,b]	8.05	9.27[c]	7.57	15.83***
Vegetables and salads[‡]	19.06[a,b]	12.00	17.89[b]	10.12	19.61[a]	11.20	15.70[c]	9.85	22.22***	23.41[a]	12.42	21.89[a]	10.70	21.84[a]	11.46	18.26[b]	10.63	20.32***
Regular soft drinks[+]	.44[c]	1.18	.82[b]	1.84	.52[c]	1.61	1.12[a]	2.40	18.13***	.19[b]	.81	.38[b]	1.31	.27[b]	1.18	.60[a]	1.91	10.07***
Diet soft drinks[+]	.70[a,b]	1.95	.84[a]	2.21	.54[a,b]	1.71	.69[b]	2.08	2.62*	.69	2.01	.68	2.14	.79	2.36	.56	1.95	1.70
Sweets and savouries[†]	3.83[b]	4.10	4.69[a,b]	4.28	4.65[a,b]	4.73	4.95[a]	5.29	4.05**	4.07[b]	4.69	4.68[a,b]	4.66	4.60[a,b]	4.79	5.19[a]	5.23	4.63**

Note. Consumption frequencies can only be compared between clusters and between men and women, and not between product categories as the number of assessed products differed per product category. Higher mean values indicate higher consumption frequencies. Mean values with different superscripts differ significantly from each other within the product category (i.e. clusters differ significantly). Different scales were used to measure consumption frequencies: [#]Scale is based on sum of two products, ranging from 0 to 21. [+]Scale is based on consumption of one product, ranging from 0 to 14. [§]Scale is based on frequency × portion size for one product, ranging from 0 to 42. [‡]Scale is based on frequency × portion size for two products, ranging from 0 to 84. [†]Scale is based on sum of four products, ranging from 0 to 56 (each assessed from several times per day to less or never).

Table 9.5 Means and standard deviations of self-reported food frequencies of convenience and functional food products per nutrition information cluster and gender, including the F-values for the main effect of the clusters in each gender.

	Men									Women								
	Official Info. Users		Internet Users		Moderate Users		Uninterested			Official Info. Users		Internet Users		Moderate Users		Uninterested		
	M	SD	M	SD	M	SD	M	SD	F(3, 2321)	M	SD	M	SD	M	SD	M	SD	F(3, 2321)
Convenience food[#]	1.34	4.05	1.28	1.92	.98	1.88	1.23	3.04	2.26	$.63^{b}$	1.48	$.71^{b}$	1.38	$.65^{b}$	1.27	$.93^{a}$	1.80	5.26**
Cholesterol reducing margarine[+]	$.93^{a,b}$	2.09	$.63^{b}$	1.74	$.92^{a}$	2.18	$.59^{b}$	1.76	5.70**	.74	1.90	.53	1.55	.68	1.86	.66	1.85	1.58
Cholesterol reducing milk and yogurt[+]	.19	.79	.10	.62	.15	.82	.12	.79	1.29	.12	.72	.04	.36	.12	.80	.13	.84	2.34
Probiotic yogurt and milk[+]	$.55^{a,b}$	1.52	$.46^{a,b}$	1.33	$.62^{a}$	1.60	$.33^{b}$	1.10	7.19***	$.84^{a}$	1.80	$.85^{a}$	1.83	$.70^{a,b}$	1.54	$.52^{b}$	1.36	5.09**
Fortified juice[+]	$.62^{a}$	1.63	$.46^{a,b}$	1.34	$.41^{a,b}$	1.32	$.37^{b}$	1.31	2.59*	.44	1.36	.53	1.47	.40	1.28	.46	1.48	1.33

Note. Consumption frequencies can only be compared between clusters and between men and women, and not between product categories as the number of assessed products differed per product category. Higher mean values indicate higher consumption frequencies. Mean values with different superscripts differ significantly from each other within the product category (i.e. clusters differ significantly). [#]Scale is based on sum of four products, ranging between 0 and 28 (each assessed from daily to less or never). [+]Scale is based on consumption of one product, ranging from 0 to 7. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 9.6 Means and standard deviations of various determinants of food consumption, per nutrition information cluster.

	Men									Women								
	Official Info. Users		Internet Users		Moderate Users		Uninterested			Official Info. Users		Internet Users		Moderate Users		Uninterested		
	M	SD	M	SD	M	SD	M	SD	F(3, 2805)	M	SD	M	SD	M	SD	M	SD	F (3, 3022)
Liking healthier foods	$5.10^{a,b}$	.85	4.99^{b}	.82	5.15^{a}	.83	4.66^{c}	1.01	51.92***	5.48^{a}	.66	5.40^{a}	.74	5.39^{a}	.75	5.06^{b}	.91	35.72***
Liking less healthy foods	3.83^{c}	1.28	4.26^{a}	1.04	4.08^{b}	1.15	4.08^{b}	1.18	9.11***	3.99^{b}	1.19	4.34^{a}	1.12	4.01^{b}	1.20	4.16^{b}	1.21	13.67***
Perceived healthiness of healthier foods	$5.59^{a,b}$	.65	5.49^{b}	.67	5.60^{a}	.65	5.33^{c}	.83	25.80***	5.71	.55	5.68	.58	5.69	.63	5.63	.62	1.83
Perceived healthiness of less healthy foods	2.36^{b}	.81	2.31^{b}	.74	2.53^{a}	.82	2.55^{a}	.85	13.74***	2.17^{a}	.84	2.03^{b}	.75	2.24^{a}	.83	2.28^{a}	.78	13.86***

Note. Mean values with different superscripts differ significantly from each other within the measured construct (i.e. clusters differ significantly). * $p < .05$, ** $p < .01$, *** $p < .001$.

The Internet Users

The Internet Users (21%, *n* = 1,290) were mainly characterised by high Internet consumption to locate information on nutrition. Moreover, this group appeared more likely to use nutrition tables than the Moderate Users and the Uninterested (see Table 9.2). However, the Internet Users reported lower levels of health consciousness than the Moderate Users and the Official Information Users. The Internet Users' cluster included more women than men and was the youngest of the four clusters (see Table 9.3). This cluster had, on average, a higher education level than the other three clusters. Additionally, about 25% of the female members of this group indicated that they had followed a special diet during the last 12 months. The Internet Users consumed regular soft drinks, sweets and savouries relatively frequently (see Table 9.4). The male Internet Users also consumed diet soft drinks relatively often. The Internet Users had a lower consumption of fish and whole-grain bread than some of the other groups and especially the women of this group had a relatively high vegetable and salad consumption (Table 9.4). This cluster reported the highest liking for unhealthy foods among all four clusters (see Table 9.6).

The Moderate Users

The Moderate Users (34.7%, *n* = 2,105) formed the largest segment. They were characterised by relatively high health consciousness and interest in nutrition information (see Table 9.2). However, the Moderate Users reported lower usage of nutrition tables and of the Internet compared with the Official Information Users and the Internet Users. The gender distribution was more or less even among the Moderate Users (see Table 9.3). The Moderate Users, together with the Uninterested, were older than the Official Information Users and the Internet Users. Their consumption frequency of some of the healthy products was relatively high, although not as high as that of the Official Information Users (see Tables 9.4 and 9.5). That is, the Moderate Users consumed more portions of fruits and vegetables and more whole-grain bread than the Uninterested. Male Moderate Users also reported higher consumption frequencies of whole grain bread, fruit and vegetables than the male Internet Users. Moreover, male Moderate Users reported the highest consumption frequencies of functional foods (e.g. cholesterol reducing margarine and probiotic milk and yogurt). Remarkably, this cluster also had a relatively high consumption of both full-fat and low-fat dairy products, and showed relatively low consumption of regular soft drinks. When looking at the determinants of food

consumption, the Moderate Users perceived unhealthier foods as not particularly tasteful but estimated them as healthier than the Internet Users (Table 9.6).

The Uninterested

The Uninterested segment (27.7%, *n* = 1,677) was the least interested in using nutrition tables or other sources for nutrition information and showed the lowest usage of nutrition information sources. The Uninterested were also the least health conscious of all the groups (see Table 9.2). This is the only segment to contain a majority of men (Table 9.3). The Uninterested were older than the Official Information Users and the Internet Users. They were the least likely of all the segments to follow a special diet. Moreover, the women in the Uninterested segment had a higher BMI than the Internet users and the Moderate Users. Overall, the consumers in the Uninterested cluster reported eating healthier foods less often than the other clusters, e.g. they had the lowest consumption of fruits, vegetables and salad, whole-grain bread and fish (Tables 9.4 and 9.5). Moreover, their self-reported consumption frequency of unhealthier products such as full-fat dairy, sweet and savoury foods, regular soft drinks and cold meat products was relatively high. Female Uninterested consumers also reported a higher consumption of convenience products compared to the women in the other segments. The Uninterested liked healthier products less than the other clusters. The male Uninterested perceived unhealthier products as healthier and healthier products as less healthy than men in the other clusters (Table 9.6).

Gender differences

We investigated whether the patterns of the differences between the segments on the input variables of the cluster analysis, food frequency items and food perception items differed between men and women. Gender has been identified as an important determinant of nutrition information interest and usage and of food consumption and attitudes related to nutrition (Campos, et al., 2011; Cowburn & Stockley, 2005; Hartmann et al., in press). Different patterns in these variables for men and women could therefore indicate that the different gender distributions in the four clusters (see Table 9.3) caused the differences between the clusters and not the clusters themselves. As is described in the footnote below Table 9.2, the differences between the four segments on the input variables of the cluster analysis were the same among men and among women. Thus, it is unlikely that the unequal gender distributions in the segments caused the differences between the segments.

In three types of food products, we found large differences between men and women in the four clusters regarding consumption frequencies: diet soft drinks, convenience food and three of the functional food (see Tables 9.4 and 9.5). In addition, in the perceived healthiness of healthier food products, the clusters differed among men but not among women (see Table 9.6). In short, the majority of the differences between the clusters in relation to food consumption and food perceptions could be attributed to the clusters and not to the unequal gender distribution in the clusters.

9.4 Discussion

In this survey, we aimed to investigate whether consumers can be segmented based on their nutrition information usage and on which aspects these segments differ from each other, for example, in their food consumption. Based on the results of a cluster analysis, we considered four segments to describe our respondents well regarding their nutrition information usage and their importance of health and nutrition information. The four groups clearly differed in various characteristics such as age, gender, BMI, food consumption and liking of food products. Using these characteristics, we will now make suggestions for a targeted communication approach for each segment to motivate consumers to use nutrition tables or other information sources and to make healthy food choices. Then, we will explain the possible limitations of our study and how it could be improved.

We considered the following issues in our suggestions for a targeted communication approach to nutrition information and healthy eating. Firstly, we took the reachability of the segment into account. Segments that are relatively health conscious and interested in nutrition information are easier to motivate to consider nutrition information. Moreover, the types of information channels that a segment uses determine its reachability. Secondly, we evaluated the mean BMI and food consumption behaviour of the segments as indicators of the need for intervention. Thirdly, the size of the segment was considered when determining the priority of intervening if the segment's reported food consumption was relatively unhealthy.

Our segmentation showed that two of our four clusters may be more easily reached by information than the others: the Official Information Users and the Internet Users. These two clusters appeared to be interested in nutrition information and to use various information channels. However, the BMI of the Official Information Users was relatively high compared with that of two of the other segments. Their food choices were relatively healthy (e.g. higher consumption of fruit and vegetables and lower consumption of sweet and savoury foods than

the other segments). This indicates that greater nutrition information usage is related to food choices with higher nutritional value, but not automatically to a lower weight. It may be that the Official Information Users were trying to lose weight by consuming healthier food products.

Overall, this group would not be served by a communication strategy that convinces them to refer to nutrition information—because they already do—but they may need information that besides a healthy diet, physical activity determines a healthy weight. In addition, this group may benefit from reinforcement and feedback that confirm their current nutrition information usage (Prochaska et al., 2008). However, only 13% of our sample was in the Official Information Users group, which implies that it may be more cost effective to target an intervention strategy to one of the larger segments.

The second segment that is probably rather easy to reach for communicators is the Internet Users. This is a substantial segment in our study. The Internet Users were interested in health and nutrition information, and they mainly demonstrated their interests in the use of the Internet, brochures and nutrition tables. Their BMI seemed relatively low, and their food consumption seemed relatively healthy compared with some of the other segments. The higher education level of this segment compared with the other three segments may imply that understanding nutrition information is not a problem for this segment (see Campos, et al., 2011). A point for improvement in this segment is their relatively high consumption of sweet and savoury foods and, probably related to this, the high hedonic value they attach to less healthy foods. Consequently, this group of consumers should be made aware of this suboptimal food consumption behaviour (Prochaska, et al., 2008) and that they may choose less healthy foods for their comfort value, for example, in stressful situations (van Strien et al., 2009). The Internet is obviously the information channel of choice to reach this group. More specifically, besides nutrition- and health-related websites, social media platforms may be appropriate to reach members of this segment.

In addition to these two rather easily reachable clusters, we also found two clusters that may be harder to reach by providing information alone because they use less publicly accessible information channels: the Moderate Users and the Uninterested segments. Our cluster analysis showed that most respondents were Moderate Users of nutrition tables and other nutrition information sources; they were interested in their health and in nutrition but not very likely to use nutrition information. Their relatively high interest in nutrition information and their mixed consumption pattern (e.g. the relatively high consumption

frequencies of fruits, vegetables and fish, as well as of sweets and savouries and full-fat dairy) seem to indicate that they could benefit from nutrition information. The higher age of this segment may explain its low use of the Internet. They should be encouraged to refer to nutrition information, such as nutrition tables, more often to make healthier food choices. Our results suggest that they may be best approached through official brochures and recommendations from family and peers, as well as through well-designed and comprehensible nutrition tables.

Finally, about 28% of our respondents were classified as Uninterested consumers. This is probably the most difficult group to reach, as they showed the lowest interest in nutrition and health and the lowest nutrition information usage of all the segments. In addition, the Uninterested had a higher BMI (only among the women), as well as a higher consumption of relatively unhealthy food products (e.g. sweet and savoury snacks) and a lower consumption of relatively healthy products (e.g. fruit and vegetables) compared with the other segments. The differences between this segment and the others could be due to the higher proportion of men in the Uninterested group. However, both Uninterested women and men were found to be the least health conscious, the least interested in nutrition information and to report the highest consumption frequencies of sweets and savouries, as well as the lowest consumption frequencies of fruits and vegetables, compared with the other segments. Also, the Uninterested seemed to estimate healthier food products as less healthy and less healthy food products as healthier than the other segments. Therefore, a lack of knowledge about nutrition may explain the less healthy food choices of this group.

Overall, these findings seem to imply that the Uninterested probably have little awareness of their unhealthy food consumption pattern. Low awareness, in combination with low interest and low usage of various information sources, suggests that trying to consciously stimulate and educate the Uninterested to use nutrition information will not improve this group's food consumption behaviour. Moreover, improving nutrition labels will not help the Uninterested consumers because they will not refer to this information. Other cues to promote healthy eating that are embedded in the environment (so-called 'nudges') may be more effective to change this segment's food consumption behaviour (Rozin et al., 2011; Saarela, in press). For example, there are indications that healthier products are chosen and consumed more often when they have more shelf-space in the supermarket (Cheadle et al., 1991) or when they have more prominent locations in the supermarket (Curhan, 1974). Similarly, Bucher and colleagues (2011) showed that people choose more vegetables from a buffet with

a higher variety of vegetables than from a buffet with a lower variety of vegetables. Increasing shelf-space or the variety of products of course requires the cooperation of the grocery stores, which may be an obstacle.

The current and proposed policies on food information for consumers in the EU and the US focus on education through labelling on food products (EU No 1169/2011, 2011; NLEA, 1990), on menus and on vending machines (US Food and Drug Administration, 2011a, 2011b). Such measures can be useful for certain consumers, but not for all, as our results suggest. Additional policy measures which create an environment that stimulates healthy food choices are also necessary to reach certain consumer groups. For example, school and work cantinas could be enforced to offer a large variety of healthy snacks that are easy to consume (e.g. sliced fruits). Moreover, food manufactures could be stimulated to join a qualified label that is known by consumers and that motivates manufactures to reformulate the content of their products to meet the label's criteria (see also Capacci et al., 2012).

We do not claim to have identified the only single nutrition information segmentation of consumers. A main disadvantage of a cluster analysis is that the type and the validity of the variables included in the analysis as well as the sample determine the composite and quality of the identified clusters. Therefore, it would be very interesting to investigate a consumer segmentation in a different country using the same variables, for example, in a country where front-of-package labels are more common than in Switzerland. Moreover, the decision about the number of final clusters is based partly on subjective opinion. Although we discussed the number of possible clusters, it may be that different researchers would have decided upon a different number of clusters.

Our sample had two limitations: the response rate to our survey was rather low and our sample was older and better educated than the general Swiss population. The non-responders analysis however showed that our sample was unlikely to be biased on its interest in our survey's topic, namely nutrition. The Food frequency questionnaire also had a few limitations. Due to our survey method, we had to ask our participants to report their food frequencies themselves and could not measure their exact dietary behaviour. Food frequencies do not indicate the absolute healthiness of a person's diet. Moreover, previous studies have shown that people tend to over-report their own behaviour, especially behaviour relating to nutrition table usage (Bingham et al., 1994; Grunert, et al., 2010). Over-reporting was probably present in our whole sample, which makes comparisons between segments on these variables possible.

We assessed only the consumption frequencies of certain food products and not respondents' full consumption pattern, let alone their physical behaviour. Moreover, the response categories of the functional foods and the convenience foods differed from those of the other food products (e.g. sweets and savouries) because the response categories of the former food products fitted best to answer two specific research questions (e.g., van der Horst & Siegrist, 2011). The authors however thought it would also be interesting to include these two product categories in the current paper, although their food frequencies could not be compared one-to-one to those of the other food products. Thus, we can only compare the four nutrition information segments in terms of their consumption frequencies of the assessed food items and not on their complete diet.

Conclusion

Our study is one of only a few to investigate the segmentation of consumers according to their nutrition information usage. Our results indicate that it is worthwhile to promote nutrition information usage as some consumer groups are interested in this type of information. However, not all consumers seem to benefit from nutrition education or from the improvement of nutrition information/tables. Cues present in the food environment that prime healthy food choices should also be considered and investigated in future research.

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Chapter 10

Snack frequency and dietary pattern

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Manuscript published
Hartmann C, Siegrist M, & van der Horst K. (2013). Snack frequency: associations with healthy and unhealthy food choice. *Public Health Nutrition* 16(8), 1487-96.

Abstract

Objective. We examine associations between snack frequency, socio-demographic characteristics, Body Mass Index, dietary and eating behaviour. In order to identify whether various sub-groups of high-frequency snack consumers exist, we investigated underlying food patterns and lifestyle factors.

Design. The data are based on the Swiss Food-Panel questionnaire of 2010, which included a Food Frequency Questionnaire, questions relating to socio-demographics and lifestyle factors. Data were examined using analyses of variance, regression analysis, and hierarchical cluster analysis. Gender differences were also investigated in the analysis of the data.

Setting. A sample of 6189 adults participating in the Swiss Food-Panel filled in a questionnaire (response rate 30 %).

Subjects. The sample consisted of both men and women, with a mean age of 54·4 years (SD 13·5).

Results. There was no association between snack frequency and BMI. Consumption frequency of sweets and savouries as well as fruit intake increased with increasing snack frequency. Additionally, three different sub-groups of high frequency snack consumers could be revealed: a healthy, moderate and unhealthy dietary-pattern group. The latter one included lesser health conscious respondents and was characterized by high alcohol consumption frequency, daily breakfast skipping and TV watching during main meal.

Conclusions. High snack frequency occurred in the context of healthy as well as unhealthy dietary behaviour and lifestyle patterns. Women made healthier dietary food choices and were more likely to consume fruits as snacks, while men chose unhealthy foods, such as sweets and savouries, more often.

10.1 Introduction

Eating frequency is affected by cultural/social norms, lifestyle factors, the environment and an individual's personal attitudes towards their health (Chiva, 1997; La Bounty Paul et al., 2011). Changes in lifestyle and the environment over the last few decades have probably been the most important causes of the overweight epidemic in the Western society (Hill & L., 1999). The increasing proportion of snacking in the Western diet has been a particular cause for concern, since the foods and drinks typical consumed as snacks tend to be energy-dense (Piernas & Popkin, 2010). In the scientific literature, no consensus exists about whether a higher frequency of eating, and particularly snacking, promotes or prevents weight gain (Hampl et al., 2003; Johnson & Anderson, 2010).

In spite of an unclear association with body weight, snacking per se does not have a negative effect on diet quality. Snacking can increase the opportunity for healthy, low-calorie food choices resulting in a wider variety of foods in the diet, and a balanced intake of nutrients contributing significantly to the daily micro- and macronutrient intake (Holmback et al., 2010; Mills et al., 2011; Whybrow & Kirk, 1997).

An important issue related to snack frequency is whether caloric intake from snacks between meals will be compensated for by a lower caloric intake from the main meals, because a higher number of eating occasions seems not to be associated with an improvement in appetite control, and provides more opportunities to consume excess energy (Leidy & Campbell, 2011). Nevertheless, meal skipping, especially breakfast skipping, is associated with overeating later in the day, due to intense hunger followed by ingestion of high-fat, sugar-dense snacks (Schlundt et al., 1992). Overweight and obesity status was found to be associated with higher intakes of fat, refined grains, red meat, added sugars and sugar-sweetened beverages (Mills, et al., 2011). These foods are common in an obesogenic environment (Swinburn et al., 1999), which may increase the likelihood for choosing unhealthy snacks, make restrained eating more difficult and result in an increased energy intake over the course of the day. A comparison between snacking patterns in obese adults and a reference population showed that with increasing snack occasions, the energy intake from candies, chocolate, cakes, cookies and desserts increased more steeply in the obese population compared to the control population (Berteus-Forslund et al., 2005).

However, high snack frequency is not in itself a reason for energy increase and weight gain. The inconsistent associations between snack frequency and body weight reported in the

literature could indicate that an individual's overall nutrition pattern plays a more important role than snack frequency itself. Certain energy-dense foods with trends for increased consumption (e.g. beef, pork and pizza) were shown to be important components of meals, rather than snacks (Nielsen et al., 2002). Dietary behaviour should also be considered when assessing snacking (Johnson & Anderson, 2010), because a food that is consumed as a snack and a food that is consumed as a meal could both have a considerable influence on the quality of the diet, energy intake and weight gain.

The meal environment may be another influencing factor on dietary and eating behaviour. For example, family meals were associated with higher fruit and vegetable consumption (Boutelle et al., 2003), whereas families with higher frequency of television watching during meals reported higher proportions of energy intake from snack foods, sodas and meat (Coon et al., 2001). In general, watching television during dinner is considered to be a less healthy eating behaviour, and it is likely to correspond with diets high in fat, and low in fruit and vegetable consumption (Boutelle, et al., 2003; Coon, et al., 2001). Lifestyle and socio-economic factors are likely to be related to different food choices as well. In the study by Holmback *et al*., a low daily eating frequency (referring to all eating occasions, including snacks) occurred in the context of an unhealthy lifestyle, which was defined by higher intakes of alcohol and high-fat foods, and low levels of leisure-time physical activity (Holmback, et al., 2010). Gender differences in behaviours relating to food choices have also been observed. For example, on the whole men eat less fresh fruit and vegetables and consume more meat than women do (Beer-Borst et al., 2000; Dynesen et al., 2003).

The current literature does not contain any universally accepted definition of snacking, but two main approaches have been used to define the term "snack" (Johnson & Anderson, 2010). The first approach focuses on the food consumed; foods are identified as snacks by their nutrient content or because they are commonly associated with snacking (Johnson & Anderson, 2010; Whybrow et al., 2007). The second approach focuses on the time of food consumption (Johnson & Anderson, 2010). Everything consumed between the main meals is defined as snack. In our study, we asked for the usual frequency of food consumption between the three main meals (breakfast, lunch, dinner), and calculated "snack frequency" per week.

The aim of the present study was to examine the associations between snack frequency, socio-demographic characteristics, Body Mass Index (BMI), dietary and eating behaviours. In order to identify whether different sub-groups of high-frequency snack

consumers existed, we investigated underlying food patterns and lifestyle factors. It was hypothesised that 'high snack consumers' could be separated into two groups, a group with mainly unhealthy food choices and snack consumption preferences for sweets and savouries, and a group with more healthy food choices and snack consumption preferences for items such as fruits.

10.2 Methods

Procedure and sample

This study examined data from the Swiss Food Panel, a study into the eating behaviour of the Swiss population. In 2010, a mail survey was sent out to 20,912 randomly selected household addresses from the telephone book in the German-speaking and French-speaking part of Switzerland. After five weeks, we sent one reminder, with another copy of the questionnaire, to persons who had not yet responded. We received 6290 filled-in questionnaires (a response rate of 30·1 %). Respondents missing either values on the Identification Code or both key variables of age and gender (n=101) were deleted from the sample. Data from 6189 (29·6 %) subjects consisting of 47·6 % males remained available for the analysis. The respondents' mean age was 54·4 years (SD=15·3; range= 20–99). Compared to the general Swiss population(Office, 2010), fewer males participated in the study (census=49·2 %), more participants had a higher secondary or college/university degree, and the percentage of young adults (20–39 years old) was lower (18·1 % vs. 26·7 %).

Swiss Food Panel Questionnaire

One part of the Swiss Food Panel questionnaire was a Food Frequency Questionnaire (FFQ), which was specially designed for the Swiss Food Panel. The FFQ was used to estimate habitual consumption frequency of various food products and snack frequency per week.
In a separate study, FFQ scales were examined on two-week test-retest reliability. Data were analysed for 247 people who had responded to both questionnaires, and the test-retest correlation between snack frequency scales was r=0·8, whilst for the food groups, the scales varied between r=0·7 and r=0·9.

For investigating *snack frequency per week*, respondents were asked how often they usually eat a snack in the morning, an afternoon snack, an evening snack and additional

snacks (e.g. a nibbling pattern, eating smaller sweets and savoury snack foods). Participants answered on a five-point answering scale. For calculating the average weekly snack frequency during the previous year, the answering scale was recoded (daily = 360 days per year, 4–6 times per week = 260, 1–3 times per week = 104, 1–3 times per month = 26, less or never =0). The items were summed and divided by 52. The calculated scores ranged from zero to a maximum of 28·1.

Dietary behaviour assessment

Table 10.1 shows food items used in the FFQ, which were grouped into the categories *convenience food*, *sweets and savouries*, *sugar-sweetened beverages* and *meat*. These food groups were chosen to represent food choices, either because they had been established by dietary guidelines, or because their high frequency of consumption had been shown to have unfavourable health effects(Faramawi et al., 2007; Hu & Malik, 2010; van der Horst et al., 2010).

The questionnaire did not collect information on portion size or number of portions, except for fruit and vegetable consumption.

Items relating to *sweets and savouries, sugar-sweetened beverages* and *meat* consumption frequency were assessed on a six-point answering scale. For statistical calculation, ‘several times per day’ was assumed to be two times per day (coded as 14 times per week); ‘daily’ was assumed to be one time per day (coded as seven times per week); ‘several times per week’ was assumed to be three times per week (coded as three times per week); ‘several times per month’ was assumed to be three times per month (coded as 0·75 times per week), ‘several times per year’ and ‘less or never’ were considered as negligible (coded as zero). Items falling into each food group were summed to reflect consumption frequency of these foods per week.

Convenience food consumption was assessed on a five-point answering scale: daily (coded as seven times per week), several times per week (coded as three times per week), several times per month (coded as 0·75 times per week), several times per year (coded as zero) and less or never (coded as zero). To reflect weekly consumption frequency the items were summed.

Fruit and vegetable consumption was assessed on a five-point answering scale: daily (coded as seven times per week), 4–6 times per week (coded as five times per week), 1–3 times per week (coded as two times per week), 1–3 times per month (coded as 0·5 times per

week) and less or never (coded as zero). Additionally respondents were asked how many portions of vegetables (one portion= a handful, or 50 g) and fruit (one piece or one handful) they usually eat. The items relating to portion number and consumption frequency were combined to reflect 'servings' of vegetables and 'pieces' of fruit consumed per week.

Additionally, the internal reliability of items from the convenience foods scale, meat scale and the sweets and savoury scale were explored using Cronbach's alpha (α) (Table 10.1).

Eating behaviour assessment. Meal frequency was assessed by asking respondents how often they usually eat breakfast, lunch and dinner. The answering scale was as follows: daily, 4–6 times per week, 1–3 times per week, 1–3 times per month, less or never. Two-week test-retest reliability was r=0·88 for breakfast, r=0·73 for lunch and r=0·68 for dinner. Two additional items assessed the frequency of *family meals*, and *watching television during the main meal* on a five-point answering scale (daily, 4–6 times per week, 1–3 times per week, 1–3 times per month, less or never). Because the items *meal frequency*, *family meals*, and *watching TV during the main meal* were highly skewed, they were categorised into binary variables indicating daily breakfast (yes/no), daily lunch (yes/no), daily dinner (yes/no), having family meals 4–7 times per week (yes/no) and watching TV during the main meal 4–7 times per week (yes/no).

Socio-demographic and lifestyle variables

Age, gender, having children (≤ 16 years old), weight and height were all assessed in the Swiss Food Panel Questionnaire. Educational level was categorised in three groups: 1) low (primary and secondary school), 2) medium (vocational school) and 3) high (college and university). BMI (kg/m^2) was calculated from the self-reported body weight (kg) divided by square of the self-reported height (m^2) of participants (range=15·3-62·1 kg/m^2). Participants with a BMI >25 kg/m^2 were classified as being overweight.

Wine and beer consumption frequency per week was also assessed. Respondents stated on a six-point answering scale how often they usually drink wine and beer: several times per day, once a day, several times per week, several times per month, several times per year, less or never.

Average daily physical activity was calculated from two items in the questionnaire. A short introduction encouraged the respondents to take into account only physical activity

above a minimum of 10 minutes. ‘During the last seven days, on how many days did you do physical activities like heavy lifting, digging, sports, cycling or walking?’ ‘How much time did you usually spend on one of those days doing physical activities?’ The second item had to be answered by filling in the minutes per day. Respondents with missing values in one of the two items and with values less than 10 min or more than 960 min were coded as missing (13·9 % missing values). Additionally, physical activity was grouped into two categories: physical activity ≥ 30 min per day (*n*=3588) and less physical activity (*n*=1738).

Health consciousness (α=0·79) related to eating was assessed with following statements using a six-point answering scale ranging from 1 = ‘do not agree at all’ to 6 = ‘totally agree’: ‘I think it is important to eat healthily’, ‘My health is dependent on how and what I eat’, ‘If one eats healthily, one gets ill less frequently’, ‘I am prepared to leave a lot, to eat as healthily as possible’(Schifferstein & Oude Ophuis, 1998).

Data analysis

Data were analysed to examine which eating behaviours, dietary behaviours, socio-demographics, and lifestyle factors were of importance for high snack frequency. All analyses were performed using SPSS statistics software package 19.0 (SPPS Inc., Chicago, IL, USA).

Firstly, one-way analysis of variance (ANOVA) and chi-square (χ^2) tests were used to evaluate gender differences in eating behaviours, dietary behaviours, lifestyle and socio-demographic variables. Additionally, the study population was categorised into tertiles based on weekly snack frequency (high, moderate, low). The highest tertile includes all respondents who indicated having a snack frequency between 7·5 to 20·1 times per week, the moderate tertile includes all respondents who indicated having a snack frequency between 2·5 to 7·0 times per week, and the lowest tertile includes all respondents who indicated having a snack frequency between 0 to 2·0 times per week. One-way ANOVA and chi-square test were used for examining differences in mean scores for all variables between tertiles. ANOVA and χ^2-Test were done for males and females separately. Significant *F*-tests were followed up by the examination of contrasts using Tukey HSD tests. Secondly, linear regression analysis was used to identify associations between snack frequency as the dependent variable and the other characteristics. No cases of multicollinearity were detected by bivariate correlations. Thirdly, cluster analysis was used to identify relatively homogenous profiles of dietary behaviours, using only the respondents from the highest snack frequency tertile (*n*=1890). Clustering

variables were the six dietary behaviours: consumption frequency of vegetables, fruit, convenience foods, sweets and savouries, sugar-sweetened beverages and meat. Hierarchical, agglomerative cluster analysis was performed with the squared Euclidean distance as the distance measure in the clustering procedure. Therefore, the procedure was accomplished using standardized scores (z-scores), employing Ward's method. Cluster solutions of two to eight segments were generated initially. The final cluster-solution was chosen by examining the agglomeration schedule. The three-cluster solution was found to be adequate and meaningful regarding the different patterns found, and therefore, it is reported in the results section (Table 10.5). Comparisons of the three clusters based on eating behaviour, socio-demographics, and lifestyle factors are displayed separately for male and female subjects (Table 10.5).

Table 10.1 Food groups and their underlying items from the FFQ, used to characterize dietary behaviour of respondents.

Food group	**Selected Items from the FFQ**	**Cronbach's Alpha**
Sweets and savouries[1]	Cookies, Chocolate, Sweet pastries, Salty snacks	0·71
Sugar-sweetened beverages[1]	Beverages sweetened with sugar (e.g. Cola, Fanta)	-
Meat[1]	Beef or veal, Pork, Poultry (e.g. turkey, chicken), Meat products (e.g. cold cuts, pepperoni, ham, sausages)	0·69
Convenience food[2]	Pre-packed sandwiches, Pizza (chilled/frozen), Pizza (take-away/home delivery), A meal in a can, Ready meals (frozen/chilled), Instant noodles or pasta in a can, Instant noodles or pasta with powder sauce in a bag, Soup ready to heat	0·71
Fruit[3, *]	Fruit	-
Vegetable[3, *]	Vegetables (cooked/steamed), Salad (lettuce, tomatoes) or raw vegetables	-

Note. [1, 2, 3] Variables were measured using the following response categories in the FFQ: [1]*six response category*: several times per day, once a day, several times per week, several times per month, several times per year, less or never; [2]*five response category*: daily, several times per week, several times per month, several times per year, less or never; [3]*five response*

category: daily, 4–6 times per week, 1–3 times per week, 1–3 times per month, less or never.* These items were measured with portion number *and* frequency of consumption.

10.3 Results

Table 10.2 shows snack frequency, eating behaviours, dietary behaviours, socio-demographics and lifestyle variables by gender. Mean snack frequency per week was higher for females (M=6·6) than for males (M=5·2). Females indicated having higher vegetable and fruit consumption, while male respondents reported higher mean intakes of meat, sugar-sweetened beverages and convenience food. Males were also less likely to have a daily breakfast and lunch, were less health conscious, had higher BMIs, were more physically active, had a higher mean consumption of wine and beer, were older, had a higher educational level and were less likely to have children. No significant gender difference was found for having dinner on a daily basis, or for consumption of sweets and savouries.

Table 10.2 Characteristics of the study population according to gender

	Males	Females	
n†	2938	3234	
	Mean (SD) or %		*F (Df_1, Df_2) or χ^2 (Df)*
Eating behaviour			
Snack frequency per week	5·2 (5·4)	6·6 (5·8)	90·7 (1, 6103)***
Daily breakfast	66·6 %	71·9 %	19·8 (1)***
Daily lunch	72·0 %	76·8 %	18·8 (1)***
Daily dinner	82·3 %	83·0 %	0·5 (1)^{ns}
Having family meals 4–7 times per week	71·3 %	64·7 %	29·6 (1)***
Watching TV during main meal 4–7 times per week	11·5 %	14·0 %	8·1 (1)**
Dietary behaviour (consumption frequency per week)			
Sweets and savouries	4·7 (4·9)	4·6 (4·8)	0·7 (1, 6049)^{ns}
Sugar-sweetened beverages	0·8 (2·0)	0·3 (1·3)	102·1 (1, 6083)***
Meat	5·7 (4·2)	4·0 (3·3)	280·2 (1, 6065)***
Convenience food	1·2 (2·6)	0·7 (1·5)	72·1 (1, 5984)***
Vegetables incl. salad (servings/week)	17·9 (10·9)	21·4 (11·5)	146·9 (1, 6066)***
Fruit (pieces/week)	8·8 (7·9)	11·2 (8·0)	143·9 (1, 6083)***
Socio-demographic and lifestyle characteristics			
Age (years)	56·9 (15·1)	52·1 (15·1)	155·6 (1, 6089)***
Health consciousness	4·4 (1·0)	4·7 (0·9)	144·3 (1, 6088) ***
Wine and beer consumption (frequency per week)	3·4 (3·7)	1·6 (2·4)	463·3 (1, 6129) ***
BMI (kg/m^2)	25·8 (3·7)	23·5 (4·3)	491·5 (1, 6097) ***
Overweight	54·0 %	28·0 %	429·4 (1) ***
Physical activity ≥ 30 min/day	66·6 %	60·2 %	25·3 (1) ***
Having children < 16 years	20·3 %	29·1 %	61·7 (1) ***
Education low	8·9 %	12·6 %	50·2 (2)***
middle	34·8 %	39·6 %	
high	56·3 %	47·8 %	

Note. *P<0·05, **P<0·01, ***P<0·001, ^{ns} not significant. † n could vary due to missing values

Table 10.3 presents the investigated variables by tertiles of snack frequency per week, showing males and females separately. The dietary behaviours in the highest snack-frequency tertile were different from those in the lowest group with respect to higher frequency consumption of *all* food groups, with the exception of vegetable consumption in females.

Male respondents with a low snack frequency were more likely to be older, ate main meals on a more regular basis and indicated having family meals more often than male respondents with a high-frequency snack consumption. Female respondents with a high-frequency snack consumption are more likely to skip breakfast, and reported lower health consciousness compared to female respondents in the lowest snack-frequency group.

Table 10.4 illustrates the results of the regression analysis with snack frequency as the dependent variable (N=4871). Seven variables showed a significant effect ($P \leq 0{\cdot}01$), and the model accounted for 23 % of the variance in snack frequency per week. Significant positive associations were found for sweets and savouries (β=0·34), fruit (β=0·13), watching TV during the main meal (β=0·04) and having family meals 4–7 times per week (β=-0·04). Inverse associations were found for age (β=–0·23), a high educational level (β=–0·09) and wine and beer consumption frequency (β=–0·08).

Table 10.3 Characteristics of the study population according to tertiles of snack frequency per week (*N*=6105).

Characteristics	Tertiles of snack frequency per week							
	Highest[1]		Moderate[2]		Lowest[3]			
	Mean (SD) or %						*F (Df_1, Df_2) or χ^2 (Df)*	
n[†]	Male 809	Female 1200	Male 878	Female 985	Male 1227	Female 1006	Male	Female
Eating behaviours								
Snack frequency per week	12·3 (4·4)	12·7 (4·2)	4·8 (1·6)	5·0 (1·6)	0·7 (0·8)	0·8 (1·6)	5145·2 (2, 2911)***	5283·9 (2, 3188)***
Daily breakfast	58·5 %	66·8 %	62·5 %	71·7 %	74·8 %	77·7 %	67·6 (2)***	32·2 (2)***
Daily lunch	69·7 %	77·9 %	68·0 %	76·0 %	76·2 %	76·0 %	19·6 (2)***	1·6 (2)^{ns}
Daily dinner	80·8 %	84·6 %	80·6 %	80·9 %	84·4 %	82·9 %	6·7 (2)*	5·4 (2)^{ns}
Family meals 4–7 times per week	63·0 %	66·6 %	68·6 %	65·9%	78·5 %	61·1 %	60·7 (2)***	7·8 (2)*
Watching TV during main meal 4–7 times per week	14·6 %	15·4 %	11·8 %	11·6 %	9·3 %	14·6 %	13·0 (2)**	6·8 (2)*
Dietary behaviours (consumption frequency per week								
Sweets and savouries	6·9^{a} (6·4)	6·4^{x} (5·8)	4·8^{b} (4·4)	4·1^{y} (3·7)	3·1^{b} (3·3)	2·9^{z} (3·4)	150·8 (2, 2857)***	172·3 (2, 3125) ***
Sugar-sweetened beverages	1·1^{a} (2·3)	0·5^{x} (1·6)	0·8^{b} (2·0)	0·3^{y} (1·3)	0·5^{c} (1·6)	0·2^{z} (1·3)	23·1 (2, 2873)***	12·2 (2, 3147)***
Meat	6·4^{a} (5·2)	4·3^{x} (3·4)	5·6^{b} (3·7)	4·0$^{x, y}$ (3·1)	5·2^{b} (3·7)	3·8^{y} (3·2)	19·0 (2, 2872)***	9·2 (2, 3124)***
Convenience food	1·7^{a} (3·6)	0·8^{x} (1·6)	1·1^{b} (1·9)	0·8^{x} (1·5)	0·8^{c} (1·6)	0·5^{b} (1·2)	36·5 (2, 2859) ***	14·1 (2, 3105)***
Vegetables	18·5^{a} (11·1)	21·4 (11·2)	18·0$^{a, b}$ (10·9)	21·3 (10·8)	17·3^{b} (10·7)	21·6 (12·3)	3·4 (2, 2884)*	0·6 (2, 3160)^{ns}
Fruit	9·3^{a} (7·7)	11·9^{x} (8·0)	8·5$^{a, b}$ (7·8)	10·6^{y} (7·8)	8·2$^{b, c}$ (7·7)	10·6^{y} (8·0)	4·7 (2, 2897)**	7·0 (2, 3163)**

(table continues)

(table 10.3 continued)

Characteristics	Tertiles of snack frequency per week							
	Highest[1]		Moderate[2]		Lowest[3]			
	Mean (SD) or %						*F (Df_1, Df_2) or χ^2 (Df)*	
	Males	Females	Males	Females	Males	Females	Males	Females
Socio-demographic and lifestyle characteristics								
Age (years)	49·6^{a} (13·8)	46·6^{x} (13·4)	54·8^{b} (14·4)	51·0^{y} (14·0)	61·9^{c} (13·9)	56·7^{z} (14·6)	181·5 (2, 2870)***	145·8 (2, 3149)***
Health consciousness	4·3^{a} (1·0)	4·6^{x} (0·9)	4·4^{a} (1·0)	4·7^{x} (0·9)	4·5^{b} (1·0)	4·9^{y} (0·9)	9·6 (2, 2891)***	14·3 (2, 3132)***
Wine & beer consumption frequency per week	2·9^{a} (3·6)	1·3^{x} (2·1)	3·3^{b} (3·5)	1·6^{y} (2·2)	3·7^{b} (3·9)	2·0^{z} (2·7)	9·3 (2, 2887)**	27·9 (2, 3164)***
BMI (kg/m^2)	25·4^{a} (3·5)	23·2^{x} (4·3)	25·9^{b} (4·0)	23·6^{y} (4·3)	26·0^{b} (3·5)	23·6^{y} (4·2)	6·9 (2, 2887)^{ns}	4·6 (2, 3149)**
Overweight	47·8 %	23·9 %	54·0 %	30·5 %	58·1 %	29·5 %	20·9 (2)***	13·8 (2)**
Physical activity ≥ 30 min/day	66·4 %	59·0 %	63·4 %	59·7 %	69·5 %	62·5 %	8·0 (2)*	0·3 (2)^{ns}
Having children < 16 years	27·2 %	36·7 %	21·2 %	30·6 %	15·2 %	18·6 %	42·3 (2)***	83·6 (2)***
Education low	9·2 %	11·3 %	7·5 %	11·3 %	9·4 %	14·7 %	10·8 (4)*	2·7 (2)^{ns}
middle	38·6 %	40·1 %	34·8 %	40·6 %	32·5 %	38·4 %		
high	52·2 %	48·6 %	57·7 %	48·0 %	58·1 %	46·9 %		

Note. ^{ns} not significant, *P<0·05, **P<0·01, ***P<0·001; One-way ANOVA, and Chi^2-test (χ^2) were used for examining differences between tertiles. Analysis was done for males and females separately. Mean values within rows with unlike superscript letters were significantly different (*Post hoc test*: Tukey HSD test, P<0·05).$^{a, b, c}$ for significant differences between tertiles for males, $^{x, y, z}$ for significant differences between tertiles for females.[1] Highest tertile includes all respondents who indicated having a snack frequency between 7·5-20·1 times per week. [2] Moderate tertile includes all respondents who indicated having a snack frequency between 2·5 –7·0 times per week. [3] Lowest tertile includes all respondents who indicated having a snack frequency between 0–2·0 times per week.[†] *n* could vary due to missing values

Table 10.4 illustrates the results of the regression analysis with snack frequency as the dependent variable (*n*=4871). Eight variables showed a significant effect (*P*≤0·01), and the model accounted for 23 % of the variance in snacking frequency per week. Significant positive associations were found for sweets and savouries (β=0·320), fruit (β=0·143), watching TV during the main meal (β=0·053) and having a daily dinner (β=0·040). Inverse associations were found for age (β=–0·198), a high educational level (β=–0·097), wine and beer consumption (β=–0·096), and family meals (β=–0·046).

Table 10.4 Results from the multiple regression analysis with snack frequency per week as the dependent variable (*N*=4871).

	ß	*SE ß*	*Standard ß*	*P-value*
Eating behaviours				
Daily breakfast (yes=1/no=0)	–0·38	0·17	–0·03	0·026
Daily lunch (yes=1/no=0)	0·20	0·18	0·02	0·368
Daily dinner (yes=1/no=0)	0·43	0·20	0·03	0·032
Having family meals 4–7 times per week (yes=1/no=0)	–0·43	0·17	**–0·04**	0·009
Watching TV during main meal 4–7 times per week (yes=1/no=0)	0·72	0·23	**0·04**	0·001
Dietary behaviours (consumption frequency per week)				
Sweets and savouries	0·40	0·02	**0·34**	0·000
Sugar-sweetened beverages	0·06	0·05	0·02	0·236
Meat	–0·03	0·02	–0·02	0·165
Convenience food	0·04	0·04	0·01	0·301
Vegetables	–0·05	0·05	–0·01	0·308
Fruit	0·67	0·07	**0·13**	0·000
Socio-demographic and lifestyle characteristics				
Age [years]	–0·09	0·01	**–0·23**	0·000
Health consciousness	0·08	0·08	0·01	0·316
Wine and beer consumption frequency per week	–0·14	0·03	**–0·08**	0·000
BMI	–0·02	0·02	–0·01	0·419
Physical activity ≥ 30 min/day (yes=1/no=0)	0·06	0·15	0·01	0·715
Having children < 16 years (yes=1/no=0)	0·24	0·19	0·02	0·205
Gender (females)	0·32	0·17	0·03	0·052
Education medium vs. low	–0·43	0·28	–0·04	0·126
high vs. low	–0·98	0·27	**–0·09**	0·000

Note. R^2=0·23

Clusters of high-frequency snack consumers

The cluster analysis resulted in a three-cluster solution for high snack consumers (*n*=1890) with Cluster 1 representing a healthy dietary pattern, Cluster 2 representing a moderate dietary pattern, and Cluster 3 characterized by an unhealthy dietary pattern (Table 10.5 and Table 10.6).

The healthy Cluster 1 (*n*=851) consisted mainly of older females, and was characterized by the highest consumption of vegetables and fruit, and the lowest consumption frequency of more unhealthy food groups such as sweets and savouries, and meat. Subjects in this cluster reported the highest levels of health consciousness, and reported more regular breakfast consumption. This cluster mostly included higher educated males.

The unhealthy Cluster 3 (n=85) was the smallest cluster and consisted mainly of male subjects. It was characterized by the highest consumption frequency of the more unhealthy foods, and low fruit and vegetable consumption. A higher percentage of respondents skipped breakfast on a daily basis, and watched TV during the main meal compared to the other two clusters. In addition, wine and beer consumption frequency in males was the highest in this cluster.

Cluster 2 was the largest group (n=954), and respondents in this cluster had dietary behaviours ranging between the healthy and unhealthy clusters. Females in this cluster indicated having moderate consumption frequencies of the more unhealthy food groups, such as sweets and savouries, sugar-sweetened beverages and meat, but also had infrequent intakes of fruit and vegetables. Male subjects in this cluster reported moderate consumption frequencies of sugar-sweetened beverages and convenience food, but also infrequent intakes of fruit and vegetables.

The variables of BMI, percentage of overweight subjects, the percentage of physically-active males, daily lunch for males, having family meals 4–7 times per week, and having children <16 years old did not differ significantly among clusters.

Table 10.5 Cluster centres for the six dietary behaviours included in the cluster analysis; presented for males and females separately. Only high frequency snack consumers (7·5-20·1 snack occasions per week) were included in the cluster analysis (*N*=1890).

	Cluster 1 *'Healthy'*		Cluster 2 *'Moderate'*		Cluster 3 *'Unhealthy'*		F-statistic	
	Mean (SD)						*F (2, 759)*	*F (2, 1125)*
Clustering factors	Male	Female	Male	Female	Male	Female	Male	Female
n	254	597	456	498	52	33		
Sweets incl. savouries	$7·2^{a}$ (7·5)	$6·8^{x}$ (6·5)	$6·2^{a}$ (4·7)	$5·9^{y}$ (4·7)	$10·3^{b}$ (10·4)	$8·1^{x, y}$ (6·5)	16·3***	11·2***
Sugar-sweetened beverages	$0·4^{a}$ (1·3)	$0·1^{x}$ (0·4)	$0·8^{b}$ 1·2)	$0·4^{y}$ (8·7)	$7·5^{c}$ (3·8)	$7·9^{z}$ (3·4)	470·1***	1243·4***
Meat	$5·5^{a}$ (6·2)	$3·6^{x}$ (3·1)	$6·2^{a}$ (3·6)	$5·1^{y}$ (3·7)	$11·5^{b}$ (8·7)	$6·3^{y}$ (3·6)	29·6***	14·1***
Convenience foods	$0·9^{a}$ (1·8)	$0·5^{x}$ (1·1)	$1·6^{b}$ (2·0)	$1·1^{y}$ (1·8)	$7·8^{c}$ (12·7)	$2·2^{z}$ (3·9)	72·0***	20·9***
Fruit	$20·2^{a}$ (6·9)	$20·1^{x}$ (7·2)	$6·9^{b}$ (5·3)	$8·3^{y}$ (4·9)	$6·2^{b}$ (5·9)	$8·2^{y}$ (7·4)	318,1***	506·2***
Vegetables	$27·7^{a}$ (14·8)	$28·7^{x}$ (13·0)	$16·7^{b}$ (8·6)	$18·2^{y}$ (8·5)	$13·5^{b}$ (9·6)	$15·2^{y}$ (9·9)	74·7***	135·2***

Note. ****P*<0·001; Mean values indicate consumption frequency per week. $^{a, b, c, x, y, z}$ One-way ANOVA were used for examining differences between clusters (*P*<0·001). Analysis was done for males and females separately. Mean values within rows with unlike superscript letters were significantly different (*Post hoc test*: Tukey HSD test, *P*<0·05). $^{a, b, c}$ for significant differences between clusters for males, $^{x, y, z}$ for significant differences between clusters for females.

Table 10.6 Descriptive factors for the three clusters; presented for males and females separately.

	Cluster 1 *'Healthy'*		Cluster 2 *'Moderate'*		Cluster 3 *'Unhealthy'*			
	Mean (SD) or %						*F (Df_1, Df_2) or χ^2 (Df)*	
Descriptive factors	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*
Age (years)	$53{\cdot}3^{a}$ (13·0)	$48{\cdot}2^{x}$ (13·5)	$47{\cdot}8^{b}$ (13·6)	$45{\cdot}6^{x}$ (13·6)	$47{\cdot}6^{b}$ (16·4)	$37{\cdot}9^{y}$ (10·8)	4·2 (2, 759)*	8·6 (2, 1115)***
Health consciousness	$4{\cdot}6^{a}$ (0·9)	$4{\cdot}9^{a}$ (0·8)	$4{\cdot}2^{b}$ (1·0)	$4{\cdot}5^{b}$ (1·0)	$3{\cdot}7^{c}$ (1·1)	$4{\cdot}2^{b}$ (0·9)	16·8 (2, 757)***	24·1 (2, 1112)***
Wine and beer consumption (times a week)	$2{\cdot}8^{a}$ (3·3)	$1{\cdot}2^{x, y}$ (2·1)	$2{\cdot}8^{a}$ (3·3)	$1{\cdot}4^{x}$ (2·1)	$4{\cdot}8^{b}$ (7·1)	$0{\cdot}4^{y}$ (0·6)	6·9 (2, 759)**	3·8 (2, 1123)*
BMI (kg/m^2)	25·3 (3·4)	23·1 (4·1)	25·5 (3·6)	23·4 (4·4)	24·5 (3·6)	22·1 (3·3)	$1{\cdot}7$ (2, 757)^{ns}	$1{\cdot}6$ (2, 1110)^{ns}
Overweight	47·6 %	23·2 %	47·8 %	24·7 %	46·2 %	18·8 %	$0{\cdot}1$ (2)^{ns}	$0{\cdot}9$ (2)^{ns}
Physical activity ≥ 30 min/day	68·6 %	63·7 %	64·4 %	52·1 %	68·9 %	58·6 %	$3{\cdot}3$ (2)^{ns}	10·9 (2)**
Having children < 16 years	29·0 %	33·6 %	27·7 %	39·9 %	22·4 %	45·5 %	$1{\cdot}0$ (2)^{ns}	$4{\cdot}5$ (2)^{ns}
Family meals 4–7 times per week	64·8 %	63·7 %	62·6 %	68·2 %	55·8 %	75·8 %	$2{\cdot}3$ (2)^{ns}	$3{\cdot}0$ (2)^{ns}
Watching TV during main meal 4–7 times per week	10·2 %	13·5 %	15·2 %	15·7 %	30·6 %	33·3 %	12·3 (2)**	8·9 (2)*
Daily breakfast	70·4 %	73·7 %	52·6 %	59·5 %	44·2 %	33·3 %	11·3 (2)**	26·8 (2)***
Daily lunch	74·7 %	79·8 %	66·9 %	75·1 %	69·2 %	75·8 %	$0{\cdot}1$ (2)^{ns}	7·2 (2)*
Daily dinner	86·5 %	85·5 %	77·8 %	81·6 %	74·5 %	90·9 %	$2{\cdot}6$ (2)^{ns}	6·0 (2)*
Education Low	7·5 %	10·2 %	8·3 %	11·1 %	17·3 %	12·1 %	13·7 (4)**	$5{\cdot}6$ (4)^{ns}
Middle	37·3 %	37·7 %	37·9 %	42·1 %	51·9 %	54·5 %		
High	55·2 %	52·1 %	53·7 %	46·8 %	30·8 %	33·3 %		

Note. ^{ns} not significant, **P*<0·05, ***P*<0·01, ****P*<0·001; One-way ANOVA, and Chi^2-test (χ^2) were used for examining differences in descriptive factors between clusters. Analysis was done for males and females separately. Mean values within rows with unlike superscript letters were significantly different (*Post hoc test*: Tukey HSD test, *P*<0·05). $^{a, b, c}$ for significant differences between clusters for males, $^{x, y, z}$ for significant differences between clusters for females.

10.4 Discussion

We investigated snack frequency and its association with socio-demographic characteristics, dietary and eating behaviour, and lifestyle factors. We hypothesised that high-frequency snack consumers could be separated in different sub-groups with different underlying food patterns and lifestyle factors.

Our results show, that high-frequency snack consumers (with at least 7·5 snack occasions per week) more frequently consumed both healthy and unhealthy food groups compared to low-frequency snack consumers. Increasing snack frequency was associated with a more unhealthy dietary behaviour, such as consuming sweets and savouries. It was also associated with watching TV during the main meal, having fewer family meals, and lower alcohol intake. Fruit consumption was positively associated with snack frequency, indicating higher fruit intake with increasing snack frequency. Finally, we found three sub-groups of high-frequency snack consumers: a healthy, a moderate and an unhealthy dietary pattern group.

The highest levels of health-consciousness were reported by subjects in the healthy and moderate eating cluster, indicating that individuals in this group tended to act more in accordance with their internal attitudes towards health than the less health-conscious individuals, who might be more subject to external influences (Gould, 1990). Thus, less health-conscious individuals might be more affected by the obesogenic environment, which makes a healthy lifestyle, and particularly the healthy food choices associated with this lifestyle, more difficult.

Differences in health-conscious ratings could also be seen between genders; men seemed to be less health-conscious than women were. Therefore, women were more likely to be mindful of their daily diet and to make healthier food choices. Former studies indicate that men give a lower priority to health compared to other considerations, like taste or convenience, when making their food choices (Fagerli & Wandel, 1999; Wardle et al., 2004). It is thus not surprising that men in our study showed a higher frequency consumption of meat, sugar-sweetened beverages and alcohol. In addition, the highest frequency of convenience food consumption occurred in male subjects in the unhealthy cluster. Convenience food consumption was also shown to be an unfavourable dietary behaviour, as it was associated with obesity (van der Horst, et al., 2010). As reported in other studies, our results suggest that men practise an unhealthy lifestyle more often than women do (Haveman-Nies et al., 1998).

BMI was not found to be associated with snack frequency in the regression analysis. Thus, the results of our study do not support the notion that increased snack frequency, in itself, is a cause of obesity. However, consumption frequency scores from the questionnaire might be biased by

conscious or unconscious under/over-reporting of true food consumption (Voss et al., 1997). Additionally, in the case where respondents indicated a recent change to their nutrition pattern, the cross-sectional design made it impossible to differentiate between whether their actual body weight status was a cause or a consequence of their reported nutritional pattern. BMI was calculated from self-reported weight and height. Thus, an underestimation/underreporting of weight was likely to occur, particularly among overweight and obese subjects (Nyholm et al., 2007).

In general, FFQs are used most often in studies with large sample sizes, to estimate individuals' habitual food intake (Cade et al., 2002). Nevertheless, they give only limited information about individuals' food intake, and they do not capture dietary behaviour in its entirety. Interpretation of snack frequency per week might have been biased by the fact that there are conflicting views held by the general public about the definition of a 'snack' and a 'meal' (Gatenby, 1997). Consumers conceptualise snacks differently – for example, using time of day or food type as a means of classification (Gatenby, 1997). In particular, food intake close to main meal consumption might be classified either as part of the main meal or as snack, depending on individual views. Additionally, people practicing a non-traditional mealtime pattern with more than four snack occasions per day, or with a so-called 'nibbling pattern', could not be clearly detected using this method.

Some studies do not control for physical activity, a possible confounder of the association between eating frequency and BMI (Duval et al., 2008). Therefore, we interpreted physical activity of more than 30 min per day to identify an active lifestyle. In our study, we did not find an association between snack frequency and physical activity. A possible limitation may be that we could not distinguish between different exercise intensities, which may influence snack frequency as well as energy balance, and thus body weight status. It should also be mentioned that the response rate was low and that the study population had significantly fewer lower-educated participants than higher-educated subjects. This should be taken into consideration when the results are interpreted.

Conclusion

In our study, we measured snack frequency, which refers to the number of additional food items consumed between main meals. The results indicate that there is no association between BMI and snack frequency. High-frequency snack consumption occurs in the context of healthy, as well as unhealthy, dietary behaviour and lifestyle patterns. Women are more likely to make healthier dietary food choices, while men are likely to choose unhealthy foods, such as sweets and savouries more often. In developing prevention strategies or interventions, instead of advising a specific

number of snacks per day, healthy food choices and healthy lifestyles should be stimulated. Advising a general increase in snack consumption might even have unfavourable effects, as increasing the number of eating occasions per day without increasing the energy intake at the same time might be difficult to achieve (Forslund et al., 2002). The consumption of nutritious snacks should be promoted, and consumers, especially men, need to be sensitized to the energy density of sweets and savouries as snacks.

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Chapter 11

Life events and changes in food choices

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Published manuscript
Hartmann, C., Dohle, S., & Siegrist, M. (2014). Time for change? Food choices in the transition to cohabitation and parenthood. *Public Health Nutrition* 17(12), 2730-2739

Abstract

Objective. We compared the dietary behaviour of three different household types and explored developmental trends in food choices following a life event.

Design: The study is based on data from three Swiss Food Panel survey periods. A cross-sectional comparison between household types was conducted by using a one-way independent ANOVA. Repeated measures were analysed with a mixed ANCOVA to examine changes in dietary behaviour following a life event.

Setting. Participants in the survey filled in a questionnaire in the years 2010, 2011 and 2012.

Subjects: The final sample consisted of 3559 persons with a mean age of 56 years (range 22–94, 46% men). Seventy-two people moved in with their partner and 65 people reported the birth of their first child.

Results. Cross-sectional evidence confirmed that women living in households with a partner reported higher consumption frequencies for meat and processed meats compared to those living alone. Men living in cohabitation had a higher vegetable intake. The transitional effect of moving in with a partner, however, resulted in a higher intake of processed meats for both genders, and a higher intake of pork and savoury items for men. Transition to motherhood was linked to an increase in vegetable consumption, while the transition to fatherhood did not significantly change consumption patterns.

Conclusion. Individuals in life-stage transitions are more likely to change their nutritional strategies and life events can be a window of opportunity for changes towards better food choices.

11.1 Introduction

Social influences and interactions embedded in our domestic environment seem to play an important and critical role in the development and regulation of our eating behaviour (Sobal & Bisogni, 2009). Efforts to implement changes in our daily eating routines fail not least because the domestic environment, which often remains constant over long periods, can trigger disadvantageous eating habits. Therefore, it is especially interesting to investigate special periods in a person's life that might be associated with adapting new eating patterns. To gain insights into the individual's dietary behavioural development over time and to detect factors triggering change, previous research has focused on special periods marked by major events in a person's life. Special life events such as childbearing, starting to cohabit with a partner or leaving home are powerful determinants of rapid changes in a person's domestic environment. They indicate transitions from one life stage to another, and are accompanied by the acquisition of new social roles, changes in family status and living environments (Elder, 1987; Wethington & Johnson-Askew, 2009). Those new life circumstances require behavioural adaptations in general, lead to changes in consumer behaviour in particular (Andreasen, 1984; Mathur et al., 2008), and might also be linked to the acquisition of new nutritional strategies.

Moving in with a partner and cohabitation

Living with a partner and its effect on eating habits has most often been studied in terms of marital status. Marital status was suggested as an important determinant for health-promoting behaviours including healthier eating habits (Johnson et al., 2000; Joung et al., 1995; Pollard et al., 2001; Roos et al., 1998; Umberson, 1992; Wickrama et al., 1995; Yannakoulia et al., 2008). It has been hypothesized that marital relationships provide social support and guidance, and especially men were reported to be positively influenced by the presence of a female partner and their more health-conscious food decisions (Donkin et al., 1998; Horwath, 1989; Waite, 1995). Accordingly, cross-sectional evidence has shown that married people have a higher consumption of foods such as vegetables, fruit and fish and a lower consumption of calorie-dense foods compared to their unmarried counterparts (Devine et al., 1999; Horwath, 1989; Pollard, et al., 2001; Roos, et al., 1998; Schafer, 1978; Yannakoulia, et al., 2008). Nevertheless, longitudinal studies are required to unravel the individual dietary behavioural adaptations brought on by significant life events. For example, Craig and Truswell (1994) reported that a sample of newly married Australian couples converged their diet after marriage or following on from setting up home together. Moreover, the highest convergence occurred in the traditional 'core' foods of the Australian diet such as beef, lamb,

potatoes, breakfast cereals and cakes. Additionally, Eng et al. (2005) and Lee et al. (2005) suggested that, on the one hand, remarriage was associated with an increase in vegetable consumption in both genders and, on the other hand, with an increase in meat and alcohol consumption in females (Eng et al., 2005; Lee et al., 2005). However, given that those results were based on a four-year follow-up period, the authors admitted that it was likely that long-lasting effects rather than transitional-related effects had been observed in the cohort.

Another limitation of the previous research is that it is mostly based on qualitative interviews with couples shortly before and after marriage or when starting cohabitation (Bove et al., 2003; Craig & Truswell, 1990; Kemmer et al., 1998). Moreover, the majority of those studies focused on marriage per se rather than on cohabitation. The early cohabitation period, however, is assumed to be particularly important, because people start sharing their eating environment, are confronted with their partner's preferences and food negotiations occur. Additionally, cohabitation before or without getting married has become an increasingly popular form of living status in Western societies (Bumpass et al., 1991; De Vaus, 2004; Kalmijn, 2007), and it seems more appropriate to concentrate on living status and its associations with health affairs instead of on the presence of a 'legal' relationship (Anderson et al., 2004; Lund et al., 2002).

Birth of a first child and living with children

Another important event in a person's life is the birth of the first child. Such a life event can encourage parents, especially mothers, to change their health attitudes and to start paying more attention to their diet than they did prior to the event (Devine et al., 2000; Szwajcer et al., 2005). In particular, pregnancy marks the beginning of a new life stage in which women are more motivated to take care, not only of their own nutritional needs, but also of those of their child (Wethington & Johnson-Askew, 2009). A study by Olson (2005) emphasized that two years after motherhood transition, the proportion of women having breakfast daily, and eating three or more fruits and vegetables per day was higher than prior to pregnancy (2005). Similar results were observed by Pollard et al. (2001), who found that women with younger children ate more servings of vegetables than childless women did (2001). Furthermore, in most families, women are the nutritional gatekeepers and are responsible for meal preparation (Hartmann et al., 2013). Their food choices are influenced by various factors, such as the family members' food preferences, and their beliefs about nutritional requirements in terms of maintaining the health and optimal growth of their children (Devine & Olson, 1991, 1992). The presence of children might therefore not only affect women's eating behaviours, but may also have an impact on the whole family's food system.

Additionally, with the beginning of parenthood people might be more motivated to improve their food choices and to set a good example for their children with their own eating habits (Devine & Olson, 1992). What is known about eating-behaviour changes in the transition to parenthood is largely based on cross-sectional studies that include children as a socio-demographic factor (Devine, et al., 1999; Pollard, et al., 2001; Roos, et al., 1998), and on several qualitative studies (Devine, et al., 2000; Devine & Olson, 1991, 1992). One study investigated food-choice behavioural changes when transitioning to parenthood (Olson, 2005). Unfortunately, only three food groups were analysed in the study and the study was limited to women. In general, most of the previous work focused on females, and there is a lack of studies examining dietary behavioural adaptations in males during the transition to parenthood.

The present study

Given the importance of domestic influences on nutritional routines, the present study focuses on two life events which are experienced by most people within their family life course; namely, moving in with a partner and birth of the first child. Both life events are accompanied by a rapid change in a persons' domestic environment, and might lead to nutrition behaviour adaptations. Cross-sectional analysis was conducted to examine if usual food consumption differed between three different household types. The household types comprised living alone, living in a two-adult-person household with a partner and living in a two-adult-person household with a partner and children. The present study sought to examine if the differences in food choices reported in studies focusing on marital status could also be detected if household types outside of marital status were considered. To account for changes in eating behaviour due to changes in household type and family composition, repeated measurements, collected before and after one of the two life events, were analysed. They provide insights into within-individual changes over time, and, through this, a better understanding might be gained of the domestic context in which people make their food choices. It was hypothesized that men's dietary behaviour would be influenced positively by the presence of a woman in the household and that better food choices would be made in families with children. We predicted that vegetable and fruit consumption would mainly be higher in those households.

11.2 Method

Swiss Food Panel

The Swiss Food Panel is a population-based longitudinal study of the eating behaviour of the Swiss population and of other aspects related to nutrition. The Swiss Food Panel started in February 2010, and the same individuals filled in a paper-and-pencil questionnaire for each subsequent year. The questionnaire included, among others, a Food-Frequency Questionnaire (FFQ), questions related to eating behaviour, lifestyle factors, socio-demographic characteristics and life events.

Participants

A mail survey was sent out to 20,912 randomly selected household addresses from the telephone book in the German-speaking and French-speaking parts of Switzerland. In 2010, 6290 of all those who were invited filled in the questionnaire (a response rate of 30%). In 2011, all of the respondents from 2010 were contacted for the second survey, except for those persons who had to be excluded (see Figure 3.1, p23). For the third survey in 2012, only those who responded in 2011, and who did not have to be excluded in the data file matching procedure because of differences in their indicator variables (gender, birth date) were contacted (N = 4412). Additionally, respondents who reported inconsistent body height at baseline and follow-up (> 5 cm difference) (n = 164) were also excluded, because it was assumed that another person had filled in the questionnaire on their behalf. The longitudinal sample for 2010, 2011 and 2012 consisted of 3559 persons: 46% of the participants were male. In 2012 the mean age was 56 years (SD=14, range 22–94). Compared to the general Swiss population, the percentage of young adults (20-39 years old) was lower, and more respondents had a higher secondary or college/university degree(Swiss Federal Statistical Office, 2013). The whole sample's average body mass index (BMI) was M=25·7 kg/m^2 (SD=0·1) for men, and M=23·4 kg/m^2 (SD=0·1) for women.

Dietary and eating behaviour assessment

The FFQ was specially designed for the Swiss Food Panel and was used to estimate the frequency of habitual consumption of various foods (Table 11.1). The 2-week test–retest reliability for the FFQ was determined in a separate study. Test–retest correlations for the foods varied between r = 0·7 and r = 0·9; detailed description of the test-retest study have been published previously(Hartmann et al., 2012). The following food items were included in the present study: fruit; salad (lettuce, tomatoes) or raw vegetables; vegetables (cooked/steamed); pork; beef or veal; poultry (e.g. turkey, chicken); processed meats (e.g. cold cuts, sausages, ham); cookies, sweet

pastries, chocolate; savouries (e.g. chips, nuts, salty snacks); wine; and beer. These foods were chosen because either they are part of dietary recommendations or because their high or low frequency of consumption had been shown to have unfavourable health effects (Faramawi et al., 2007; Hu & Malik, 2010; Lock et al., 2005; van der Horst et al., 2010). One additional question that was asked related to participants' eating behaviour: 'How often do you usually eat your main meal with the whole family?' Participants responded based on a five-point scale, which was coded as shown in Table 11.1.

Socio-demographic characteristics

Age, gender, educational level and household income were also assessed. The educational level was coded as follows: (1) no education, primary school and lower secondary school; (2) vocational school; (3) higher secondary school; (4) college; and (5) university. Household income was coded as follows: (1) low ≤ 5000 CHF (Swiss Franc), (2) medium 5001–9000 CHF, and (3) high ≥ 9001 CHF. In order to identify household type, participants were asked how many adults and how many children under 16 years old lived in their household.

Table 11.1 Food-group variables of the present study and their underlying items from the FFQ

Variable label	'How often do you usually eat (drink) …?'
Fruit (in portions)[a,c]	Fruit
Salad (in portions)[a,c]	salad (lettuce, tomatoes) or raw vegetables
Vegetables (in portions)[a,c]	Vegetables (cooked/steamed)
Pork[b]	Pork
Beef[b]	Beef or veal
Poultry[b]	Poultry (e.g. turkey, chicken)
Processed meats[b]	Processed meats (e.g. cold cuts, pepperoni, ham, sausages)
Sweets[b]	Cookies, chocolate, sweet pastries (3 items)
Savouries[b]	Chips, nuts, salty snacks
Beer[b]	Beer
Wine[b]	Wine

Note. [a]Variables were measured using a five response category (coding): daily (7 times/week), 4-6 times/week (5 times/week), 1-3 times/week (2 times/week), 1-3 times/month (0.5 times/week), less or never (0). [b]Variables were measured using a six-response category (coding): several

times/day (14 times/week), daily (7 times/week), several times/week (3 times/week), several times/month (0.75 times/week), several times/year (0), less or never (0). [c]Participants were additionally asked how many portions of vegetables and salad (one portion = a handful), as well as fruits (one piece or one handful) they usually ate when they consumed these foods. Consumption frequencies and portion numbers were multiplied. All other variables only indicate consumption frequencies.

Life events

Respondents were asked if they had moved in with their partner in the last year (yes or no), and if they had experienced the birth of a child in the last year (yes or no). Only persons who reported a life event in the survey period from 2011 or 2012 were aggregated into the life-event group. This selection was based on the fact that the earliest data was available for 2010, and baseline consumption values for the statistical procedure corresponded to the survey period before the life event was noted.

The life event of ‘moving in with a partner’ was reported by a total of 159 persons for 2011 and 2012 combined. Only those participants who lived alone prior to the life event were included. The final group, ‘moving in with a partner’, consisted of 72 participants (35 males, 37 females) with a mean age of 44 years for males and females, and an average BMI of 25·1 kg/m^2 (SD=0·7) for males and 23·2 kg/m^2 (SD=0·7) for females in the year prior to the life event.

The second life event birth of a child was reported by 184 persons for 2011 and 2012 combined. Persons who lived in a household with children prior to the life event were excluded from the group, because the paper’s focus is on individuals who have experienced their first childbirth. Seven females over 45 years old were also excluded, as a first pregnancy in this age grouping was implausible. The final group of ‘birth of a first child’ consisted of 65 participants (37 males, 28 females) with a mean age of 32 years for females (Swiss population: 31 years on average (Swiss Federal Statistical Office, 2013)), and 44 years for males in the year prior to the life event. The average BMI in this group was 25·6 kg/m^2 (SD=0·5) for males and 24·1 kg/m^2 (SD=0·6) for females.

Data analysis

Initially, one-way analysis of variance (ANOVA) and chi-squared (χ^2) tests were used to examine the characteristics according to the three different household types: single-person households without children <16 years (n = 809), two-adult-person households without children <16 years (n = 1293) and two-adult-person households with children <16 years (n = 647). In a second step, the longitudinal data was analysed in a mixed-design mode to examine if the studied life events were linked to within-individual changes in eating behaviour. A mixed analysis of covariance (mixed ANCOVA) was conducted with the life event (yes, no) and gender (male, female) as between-subjects factors, and with time as a within-subjects factor (T1, T2). The within-subjects factor was defined by the repeated measurements of the consumption frequencies before (T1) and after the life event (T2). Age (at T1) and education (at T1) were included as covariates. Every food group and eating behaviour variable was analysed with its own model. What was particularly interesting for the present study were the within-subjects effects that included the life event as a factor, because those denote that the behaviour changed notably in the life-event group.

Despite the large sample, only a few participants indicated that they had had a life event in the period under consideration. Therefore, to take full advantage of the available data, the three waves were pooled for those participants who reported a life event. More precisely, T1 values corresponded to data from 2010, and T2 values correspond to data from 2011, for all participants who indicated a life event in 2011. At the same time, for all participants who indicated a life event in 2012, the T1 values corresponded to data from 2011, and the T2 values corresponded to data from 2012. Additionally, the life-event factor led to the implementation of a reference group consisting of all participants without a life event to detect actual trends in dietary behaviour over the study period at the population level. The T1 values for the reference group corresponded to data from 2010 and the T2 values corresponded to data from 2012.

All analyses were performed with the longitudinal data set from 2010–2012 (N = 3559) with the SPSS statistics software package 19·0 (SPPS Inc., Chicago, IL, USA).

11.3 Results

Comparison of different household types

Cross-sectional analysis of the data from 2010 revealed significant differences in eating behaviour between household types (Table 11.2, Table 11.3). Women living alone consumed meat, particularly pork, beef and processed meats less often compared to those living with a partner (with or without children). Women living in a family with children most frequently consumed the

majority of all studied food groups. They reported not only the highest intake of vegetables and a high salad intake, but they also consumed poultry, processed meats, sweets and savouries most often compared to women living in one of the other household types. In contrast, men's food-choice patterns seemed to be relatively similar between household types. Their meat consumption, except for poultry, and their consumption of sweets and savouries did not differ significantly between household types. Men's vegetable consumption was the highest when living with a partner (with or without children). No significant differences were observed for fruit intake in both genders. With regard to wine consumption, males and females living with a partner consumed wine more frequently than participants in the other household types.

Moving in with a partner

The transitional effects of the life event 'moving in with a partner' on food choices is shown in Table 11.4. First, significant *within-subjects* two-way and three-way interactions were detected. Time x Life event as highest order interactions were found for processed meats and family meals. These interactions indicate that processed meat consumption and family meal frequencies varied over time within persons, but with different manifestations for individuals in the life-event group and for those in the reference group. In particular, newly cohabiting participants increased their processed meat consumption from M_{T1} = 1·1 times per week (*SE* = 0·2) before moving in with their partner to M_{T2} = 1·4 times per week (*SE* = 0·2) after the life event, while consumption frequencies in the reference group remained stable over time (M_{T1} = 1·3 times per week (*SE* = <0·1) to M_{T2} = 1·3 times per week (*SE* = <0·1)). Additionally, newly cohabiting individuals had family meals more often after they moved in together (M_{T1} = 2·7, *SE* = 0·3; M_{T2} = 3·6, *SE* = 0·3).

Table 11.2 Females. Characteristics of the female study population according to household type (Swiss Food Panel, data 2010)

	Single-person households No children <16 years (*n* = 518)		**Two-adult-person households** No children <16 years (*n* = 545)		Children <16 years (*n* = 406)			
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*F(df1, df2) or χ^2 (df)*	*p-value*
Demographics								
Age (years)	57·9[a]	15·1	54·4[b]	14·1	41·7[c]	8·6	F(2, 1466) = 186·2	< 0·001
Household income (%)								
Low	59·5	-	20·8	-	14·3	-	$\chi^2(4)$ = 305·3	< 0·001
Middle	35·0	-	46·6	-	51·8	-		
High	5·1	-	32·6	-	33·9	-		
Education[1] (%) Low	13·3	-	7·9	-	4·9	-	$\chi^2(4)$ = 20·9	< 0·001
Middle	38·4	-	41·4	-	44·3	-		
High	48·3	-	50·6	-	50·7	-		

(table continues)

Table 11.2 continued

Dietary and eating behavior[2]								
Fruit	11·7	8·3	11·2	7·7	10·7	7·3	F(2, 1446) = 1·7	0·188[ns]
Salad	11·1[a]	7·4	13·0[b]	7·6	12·9[b]	7·6	F(2, 1451) = 10·0	< 0·001
Vegetables	8·7[a]	5·3	9·4[a,b]	5·9	9·7[b]	6·0	F(2, 1451) = 3·9	0·021
Pork	0·5[a]	0·8	0·8[b]	1·0	0·9[b]	1·0	F(2, 1452) = 14·9	< 0·001
Beef	0·8[a]	1·1	1·0[b]	1·1	1·0[b]	1·1	F(2, 1458) = 7·4	0·001
Poultry	1·1[a]	1·1	1·1[a]	1·2	1·3[b]	1·2	F(2, 1457) = 6·4	0·002
Processed meats	0·7[a]	1·2	1·0[b]	1·5	1·3[c]	1·5	F(2, 1454) = 20·8	< 0·001
Sweets	3·9[a]	4·4	4·0[a]	4·0	5·2[b]	4·7	F(2, 1449) = 10·3	< 0·001
Savouries	0·3[a]	0·7	0·4[a]	0·8	0·6[b]	0·8	F(2, 1459) = 15·8	< 0·001
Beer	0·3	0·9	0·3	1·1	0·2	0·8	F(2, 1453) = 1·3	0·265[ns]
Wine	1·4[a]	2·2	1·8[b]	2·2	1·0[c]	1·5	F(2, 1459) = 18·0	< 0·001
Family meal	1·8[a]	2·6	5·3[b]	2·2	6·1[c]	1·5	F(2, 1400) = 525·3	< 0·001

Note. $p<0.01$ statistically significant, [ns]Not statistically significant; [a, b, c]One-way ANOVA and χ^2 tests were used to examine differences between household types. Mean values within rows with different superscript letters were significantly different (post hoc test: Bonferroni, $p < 0·05$). [1] For descriptive purposes, educational level was categorized into three categories: (low) primary and lower secondary school, (middle) vocational school, (high) higher secondary school, college and university. [2] All variables reflect frequencies per week, except for fruit, salad and vegetable consumption, which reflect portions per week.

Table 11.3 Males. Characteristics of the male study population according to household type (Swiss Food Panel, data 2010)

	Single-person households No children <16 years (N = 291)		Two-adult-person households No children <16 years (N = 748)		Children <16 years (N = 241)		Statistics	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*	*F(df1, df2)*	*p-value*
Demographics								
Age	54·6[a]	15·7	62·4[b]	12·7	47·1[c]	12·2	F(2, 1277) = 130·7	< 0·001
Household Income (%)								
Low	40·9	-	20·9	-	11·9	-	$\chi^2(4) = 88·3$	< 0·001
Middle	48·3	-	48·4	-	56·4	-		
High	10·8	-	30·7	-	31·8	-		
Education[1] (%) Low	8·0	-	6·0	-	5·8	-	$\chi^2(4) = 3·0$	0·565
Middle	36·7	-	35·3	-	32·5	-		
High	55·4	-	58·6	-	61·7	-		

(table continues)

Table 11.3 continued

Dietary and eating behaviour[2]								
Fruit	9·2	8·1	8·8	7·8	8·0	8·0	F(2, 1264) = 1·6	0·210[ns]
Salad	9·3	6·8	10·3	7·2	10·7	6·8	F(2, 1268) = 3·1	0·048
Vegetables	6·8[a]	5·4	8·2[b]	5·7	8·3[b]	5·8	F(2, 1261) = 7·1	0·001
Pork	1·2	1·3	1·3	1·4	1·3	1·2	F(2, 1271) = 0·2	0·806[ns]
Beef	1·5	1·6	1·4	1·3	1·4	1·2	F(2, 1270) = 0·8	0·473[ns]
Poultry	1·3[a]	1·3	1·2[a]	1·1	1·5[b]	1·2	F(2, 1272) = 8·6	< 0·001
Processed meats	1·6	1·8	1·6	1·9	1·7	1·7	F(2, 1268) = 0·4	0·678[ns]
Sweets	4·1	4·4	4·2	4·3	4·5	4·0	F(2, 1261) = 0·6	0·562[ns]
Savouries	0·5	1·0	0·5	1·1	0·7	0·9	F(2, 1272) = 3·0	0·053[ns]
Beer	1·3	2·0	1·1	2·0	1·1	1·7	F(2, 1271) = 0·7	0·507[ns]
Wine	2·1[a]	2·7	2·6[b]	2·7	1·7[a]	2·3	F(2, 1271) = 13·1	< 0·001
Family meal	2·6[a]	2·9	5·8[b]	1·9	5·3[c]	2·1	F(2, 1254) = 213·5	< 0·001

Note. $p<0.01$ statistically significant, [ns]Not statistically significant ; [a, b, c]One-way ANOVA and χ^2 tests were used to examine differences between household types. Mean values within rows with different superscript letters were significantly different (post hoc test: Bonferroni, $p < 0·05$). [1]For descriptive purposes, educational level was categorized into three categories: (low) primary and lower secondary school, (middle) vocational school, (high) higher secondary school, college and university. [2]All variables reflect frequencies per week, except for fruit, salad and vegetable consumption, which reflect portions per week.

Time x Life event x Gender interactions were found for the consumption of pork and savouries, indicating life-event-related changes in pork and savouries' consumption that varied by gender. While men's pork consumption increased from M_{T1} = 1·4 times per week (*SE* = 0·2) before the life event to M_{T2} = 2·1 times per week (*SE* = 0·2) after the life event, the female's consumption remained stable (M_{T1} = 0·4, *SE* = 0·2; M_{T2} = 0·4, *SE* = 0·2). The same pattern was found for the consumption of savouries. While men's savouries' consumption increased from M_{T1} = 0·5 (*SE* = 0·2) to M_{T2} = 1·1 (*SE* = 0·1), the female's consumption remained stable (M_{T1} = 0·2, *SE* = 0·1; M_{T2} = 0·2, *SE* = 0·1). No significant life-event-related within-subjects effects were detected for fruit, vegetables, salad, beef, poultry, sweets, wine or beer. Therefore, those food groups did not change significantly over time in the life-event group. Second, there were significant *between-subjects* main effects and two-way interactions. A main effect of the life event was found for vegetable intake and family meal frequency. These main effects indicate intake differences between individuals in the life-event group and the reference group. Vegetable intake in the life-event group had a mean value of *M* = 7·5 servings per week (*SE* = 0·6), which was lower when compared to the reference group with *M* = 8·76 servings per week (*SE* = 0·1). The same pattern was found for family meal frequencies, with lower frequencies in the life-event group (*M* = 3·1, *SE* = 0·3) compared to the reference group (*M* = 4·7, *SE* = <0·1).

Life event x Gender interactions were found for pork, poultry, beef, sweets and savouries' consumption. These interactions indicate that consumption frequencies differed between participants in the life-event group and those in the reference group, but with different manifestations for males and females. Male participants in the life-event group[1] ate the mentioned food groups more often compared to male participants in the reference group[2]. In contrast, females in the life-event group[3] reported lower consumption frequencies for all these food groups, except beef, compared to the reference group[4].

[1] Mean consumption frequencies of men in the life-event group: pork *M* = 1·8 (*SE* = 0·2); beef *M* = 2·0 (*SE* = 0·2); poultry *M* = 1·9 (*SE* = 0·2); sweets *M* = 5·5 (*SE* = 0·6); savouries *M* = 0·8 (*SE* = 0·1);

[2] Mean consumption frequencies of men in the reference group: pork *M* = 1·3 (*SE* = <0·1); beef *M* = 1·4 (*SE* = <0·1); poultry *M* = 1·3 (*SE* = <0·1); sweets *M* = 4·2 (*SE* =0·1); savouries *M* = 0·5 (*SE* =<0·1).

[3] Mean consumption frequencies of women in the life-event group: pork *M* =0·4 (*SE* =0·2); beef *M* = 1·0 (*SE* = <0·1); poultry *M* = 1·0 (*SE* = 0·2); sweets *M* = 2·7 (*SE* = 0·6); savouries *M* = 0·2 (*SE* = 0·1).

[4] Mean consumption frequencies of women in the reference group: pork *M* = 0·7 (*SE* = <0·1); beef *M* = 0·8 (*SE* = 0·2); poultry *M* = 1·2 (*SE* = 0·3); sweets *M* = 4·2 (*SE* = 0·1); savouries *M* = 0·4 (*SE* = 0·2).

Table 11.4 Results for the life event '**moving in with a partner'** (N = 72*). Significant main effects and interactions were found by conducting a mixed ANCOVA with two between-subjects factors (life event, gender), one within-subjects factor (time), and age and education as covariates. A mixed ANCOVA was conducted for every food-group variable and the family meal variable.

	Main effects and interactions				
	Between-subjects	Within-subjects	df1, df2	F	p-value
Fruit	Gender		1, 3382	10.79	0.001
Vegetables	Life event		1, 3383	4.24	0.040
Pork	Gender		1, 3399	65.20	< 0.001
	Life event x Gender		1, 3399	11.32	0.001
		Time x Life event	1, 3399	6.52	0.011
		Time x Gender	1, 3399	4.53	0.033
		Time x Life event x Gender	**1, 3399**	**6.78**	**0.009**
Beef	Gender		1, 3402	42.91	< 0.001
		Time	1, 3402	4.70	0.030
	Life event x Gender		1, 3402	11.67	0.001
Poultry	Gender		1, 3403	16.06	< 0.001
	Life event x Gender		1, 3403	10.16	0.001
Processed meats	Gender		1, 3398	32.14	< 0.001
		Time x Life event	**1, 3398**	**6.42**	**0.011**
Sweets	Gender		1, 3371	9.06	0.003
	Life event x Gender		1, 3371	9.74	0.002
Savouries	Gender		1, 3403	20.54	< 0.001
	Life event x Gender		1, 3403	7.08	0.008
		Time x Life event	1, 3403	8.39	0.004
		Time x Gender	1, 3403	6.30	0.012
		Time x Life event x Gender	**1, 3403**	**9.68**	**0.002**
Beer	Gender		1, 3401	44.26	< 0.001
Family meal	Life event		1, 3310	29.97	< 0.001
		Time x Life event	**1, 3310**	**26.51**	**< 0.001**

Note. $p<0.05$ statistically significant.*N varies between 68 and 72, because individuals with missing information in the FFQ in one of the survey periods were excluded in the statistical procedure, resulting in slightly varying group sizes being used in every model.

Birth of the first child

The second set of analyses examined if the life event of 'birth of a first child' was associated with changes in dietary and eating behaviour between the baseline and follow-up periods (Table 11.5). Significant *within-subjects* Time x Life event x Gender interactions were found for vegetables and beer consumption as well as for the frequency of family meals. Thus, consumption of vegetables in the life-event group changed between baseline and follow-up, with different manifestations for males and females. While females' intake of vegetables increased remarkably after transition to motherhood (M_{T1} = 6·3, *SE* = 1·2; M_{T2} = 9·6, *SE* = 1·2), males' intake decreased (M_{T1} = 8·2, *SE* = 1·0; M_{T2} = 7·6, *SE* = 1·0). Additionally, men consumed beer less frequently after the transition to parenthood (M_{T1} = 1·9, *SE* = 0·2; M_{T2} = 1·3, *SE* = 0·2), while women's consumption remained stable and on a low level (M_{T1} = 0·2, *SE* = 0·3; M_{T2} = 0·1, *SE* = 0·3). No significant life-event-related within-subjects effects were detected for fruit, salad, pork, beef, poultry, processed meats, sweets, savouries or wine.

Second, there were also significant *between-subjects* main effects. A main effect of the life event was found for salad and savouries consumption. In particular, salad intake in the life-event group was generally lower (*M* = 9·2, *SE* = 0·8) compared to the reference group (*M* = 11·1, *SE* = 0·1), and with regard to savouries intake, individuals in the life-event group ate savouries more often (*M* = 0·7, *SE* = 0·1) compared to those in the reference group (*M* = 0·5, *SE* = <0·1).

Table 11.5 Results for the life event **'birth of a first child'** (N = 65*). Significant main effects and interactions were found by conducting a mixed ANCOVA analysis with two between-subjects factors (life event, gender), one within-subjects factor (time), and age and education as covariates. A single mixed ANCOVA was conducted for every food-group variable and the family meal variable.

	Main effects and interactions				
	Between-subjects	Within-subjects	df1, df2	F	p-value
Fruit	Gender		1, 3362	11.50	0.001
Salad	Life event		1, 3377	4.81	0.028
	Gender		1, 3377	21.14	< 0.001
Vegetables		Time x Gender	1, 3364	7.80	0.005
		Time x Life event x Gender	**1, 3364**	**5.84**	**0.018**
Pork	Gender		1, 3384	33.49	< 0.001
Beef	Gender		1, 3388	22.85	< 0.001
		Time	1, 3388	3.83	0.05
Poultry	Gender		1, 3389	5.89	0.015
Processed meats	Gender		1, 3384	25.75	< 0.001
Sweets		Time	1, 3357	7.12	0.008
Savouries	Gender		1, 3388	4.37	0.037
	Life event		1, 3388	9.89	0.002
		Time	1, 3388	8.14	0.004
Beer	Gender		1, 3384	49.29	< 0.001
		Time x Life event	1, 3384	5.20	0.023
		Time x Gender	1, 3384	5.27	0.022
		Time x Life event x Gender	**1, 3384**	**4.03**	**0.045**
Wine	Gender		1, 3392	8.13	0.004
		Time x Gender	1, 3392	4.01	0.045
Family meal		Time x Gender	1, 3283	4.76	0.029
		Time x Life event	1, 3283	14.65	< 0.001
		Time x Life event x Gender	**1, 3283**	**4.07**	**0.044**

Note. $p<0.05$ statistically significant. *N varies between 63 and 65, because individuals with missing information in the FFQ in one of the survey periods were excluded in the statistical procedure, resulting in slightly varying group sizes being used in every model.

11.4 Discussion

The main achievement of this study was to point out that people adapt their food choices to life-event-related changes in their domestic eating environment. The research approach combined cross-sectional and longitudinal data analysis, and provided not only insights into within-individual changes over time, but also showed that cross-sectional evidence for life-event-related changes in food choices can only partially be confirmed by longitudinal results.

Moving in with a partner and cohabitation

Although the literature suggests that married men eat healthier diets due to their partners' influences, we found no indication of healthier food choices in men within one year of starting cohabitation. Even though, in the cross-sectional analysis, vegetable consumption was higher in men living with a partner compared to men living alone, longitudinal results showed no improvements in salad, vegetable or fruit consumption with beginning of cohabitation. In contrast, men's dietary behaviour shifted to a more undesirable diet, with a higher consumption frequency of red meat, processed meats and savouries. However, it cannot be ruled out that the positive influences of a female partner, due to their more health-conscious food decisions and their role as nutritional gatekeeper, will affect men's diet positively in the long term. Women´s food choices, on the other hand, changed only significantly in regard to a higher consumption frequency of processed meat after moving in together. The consumption of processed meats such as cold cuts and sausages might be a compromise between men's desire for meat and women's avoidance of high meat consumption. Women's food decisions might also be influenced by a 'need to please' (Murcott & Gamarnikow, 1983), accompanied by a propensity to prepare and consume food that is preferred by their partner (Craig & Truswell, 1994), and as an adaptation towards the man's eating style. Additionally, some foods are less likely part of dietary convergence, because they are mostly consumed alone; independent of the partner's preferences (Craig & Truswell, 1994). For example in a previous study, high fruit consumption was linked to high snack frequency (Hartmann, et al., 2012), and the lack of significant differences in fruit intake in this study might, therefore, reflect that fruit consumption is likely to be more influenced by an individuals' snacking behaviour than by a family's meal behaviour.

Birth of a first child and living with children

Another life event which was expected to be linked to changes in food choices was the transition to parenthood. In fact, vegetable consumption was much higher in women after pregnancy, and

slightly higher consumption was also reported by women living in households with children. In contrast, men's food frequency pattern did not change remarkably after transition to parenthood, and cross-sectional analysis revealed men's food choices as being relatively stable between household types as well. Roos *et al.* (1998) found similar results, and suggested that parental status was a determinant of women's food behaviour, but not of men's. On the one hand, pregnant women are much more likely to achieve support and guidance through health care systems, and could be confronted with aspects of healthy eating during and after pregnancy. On the other hand, barriers to better food choices in men such as the symbolic value of foods (Sobal, 2005), objections to the taste of and reduced satisfaction from the health foods (Gough & Conner, 2006) as well as an unwillingness to alter their diets in favour of health aspects (Gough & Conner, 2006) might have a greater impact on men's intentions for dietary changes than factors embedded in their domestic social environment. Additionally, increasing vegetable intake might be a strategy for women in transition to eat a more health-enhancing diet, but it could also targeting weight loss after pregnancy, induced by body shape dissatisfaction and peer pressure (Devine, et al., 2000).

Two additional results are interesting when comparing food choices of women living in childless households with those living with children. First, the cross-sectional findings showed that women living in households with children were more likely to consume sweets. These findings appear to be well substantiated by the fact that especially older children have an influence on the family´s purchase behaviour in terms of sweets and snack foods (Lackman & Lanasa, 1993). Increased eating cues triggered by the availability of the children's preferred sweets in the household, and increased stress levels due to the requirements associated with a mothers' social role, might tempt women to consume more sweets (Torres & Nowson, 2007). Second, women's processed meat, beef and poultry consumption frequency was higher in households with children. Traditionally family meals in Western societies are centred around meat (Murcott, 1982; Murcott & Gamarnikow, 1983; Sobal, 2005), and in a study from 1986, the interviewed women reported meat as being the most important part of a proper family meal, because of its nutritional value for a children´s growth (Charles & Kerr, 1986; Murcott, 1982). Mothers of today might still hold those beliefs what could explain the observed high frequency of meat consumption in families with children.

In interpreting the results of this study, it is important to consider that the results are based on an FFQ in which usual consumption frequencies of some core food groups within the previous year were assessed. The frequency scores might be biased by conscious or unconscious under/over-reporting of people's true food-consumption patterns (Kroke et al., 1999). Furthermore, given the

high mean ages of the respondents in the life event groups, at least for those who reported the beginning of cohabitation, it is possible that the results are not representative for younger adults. Food choice patterns of younger persons might be more flexible and less established that those of people in older age groups who experience these transitions. Life-event related changes in dietary behavior could be more pronounced in younger people.

The current study was limited by repeated-measurement analysis of two time points; thus, no statement can be made regarding either the stability or the duration of any changes in dietary behaviour. Still, the follow-up period of one year is regarded as being long enough to develop new habits and as short enough to limit the number of other life events or influential experiences. Furthermore, we cannot exclude other household types including two individuals – such as shared-flat living – because we solely asked about the number of adults within a household. Nevertheless, the prevalence of private non-family households is, at 1·4% (2011), rather small in the Swiss population (Swiss Federal Statistical Office, 2013).

Conclusion

The evidence from this study implies that in the transition to cohabitation, people are more likely to change their dietary behaviour, although both men's and women's food choices shifted in an unfavourable direction. This may have far-reaching consequences, because the early cohabitation period seems to be a crucial time period in which people start creating their future family's eating habits (Anderson, et al., 2004). The transition to parenthood seems to be an additional period in which people are more likely to implement dietary changes. The results pointed out, however, that a transition to parenthood only seems to positively influence women's dietary behaviours. This study not only highlights that factors embedded in a domestic environment can contribute to changes in eating habits in general, but also that life events can be a window of opportunity for a change towards better food choices. Therefore, health promotion programs or nutrition counselling should pay more attention to such special time periods in a person's life, because they seem to be promising with regard to the implementation of new nutritional strategies.

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Part III

General Discussion

General Discussion

Studies presented in this dissertation investigated different factors related to psychological conditions and food skills, and to the eating context that affect food choices. Their impact as either a driver or a barrier to healthier food choices was investigated. In the following discussion, a brief outline of every study, the main findings, the implications and some suggestions for future research are presented (Chapter 12). The main findings are separated into driver- and barrier-related categories. Issues regarding the methodology of the Swiss Food Panel project in general are discussed in Chapter 13. An overall conclusion will end the discussion in Chapter 14.

12 Central findings, implications and further directions

12.1 Drivers

Cooking skills for balanced food choices

Cross-national preferences tend to become increasingly homogenous (Grunert et al., 2001), but how foods are prepared and which foods are used is still shaped by culture, regional patterns and traditions. This makes it especially difficult to measure cooking skills on a population level. We therefore designed a cooking skills scale, which is as culturally independent as possible in order to measure cooking skills in a European adult population. Furthermore, we examined which factors predict cooking skills, and investigated if there is an association between cooking skills and balanced food choices.

The results of our cross-sectional study showed that women have higher cooking skills than men, and younger women (20–30 years old) reported lower cooking skills than older women. Men's cooking skills starkly decline after the age of 40–49 years. We further showed that people who are able to cook make better food choices; in particular, they consume more vegetables and less convenience food. In fact, cooking skills enable people to prepare different food items and dishes, and therefore, may increase food choice opportunities, as well as food variety. Consumption of convenience food is highly heteronomous; thus, people lose control over food ingredients and make themselves depended on convenience food offers and industrially predefined food compositions. Although people might be able to cook, it does not necessarily mean that people use these skills in everyday life or are able to cook healthy

dishes. The lack of ideas, ease and convenience orientation and/or lack of time can be important barriers for health-orientated domestic cooking. People with high cooking skills reported more balanced food choices, but we cannot say whether people really cook, and the relevance of cooking skills for out-of-home consumption has not yet been investigated. It might be that people with high cooking skills are more informed about recipes and preparation techniques, which may help them choose healthier meals out-of-home.

Cooking enjoyment was the most important predictor of cooking skills. Interestingly, the association between cooking skills and cooking enjoyment is more pronounced in males than in females. In contrast to cooking as an everyday responsibility, men might cook when they are in the right mood, and cooking is more conceptualized as a hobby and source of pleasure than as an obligation. Interventions or public health efforts should raise awareness of the importance of cooking skills to implement dietary guidelines into daily nutrition supply. The effect of cooking as a source of pleasure should not be underestimated and people's cooking enjoyment should be targeted.

In conclusion, the presence of cooking skills is associated with better food choices. The promotion of cooking skills should, therefore, be a part of any prevention strategies. Cooking courses at school might be one of the few possibilities to reach children from low-income families, because of their restricted access to other sources of information. It might be an opportunity to raise awareness of fresh foods, food ingredients and health-promoting diets; meals that can be economically and quickly prepared. Pupils, especially boys, should be encouraged to develop cooking skills. Furthermore, there is an increasing consumer demand for ready-to-eat foods; in particular, the men in our study reported eating convenience foods more often. The consumers, as well as the industry, should be encouraged to focus on a 'healthy' and diverse convenience food assortment based on products low in fat and sugar. Individuals, especially older men with low cooking skills, might profit from such ready-to eat-foods.

Nutrition information can lead to better food choices

The food industry aggressively advertises their products under the consideration of different needs in different consumer groups and by using various communication channels. It is rarely possible to escape from advertisement influences. Nutrition communication that focuses on one communication channel is less likely to reach all consumer groups. While some consumers use, for instance, nutrition tables as source of information, others are more

interested in information from friends, official websites or brochures. However, not much is known as to whether different kinds of information channels are associated with better food choices. Therefore, a consumer segmentation was conducted to reveal whether the use of different information sources predicts food choices. The segmentation was based on participants' use of different information channels; that is, the Internet, official websites, brochures, medical doctors or dieticians, family and friends. Furthermore, the different consumer segments were characterized by their typical food choices, health consciousness and interest in general nutrition information. The results of our analysis revealed four segments: the Uninterested, the Moderate user, the Internet user and the Official user.

The Uninterested were more likely to be older men who were less health consciousness and less likely to follow a balanced diet. They perceived unhealthy food products as healthier compared to consumer in the other segments, which could indicate a lack of knowledge in this segment. Attempts to reach this consumer group by changing and improving their understanding of nutrition tables or packaging labels will not be effective. Consumers' interest in nutrition information is generally low in this segment, which might indicate that they are rather difficult to reach by information alone. Therefore, environmental changes that unconsciously nudge their food choices into the 'right' direction might positively influence their dietary behaviour.

The Moderate user segment was the cluster with the most participants. Even though people classified in this segment were health conscious and interested in nutrition information, they rarely used nutrition tables as a source of information. They reported a mixed dietary pattern based on high fruit and vegetable intakes, but also high intakes of sweets and full-fat dairy. This consumer group might be more motivated to use nutrition tables when attractive table designs and understandable table formats catch their attention. By improving both likability and understandability of nutrition tables, people in this category might be more engaged in studying food nutrient composition, which ideally leads to better food decisions.

The Internet users are mainly younger people who are interested in information, but are less health conscious. They locate information from official websites and brochures as well as the Internet in general. Their consumption pattern is characterized by frequent consumption of soft drinks with and without sugar, and a low consumption of the more healthy food groups. Because they are interested and use different information channels, they might be easier to reach through nutrition information communicated by various channels. Their fruit consumption is low, instead they have a high intake of sweets and savouries.

Both fruits and sweets are associated with a snacking pattern and are typical snack foods (Hartmann et al., 2013). This consumer group might need to be sensitised for the energy density of some commercial snack foods and might profit from healthy snack promotion through social media channels such as Instagram, Pinterest or Facebook.

The smallest segment was the Official user, which was mainly built by diet-related, health-conscious, nutrition-interested older women. They receive nutrition information from official websites and brochures, medical doctors or dieticians, and family and friends. They consume a balanced diet, but had high BMI values. We cannot make any statement whether the involvement in information seeking is ongoing in this segment or whether their interest is related to the specific situation of high BMI. They might actively search for information about weight loss strategies. This consumer segment might profit from more specific information related to situations or strategies to increase energy expenditure through PA and through lifestyle activity (e.g. walkability).

In sum, consumers are generally interested in nutrition information (Grunert & Wills, 2007) and it can help them to make better food choices by increasing their knowledge, which may lead to more informed decision making (Neuhouser et al., 1999; Verbeke, 2008). We cannot make any statement on whether their information seeking will be ongoing, but health-conscious people are more likely to be interested in health matters in the long term (Dutta-Bergman, 2005). However, our results suggest that nutrition information is unlikely to stimulate all consumer groups equally, because they are more or less interested in nutrition themes. Additionally, different consumer segments use different channels to seek for information about nutrition. Depending on their interest in nutrition and their use of different communication channels, they might be more or less easy to achieve for nutrition education. However, more research is needed to identify channels that are primarily used by the risk groups, such as lower educated people, because they have most often less access to sources of information, might be less informed about healthy eating and more prone to develop health-damaging behaviour.

Life events are windows of opportunity for positive dietary change

In recent years, there has been growing interest in discrete life events and their influence on health behaviour. However, only a few transition studies that focus on life events of early family formation have been conducted on a population level. Therefore, we used a quantitative approach and a longitudinal design in a socio-demographically diverse adult

sample in order to test whether the birth of a child and moving in with a partner go along with changes in eating behaviour. Both life events are accompanied by a rapid change in a person's domestic environment, and may lead to eating behaviour adaptations.

The evidence from our study shows that in the transition to cohabitation, people are more likely to change their dietary behaviour. It is reasonable to assume that couples converge their eating patterns and dietary behaviour to some extent when starting their shared lives. However, only a few changes were observed in our study. A lot of food choices are still made alone, based on individual's preferences and food decisions, such as lunch at work or snacks between meals. The eating behaviour of one partner is therefore not a particularly good indicator for the eating behaviour of the other partner (Louk et al., 1999). Postulated positive effects of marriage or living together on eating behaviour from previous studies cannot be undermined by longitudinal evidence from our study, because both men's and women's food choices shifted in an unfavourable direction. Still, it cannot be ruled out that a more common eating pattern develops over time.

The transition to parenthood seems to be an additional period in which people are more likely to implement dietary changes. Our results pointed out that a transition to parenthood only positively influences women's dietary behaviours. In particular, women increased their vegetables intake, but no remarkable changes were observed in men. It might be that a higher vegetable intake in women is mainly attributable to weight loss attempts after pregnancy or an increased awareness of the importance of diet on health aspects. Due to a lack of dietary changes in men in our study, one might speculate that the nutrition of the child is especially important, but those of the male parent themselves is neglected.

One explanation for different study outcomes in previous research could be that the transition term is not clearly defined in the life-event research. Indeed, some researchers focused on time frames shortly before and after the life event (Feldman & Nash, 1984) while others used data from longer follow-up periods to estimate transitional changes (Lee et al., 2005). We examined eating behaviour shortly before and after the event, because we were interested in the transitional effects. Nevertheless, longitudinal research over a longer period of time is needed to examine whether observed transitional changes in food choices persist over time. Further studies should also consider other health behaviours, such as PA. Previous research found specific life-event changes in PA levels (Brown et al., 2009), but transitional life-event studies are scarce and the direction of change is unclear. Life events could be a potential starting point, not only for eating a more balanced diet, but also for being more physically active on a daily basis.

In conclusion, the birth of a child and the transition to cohabitation are associated with changes in eating behaviour, but the changes are small and previous cross-sectional studies might overestimate their effects. Nevertheless, people are more likely to implement behavioural changes when they experience transitional events, and nutrition counselling should take into account such special windows of opportunity for a change towards better food choices.

Autonomous goal setting for a healthy body weight predicts long-term health promoting behaviour

People strive for health goals based on different underlying motives. Rather than motivation itself, the quality of motivation might be an important determinant for sustainable health behaviour. Based on the SDT approach by Deci and Ryan (1985), we assessed different types of motivation for people's desire to maintain or achieve a healthy body weight. The different types of motivation regulation were: autonomous, introjected and external motivation regulation. We explored the predictive potential of different types of motivation on PA behaviour, food choices and BMI in a longitudinal study using data from the Swiss Food Panel.

Our results showed that autonomous goal setting for a healthy body weight was cross-sectionally and longitudinally associated with healthy food choices and PA. In particular, women increased their fruit and vegetable consumption and men decreased their meat consumption in the long term. Both men and women scoring high on autonomous motivation were more likely to stay vigorously physically active. In contrast, introjected regulation was neither cross-sectionally nor longitudinally associated with food choices. But women scoring high on introjected regulation were more likely to maintain vigorous physically active; furthermore, they had lower BMI values one year later even though they were classified as being in the normal weight range, and weight reduction was not indicated.

On the basis of our findings, promoting autonomous goal setting and self-determined action related to body weight management might be an effective strategy to support long-term adherence to a PA routine. However, autonomous motivation in our study was not associated with adopting PA. Previous weight-loss interventions showed that autonomous motivation is an important predictor for behaviour change and staying in the programme (Palmeira et al., 2007; Williams et al., 1996). Initiating permanent changes in exercise habits seems not to be predicted by autonomous motivation, at least on a population level. Other objective (e.g.

injury) and perceived (e.g. lack of time) barriers might hinder individuals in changing their behaviour in the first place (Brinthaupt et al., 2010).

Negative changes in food choices were only observed in participants scoring high on external regulation in our study. They decreased their vegetable intake (men), but increased the frequency of meat (men) and alcohol (women). Pressures by significant others, negative feedback, threats or the prospect of a reward are external motives to engage in a specific behaviour, but are not associated with positive long-term behaviour change. These relationships were shown for adopting a healthy diet (Patterson et al., 1996), weight loss efforts (Williams, et al., 1996) and exercise participation (Duncan et al., 2010). Dictating a desirable behaviour, for example, by a spouse or doctor is less likely to be successful at least in the long term, or might even lead to conscious rejection of the desired behaviour (e.g. refusing to diet). Negative feedback is thought to undermine autonomous motivation mediated by a decrease in perceived competence (Vallerand & Reid, 1984), but people's need for perceived competence and autonomy are thought to be essential for sustained behaviour change and well-being.

The SDT is also an encouraging approach to better understand eating styles and disorders. For instance, restrained eaters try to control their food intake for weight purposes. Their underlying motivation and perceived locus of behavioural control might be an important mediator in predicting successful weight regulation. For instance, a person who restrains their food intake for autonomous reasons might be less susceptible to breakdown (disinhibition) and feel more volition in their behaviour, compared to a person who restricts their food intake because they feel somehow obliged to regulate their weight based on body image concerns.

In summary, in our study, autonomous motivation for a healthy body weight predicts better food choices and vigorous PA maintenance in the long term. People have internalized a healthy body weight as their own health goal, which leads to self-determined action and persistence in associated behaviour (Deci & Ryan, 1987). Social-contextual factors can hinder the self-determined initiation of a sustained behaviour change, and is less effective in promoting health behaviour. Based on this, there is still potential to improve interventions and public health efforts by considering motivational tendencies in the target population. Additionally, it is still in question whether public health messaging can influence self-regulation and autonomous goal setting. People might perceive public health messages as controlling because of their commanding nature, which might lead to rejection or a lack of acceptance at all. An autonomy-promoting environment in public and in private seems to be promising with regard to sustained behaviour change.

High snack frequency can lead to higher fruit intake

The proportion of snacking has increased in Western society propelled by changes in lifestyle, working hours and time management strategies, and is promoted by the permanent availability of ready-to-eat food (Piernas & Popkin, 2010). Until now, no scientific consensus exists on whether eating more often prevents or promotes weight gain, or helps maintain weight in the long term (Bellisle, 2008). Results from previous research were inconclusive, and in the discussion about the health and weight effects of snacking, meaningful differences in certain eating-related parameters, such as overall dietary pattern, need to be considered.

Therefore, we examined associations between snack frequency, socio-demographic characteristics, BMI and eating behaviour. The entire study population was divided into three groups (tertiles) according to their reported snack frequency per week: high, moderate and low. A regression analysis revealed that a high snack frequency is not only associated with a higher consumption of sweet, high-fat foods, but also with a higher consumption of fruits. BMI was not associated with snack frequency. Furthermore, we investigated dietary patterns of high frequency snack consumers by conducting a cluster analysis with the different food groups as clustering variables. Three distinct groups with different underlying eating patterns were identified: healthy, moderate and unhealthy. High frequency snack consumers in the healthy group were characterized by a high consumption of fruits and vegetables, and a low consumption of sweet, high-fat foods, savouries and sugar-sweetened beverages. Moreover, people in this group indicated a higher eating-related health consciousness and ate breakfast more often, compared to high-frequency snack consumers in the unhealthy group. In contrast, high frequency snack consumers in the unhealthy group ate more sweet, high-fat foods and savouries, meat and convenience food. They were also more likely to be younger, they reported a higher frequency of main meals in front of the television and they were less physically active compared to the participants in the healthy group.

Snack frequency was not associated with BMI in our study and the overall dietary and lifestyle pattern seems to be more important than snack frequency alone. Thus, the results of our study do not support the notion that increased snack frequency, in itself, is a cause of obesity. Rather, our results are in line with those of Miller et al. (2013), who concluded that food choices are likely to be a stronger determinant of body weight than snacking or eating frequency (Miller et al., 2013).

Especially for weight management programmes and strategies, eating frequency became an important target behaviour, and frequent eating is thought to improve body weight control in some population subgroups (Drummond et al., 1996). On the one hand, snacking

might increase the likelihood of food consumption in a hunger state instead of food consumption initiated by predefined mealtimes. Therefore, higher eating frequency might help in following a diet regime through craving prevention and better appetite control. On the other hand, obese people might be prone to lose control over their eating volume once they started eating, and for such risk groups, a high snack frequency might be difficult to achieve without increasing energy intake at the same time. In general, in people with an unhealthy dietary style an increase in eating frequency goes along with more opportunities for unhealthy choices and therefore might increase energy intake. It still remains in question under which conditions or in which subgroups changes in snack frequency might be helpful for weight management. Long-term investigations could uncover whether changes in snack frequency are related to higher weight gain compared to a stable eating frequency, considering different dietary and lifestyle patterns.

In conclusion, our study further expanded previous research by showing that high snack frequency occurs in the context of both a healthy and an unhealthy lifestyle and eating pattern. Therefore, high frequency snack consumption should not be denounced as unhealthy behaviour without taking the whole eating pattern into consideration. People with a healthy dietary pattern are more likely to choose fruits as snacks, but instead of advising a special number of snacks in the public health domain, a healthy lifestyle and healthy food choices should be promoted. Nevertheless, young people especially need to be sensitised for the energy density of some commercial snack foods and made aware of healthy alternatives. To promote a healthy snack choice we still need to understand how people conceptualize snacks, and what attributes of a snack are the most important in the decision-making process, under different contextual factors. For instance, snack consumption at the workplace might have to fulfil other needs than snacks consumed at the train station or at home in terms of nutritional value, convenience or taste.

12.2 Barriers

Food neophobia restricts healthy food choices

Nowadays, food is more available and diverse than ever before, and achieving an adequate supply with all the essential nutrients never seemed easier in developed countries. However, food neophobia, which describes a psychological determined tendency to reject new foods, might hinder some individuals to profit from this diversity and restrict their food selection to a small range of familiar foods. The purpose of our study was to assess how food neophobia in a European adult population sample is related to socio-demographic variables, the liking of various foods as well as daily food choices and purchase behaviour.

The results were threefold. First, it was found that men, the elderly, people living in rural areas, and people with a low income are more neophobic. Indeed, all of these investigated socio-demographic variables impact on the exposure to food. A possible explanation could be that women are more exposed with a broader range of food items through cooking; that younger people today grew up with access to a more diverse food selection than those several years ago; that people living in an urban environment are more exposed to a higher cultural diversity and 'ethnic' foods; and that people with a higher income can afford a large variety of different food items and are not economically restricted in their food choices.

Second, in our study, food neophobia was linked to lower consumption frequencies and lower liking scores for vegetables. It was also associated with a lower consumption of fish and poultry, but a higher consumption of pork. These results show that neophobic tendencies are not associated with lower consumption in general, but they can have a negative impact on the consumption of foods that are an essential part of a balanced diet, such as vegetables. One might speculate that with a reduced food variety, affected people are not only less likely to achieve nutrient recommendations (Falciglia et al., 2000), but also they might experience their diet as monotonous, unpleasant, unpalatable or unsatisfying (Schnettler et al., 2013). Further research is needed to explicitly test these hypotheses in food neophobic adults.

Third, food neophobia was positively related to the importance of a Swiss origin of food products. Providing additional information about a product related to its taste, health benefit or origin might create some kind of familiarity with the product and therefore increase the likelihood of purchase and consumption. In launching new food products it seems worthy to consider possible neophobic tendencies in the target group, and depending on the target

group's age or attitude, different kinds of information might be necessary to initiate willingness to buy and taste the novel food.

It is assumed that creating familiarity or decreasing insecurity related to a new food through repeated exposure, or providing information about the product, can decrease food neophobia (Lähteenmäki & Arvola, 2001). But little is still known about factors that influence the willingness to try unknown foods in adults in particular settings. For instance, people might be more willing to try new foods in a familiar environment, such as their company's cafeteria, because they assume the products are safe. More research is also needed to examine what type of information about a product's attributes increases people's likelihood of purchasing them. Social interaction with peers might also have an effect on willingness to buy and consume a product, not only in youths but also in elderly people. In an ageing society, it might be worthwhile to focus on possible strategies to handle neophobic tendencies in elderly people. The elderly tend to be more neophobic, and several studies showed that insufficient energy and nutrient intakes occur more often among the elderly (Wylie et al., 1999). It might, therefore, be important to consider food neophobic tendencies, especially in the elderly, when new products are launched (e.g. functional foods) or dietary changes are required (e.g. higher nutrients density).

In conclusion, our results showed that food neophobia is a food habit that can restrict adult's food choice opportunities and might even hinder some individuals in making dietary changes. Providing information about the origin of a product seems to be important for food neophobic people and could create some kind of familiarity and trust in the product, and thus willingness to buy the food. Food preferences and acceptance of new foods are mainly shaped in childhood, and it seems especially important to inform parents how to handle naturally occurring neophobic behaviour in children.

Emotional eating leads to higher sweet, energy-rich food intake, but PA might help to prevent weight gain

Emotional eating can be defined as the tendency to eat in response to positive or negative emotions or distress. Research has shown that emotional eaters consume sweet, energy-rich foods to regulate their emotions. As a result, emotional eating was associated with overconsumption and weight gain in previous research (Koenders & van Strien, 2011), but its weight modifying effect is still questionable. It is possible that recreational PA helps to reduce stress, and that physically active emotional eaters eat fewer sweets and other energy-rich foods compared to their non-active counterparts. Therefore, we tested whether emotional

eaters who are physically active in their leisure time have lower body weight than emotional eaters who are not physically active.

As expected, we found that emotional eaters have a higher body weight and consume sweet, high-fat foods (e.g. chocolate, pastries) more often. The study further demonstrated that PA is not only associated with lower body weight in general, but also can help emotional eaters to control their weight. Indeed, emotional eaters who were physically active had lower BMI values compared to non-active emotional eaters. Therefore, PA should be encouraged in risk groups, such as emotional eaters, because of its weight-modulating effect. We did not find an association between PA in emotional eaters and reduced consumption of sweet, high-fat foods. High consumption of sweet, high-fat foods in emotional eaters seems disadvantageous in terms of weight management when a person is forced to stop exercising (or doing other activities) due to structural or personal changes (e.g. an injury). Prevention campaigns and interventions targeted at emotional eating should therefore focus on coping with temptations, such as sweets and energy-rich palatable foods, and should aim at pointing out new ways of dealing with negative emotions and distress.

In our study, the DEBQ was used to measure the tendency to eat because of negative emotions. No statement can be made regarding emotional eating in more specific situations (e.g.). Also, people differ in their affective response intensity on stimuli (Larsen & Diener, 1987). Thus, people who score high on the affect intensity dimension experience sadness and joy more intensely. This may not only influences what kind of food is consumed (Dubé et al., 2005), but also how much food will be consumed in states of emotional arousal. We did not measure portion sizes, but differences in intake volumes in stages of emotional arousal might be another factor that explains different observations in previous studies regarding weight development in emotional eaters.

Future studies could examine how eating styles are linked to personality traits, and if a persons' psychological profile plays a role in food behaviour in particular situations characterized by distress and negative emotions. A stressful life event could be such a situation that requires behavioural adaptions and might lead to unhealthy coping behaviour strategies in emotional eaters. In a study by van Strien et al. (1986), emotional eating and negative life events lead to BMI increases in men, but surprisingly not in women. A possible moderating effect of life events on the association between emotional eating and PA levels could be examined. In detail, emotional eaters who modulate their weight by being physically active might change their PA routine due to life-event specific needs for behavioural adaptions. Consequently, BMI increases over time. For weight gain prevention especially, it is

important to identify windows of vulnerability in a persons' life that are associated with higher risks for weight gain. Experienced life events could be such timeframes for emotional eaters, and further research is needed to test this hypothesis.

In summary, emotional eating is disadvantageous because it is related to the consumption of sweet, high-fat foods, which can lead to weight gain over time. Emotional eaters use food to cope with emotions, but it might also impede the learning of effective strategies to cope with those emotions. Recreational PA could be a starting point for individuals who are prone to eating when emotionally distressed, because PA makes an important contribution to weight gain prevention, especially in risk groups such as emotional eaters, and might also help them to cope with emotional stress.

13 Methodological issues

For the studies described in this dissertation, we used a large, randomized population sample. The sample was diverse in terms of age and socio-demographic characteristics, and a high generalizability of the reported results is given. However, some methodological issues need to be considered when interpreting the results. The most important limitation in some of the studies presented is their cross-sectional design, which precluded conclusions about causality or direction of change. In the longitudinal studies, a linear relationship was assumed; however, some relationships could be non-linear. In addition to that, the assessment methods related to self-reports of food intake and anthropometric measures that are commonly applied in surveys are also prone to misreporting.

Dietary assessment. Assessing dietary pattern in big samples is a challenging task. The Swiss Food Panel questionnaire included a newly developed FFQ that allows is to assess the usual consumption frequencies of different food groups within the previous year. A lot of prospective cohort studies such as the EPIC study (Ocke et al., 1997) or the Nurses Health Study (Willett et al., 1985) used an FFQ as a measure of choice even though the application of FFQs in research, especially epidemiological research, is controversially discussed (Kristal et al., 2005; Kristal & Potter, 2006; Willett & Hu, 2006), and new more sophisticated methods are suggested (Kristal, et al., 2005). The research questions in the present thesis are not dependent on precise estimates of actual nutrient or energy intake to predict illness prevalence, but depend on food choices related to key components of dietary pattern. Thus, a more simplified FFQ version is appropriate. The participants' burden is comparatively lower, but good memory power and compliance is still essential. There is also a risk that participants may disproportionally consider their actual eating pattern, which can be unrepresentative of the last year's pattern. Reversed causality can be a consequence, mainly caused by overweight or obese people who intended to lose weight and recently changed their eating behaviour (Bellisle et al., 1997). Another confounder of dietary assessments in general, which is not restricted to FFQs, is related to conscious or unconscious under- or over-reporting of consumption that can substantially influence study results. For example, observed negative relationships between BMI and eating frequency in cross-sectional studies disappeared after under-reporters were excluded from the analysis (Kant & Graubard, 2006). Obese people especially frequently underreported consumption (Goris et al., 2000). Based on a literature

review, Maurer et al. (2006) postulated nine factors that influence energy misreporting. These are demographics (e.g. age, gender), diet (e.g. macronutrient intake), eating behaviour (restrained eating), social desirability, diet/weight history, body image, psychology (e.g. depression), life status (socio-economic status) and PA (Maurer et al., 2006). Some of these factors might also have played a role in reporting food consumption frequency in the present study and should be considered in interpreting results.

Portion sizes in the Swiss Food Panel FFQ were not assessed, except for the fruit and vegetable intake. Especially with regard to consumption of food groups that are prone to excess intake such as sweets or alcohol, reports of portion sizes and number would deliver more differentiated information about possible weight effects. Some factors examined in the presented studies, such as longer meal duration through the presence of a partner, might also have an impact on intake volume.

In conclusion, underreporting and reverse causality seem to issues in studies using FFQs, and we cannot rule out that some participants might have under-reported or previously changed their consumption pattern. Still, for surveys, accuracy needs to be weighed against cost and effort, and FFQs are still a useful tool for surveys on a population level with different socio-demographic groups. Nevertheless, it is becoming increasingly common to combine approaches, such as repeated 24-hour dietary recalls or an FFQ (Carroll et al., 2012), provided by new promising web tools (Subar et al., 2012), and it is worth considering an application of new methods in food choice behaviour research.

Anthropometric self-reports. Weight and high measures were self-reported in the Swiss Food Panel questionnaire and might be less accurate than standardized measures, of course. Men were reported to overestimate their height and women to underestimate their weight (Connor Gorber et al., 2007). In contrast, in a study conducted in Switzerland, height overestimation occurred in women, but not men (Faeh et al., 2008). An association with age was also postulated with weight underreporting in the younger, and height over-reporting in the older (Faeh, et al., 2008). Studies that aimed to detecting misreporting are inconclusive, and characteristics of subgroups, such as age, obesity status and sex, predict differences in self-reported and objectively measured data (Faeh, et al., 2008). Even though this might lead to BMI misclassification in some people and may underestimate overweight prevalence, self-reports are inevitably in a lot of quantitative studies. We need to work out if correction factors for misreporting (Connor Gorber, et al., 2007) or if more detailed instructions for self-

measure, as has been shown for parents (Huybrechts et al., 2014), lead to better predictions in some population groups.

Body Mass Index. The BMI is regarded as an acceptable measure for body fat mass and was shown to highly correlate with the percentage of body fat (Spiegelman et al., 1992). Even though the BMI might assess body fat mass imprecisely on an individual level or in especially high or low BMI ranges, it is still an acceptable measure to characterize body fat and possible adverse health effects on a population level (Willett et al., 1999). The BMI is not capable of differentiating between weight associated with fat and weight associated with muscles or between a peripheral (gynoid) or central (abdominal) body fat allocation, even though the latter is associated with higher health risks (Wiklund et al., 2008). People with a high body weight based on a high muscle mass can be falsely classified as overweight according to BMI values. However, to date, the BMI is commonly used as an anthropometric measure for overweight-related health risks in studies on population levels and large sample sizes.

Physical activity assessment. Measuring PA is difficult since it is a complex behaviour differing in type, duration, intensity and frequency, which can be performed in different domains (e.g. work, recreational). There are many ways to measure PA directly (e.g. motion detector, direct observation, PA record) and indirectly (e.g. oxygen uptake, heart rate, questionnaires) with focus on the behavioural or the energy expenditure side while questionnaires are the most frequently used instrument (Martin et al., 2009). In the Swiss Food Panel, the GPAQv2 was used to estimate the usual PA levels in three different settings: activity at work, travel to and from places, and recreational activity. Within the work and recreational domains, information on intensity[1], duration[2] and frequency[3] were self-reported. The GPAQ was designed by the WHO as an interview manual for PA surveillance in developing countries (Global Physical Activity Questionnaire Analysis Guide, 2014; Armstrong & Bull, 2006). The GPAQ is an advancement of the International Physical Activity Questionnaire (IPAQ), which, in its long form, was too complex, and its short form did not differentiate enough between the domains of PA. A reliability and validity study, based on nine countries, showed that the GPAQ is an acceptable instrument for PA activity surveillance on a population level(Bull et al., 2009) . However, data from only one European

[1] How much work is being performed or the magnitude of the effort required to perform an exercise or activity.
[2] The length of time in which an exercise or activity is performed.
[3] The number of times an exercise or activity is performed.

country (i.e. Portugal) was included in the study. While the IPAQ is already validated in a Swiss adult sample (Mäder et al., 2006), a validation of the GPAQ in Switzerland and other European countries is still required.

Additionally, social desirability, which indicates a person's tendency to present themselves in a manner that is perceived as congruent with the cultural norms, is a possible bias in subjective measures in general, but also in PA assessments that might lead to the over-reporting of PA and the overestimation of energy expenditure (Adams et al., 2005). Another potential factor on PA levels, whose impact is not well established, is seasonal variation. People might be more physically active in summer compared to winter especially in regions with strong variations in weather conditions and temperature. Only one study from Brazil was found that compared IPAQ data assessed in summer and winter (Bressan et al., 2012). The study revealed that an additional 10% of the study population was not physically active during winter, which resulted in almost 50% of participants in the sample being inactive (Bressan, et al., 2012). The impact of such seasonal variations on study results based on data gathered on a population level is questionable and difficult to uncover; however, the variations should be considered in interpreting the study results.

In summary, the GPAQ, developed as standardized PA surveillance tool for different population groups and countries, is relatively easy to administer and is comparatively inexpensive, plus its application in the Swiss Food Panel allows us to assess activity in a living context. Even though the GPAQ is valid in different countries, its validation as a pencil-and-paper questionnaire in an adult sample in Switzerland is required and is currently being utilized in cooperation with the University of Zurich.

14 General conclusion - the choices is yours, isn't it?

In this dissertation, different drivers and barriers related to food choices were acknowledged. In detail, factors associated with individual psychological conditions, personal food skills and with different eating context that promote or prevent healthy food choices were identified.

One might be tempted to say that eating a balanced diet and being physically active are only a question of priority, and the final decision to consume a particular food or be a coach potato is still an individual's choice. However, many food decisions are habitual, subconscious, and influenced by environmental factors. The example of food neophobia elucidates that psychological barriers can influence diet quality and might even hinder some people in making dietary changes. It shows the parents' immense influence on a child's eating behaviour development and that restricted access to food diversity, for instance, in areas of social deprivation or low-income families, potentially influences a child's food behaviour until adulthood. Parental influences on the establishment of food behaviour also find expression in the transmission of basic food skills at home (Lyon et al., 2011). We found, in particular, that the decline in cooking skills in the younger generation (20–39 years) was associated with unhealthier food choices. Cooking skills are an important part of a persons' food skills pool, which increases food choice opportunities without restricting them to ready-prepared food. The development of cooking skills should start as early as childhood, and cooking courses at school might be an exceptionally good channel to reach children across different socio-demographic groups.

The foundation of an adult's eating behaviour is rooted in their childhood, and people develop eating habits and food skills that persist until adulthood. A person's eating behaviour is not only characterized by stability and continuity, but also it is characterized by transition and changes. Timeframes in a person's life course that are associated with increased flexibility to change behaviour are scarce. However, we have identified two life events – namely, the birth of a child and moving in with a partner – that mark timeframes in which people are more likely to change their behaviour. They are special windows of opportunity that should be used to implement healthier habits into a daily routine. Conversely, people might also experience very stressful life stage transitions. People who have developed an eating style that is easily influenced by distress and emotional arousal might not be able to handle different life situations and living circumstances without reflexion on their eating behaviour. They are prone to lose control over their food intake followed by negative weight

effects (e.g. weight gain, weight cycling). Our results showed that increased levels of PA make an important contribution to weight gain prevention in such risk groups as emotional eaters, which might go beyond its energy-modulating effect. PA was reported as an effective strategy to regulate mood (Yeung, 1996), which might help the emotional eater to cope with emotional distress. Strategies to overcome the "super barriers" for PA in the life situation, that is, lack of time and lack of enjoyment (Brinthaupt, et al., 2010), should be directed towards such groups at a higher risk for overweight and obesity. Additionally, since our environment promotes low PA levels – not least because of structural aspects of the built environment, such as walkability or access to sport facilities – a PA friendly environment should be created, which might encourage people to be active even if they do not consciously intend to be so (Bauman et al., 2012).

Next to the external barriers for PA engagement, different psychosocial factors are involved in exercise and related weight management behavior. Our study highlighted the fact that autonomous motivation for a healthy body weight is a potential driver for long-term adherence to exercise participation and healthy food choices. In contrast, we found people who strive for a healthy body weight, because they feel obliged through external incentives, such as pressure by significant others, are less likely to behave in a healthier way in the long term. Rather than dictate the 'right' way to behave in a healthier way, a person's perceived autonomy and competence need to be strengthened. Therefore, an autonomy-promoting environment both in public and in private seems to be an important requirement to sustain behaviour change.

In summary, different drivers and barriers that promote or prevent healthy food choices were identified in the different studies presented. Research into effective public health strategies is warranted, since our results show that a 'one size fits it all' approach to health promotion and nutrition education might not be effective to satisfy each target group's specific needs. The results in this thesis expand our knowledge in the rather broad field of eating behaviour and partially explain why some people have difficulty in changing their diet-related health behaviour while others are more successful. It also shows that a lot of factors relating to an individual and their environment shape their choices, and not all of them can easily be changed by intention. The choice is yours, but your choice depends on your options and is shaped by different drivers and barriers.

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Summary

In the present dissertation, different drivers and barriers to healthy food choices have been investigated. The studies are based on the Swiss Food Panel data (2010-2013). The Swiss Food Panel is a longitudinal study about eating behaviour and physical activity behaviour in a Swiss adult sample (>6000 participants).

Different drivers for healthy food choices were identified. First, people who are able to cook have higher vegetable and lower convenience food consumption. Cooking enjoyment is the most important predictor for cooking skills in men and women. Second, even though nutrition education is unlikely to stimulate all consumer groups equally, it was found to be associated with healthy food choices in some consumer groups. Dependent on their interest in nutrition, different consumer groups use different communication channels for nutrition information. Third, two life events were identified, which are potential windows of opportunity to change towards better food choices; namely, the birth of a child and the transition to cohabitation. People are more likely to implement behavioural changes when they experience life-stage changes. Fourth, autonomous motivation for a healthy body weight predicts better food choices and exercise participation in the long term. People who have internalized a healthy body weight as their own health goal, act in a more self-determined way and show persistence in their associated health behaviour. Fifth, high snack frequency occurs in the context of both a healthy and an unhealthy lifestyle and eating pattern. People with a healthy dietary pattern are more likely to choose fruits as snacks, which can contribute to an adequate fruit intake over the day. Different barriers to healthy food choices were identified. First, food neophobia can restrict adult food choice opportunities and might even hinder some individuals in making dietary changes. Second, emotional eating is disadvantageous because it is related to the consumption of sweet, high-fat foods, which can lead to weight gain over time. However, physical activity makes an important contribution to weight gain prevention in emotional eaters.

The presented studies underline the importance of individual psychological conditions, various factors associated with the eating context and factors related to food skills as potential drivers and barriers to healthy food choices. It also shows that a lot of factors within an individual and in the environment shape the choice, and not all of them are easily to change just by intention.

Zusammenfassung

In der vorliegenden Dissertation wurden verschiedene Einflussfaktoren auf das Ess- und Bewegungsverhalten untersucht. Die verschiedenen Querschnitt- und Längsschnittstudien, die dieser Arbeit zugrunde liegen, basieren auf den Daten des Ernährungspanels Schweiz (2010-2015). Das Ernährungspanel Schweiz ist eine wissenschaftliche Langzeitstudie über das Ess- und Bewegungsverhalten einer Schweizer Stichprobe von Erwachsenen (>6000 Teilnehmer in 2010).

Es wurden Faktoren identifiziert, welche die Lebensmittelwahl positiv beeinflussen können. Erstens, das Vorhandensein von Kochfähigkeiten führt zu einem signifikant höheren Verzehr von Gemüse und einem geringeren Verzehr von Convenienceprodukten. Die Freude am Kochen ist dabei der wichtigste Prädiktor für das Vorhandensein von Kochfertigkeiten. Zweitens, Ernährungsinformationen können einen positiven Effekt auf die Lebensmittelwahl haben. Es ist aber unwahrscheinlich, dass alle Konsumentengruppen über den gleichen Kommunikationskanal (Bsp. Broschüren) erreicht werden können. Verschiedene Konsumentengruppen profitieren von verschiedenen Kommunikationskanälen zur Verbreitung von Ernährungsinformation. Drittens, Lebensereignisse wie die Geburt des ersten Kindes und das Zusammenziehen mit dem Partner, gehen mit einer erhöhten Wahrscheinlichkeit einher, dass Personen ihre Ernährungsweise adaptieren. Dabei können sich in Abhängigkeit von der Art des Lebensereignisses, Veränderungen sowohl in Richtung einer vollwertigeren als auch einer unausgewogeneren Ernährungsweise ergeben. Viertens, autonome Motivation für ein gesundes Körpergewicht geht mit einer langfristig gesünderen Lebensmittelwahl und andauernder sportlicher Freizeitbetätigung einher. Personen, die ein gesundes Körpergewicht als ihr eigenes Gesundheitsziel definiert haben, zeigen grössere Persistenz in ihrem ernährungsassoziierten Gesundheitsverhalten. Fünftens, entgegen der weitläufigen Meinung, ein häufiger Snackverzehr sei negativ zu bewerten, tritt Snackkonsum sowohl im Rahmen einer gesunden als auch einer eher ungesunden Ernährungsweise auf. Personen mit einer gesunden Ernährungsweise wählen eher Früchte als Snack was zu einer adäquaten Obstzufuhr beitragen kann.

Zudem wurden in der vorliegenden Arbeit verschiedene Faktoren ermittelt, die eine gesunde Lebensmittelwahl erschweren. Erstens, Lebensmittelneophobie kann auf Grund der damit einhergehenden Skepsis gegenüber neuen, unbekannten Lebensmitteln, die Lebensmittelvarietät von Erwachsenen stark einschränken und darüberhinaus verhindern, dass

Personen ihre Ernährungsweise umstellen. Zweitens, ein emotionaler Essstil kann zu einem erhöhten Verzehr von süssen und fetthaltigen Lebensmitteln führen und damit Gewichtsanstieg begünstigen. Allerdings konnte gezeigt werden, dass sportliche Aktivität einen positiv-regulatorischen Effekt auf die Gewichtsentwicklung von emotionalen Essern ausüben kann.

Psychologische Faktoren, Einflüsse des Esskontexts, als auch mit Ernährungskompetenzen assoziierte Faktoren, können eine gesunde Lebensmittelwahl fördern oder erschweren. Die Ergebnisse der vorliegenden Dissertation verdeutlichen, dass sowohl Faktoren innerhalb als auch ausserhalb des Individuums einen Einfluss auf die Lebensmittelwahl ausüben und nicht alle willentlich einfach beeinflussbar sind.

Danksagung

Ohne die Unterstützung zahlreicher Menschen wäre die Realisierung dieser Dissertation nicht möglich gewesen.

Als erstes möchte ich mich bei Prof. Dr. Michael Siegrist bedanken für seine andauernde Unterstützung und die Entwicklungsmöglichkeiten, die er mir geboten hat. Ich hatte immer viel Freude mit ihm zusammen zu arbeiten und habe viel von ihm gelernt. Ebenso gilt mein besonderer Dank Dr. Simone Dohle, auf die ich mich immer verlassen konnte, die mir Feedback und Rat gegeben hat, wenn es nötig war, und die für die Überwindung allenfalls auftretender „PhD-Krankheiten“ fortwährend die passende Medizin in petto hatte.

Prof. Dr. Christine Brombach und Dr. Klazine van der Horst möchte ich dafür danken, dass sie sich bereit erklärt haben Teil meines Prüfungskomitees zu sein. Ich danke Dr. Klazine van der Horst für ihre Unterstützung in den ersten Monaten meines PhDs. Zudem wäre ohne ihre gute Vorarbeit das Ernährungspanel sicherlich nur halb so erfolgreich gewesen.

Ein grosser Dank geht auch an meine tollen KollegeInnen bei der Gruppe Consumer Behavior. Im Speziellen an mein ehemaliges „Bürogspänli“ Signe Wächter, Angela Bearth und Angelina Gmür, mit denen ich viel, geradezu unanständig viel, Freude im Büro hatte, die für jeden Spass zu haben sind und mit denen man Pferde stehlen kann.

Für die finanzielle Unterstützung des Projektes und die angenehme Zusammenarbeit danke ich dem Bundesamt für Gesundheit sowie den fleissigen Ernährungspanel Teilnehmern, ohne deren Zeitopfer keine tausende von ausgefüllten Fragebögen bereit gestanden hätten.

Von ganzem Herzen danke ich all meinen Freunden, vor allem meinen beiden engsten, Kerstin Hoch und Sabrina Beck, für ihre aufmunternden Worte in schwierigen Zeiten, für ihr Verständnis für meinen andauernden Zeitmangel und dafür, dass sie einfach da sind, wenn man sie braucht.

Und nicht zuletzt danke ich meiner Familie ohne deren Unterstützung über all die Jahre meiner Ausbildung hinweg ich vermutlich niemals so weit gekommen wäre. Meine Eltern haben mich immer motiviert meinen eigenen Weg zu gehen, und dafür bin ich ihnen zutiefst dankbar.

Curriculum Vitae

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