YOUTH OVERWEIGHT IN DENMARK:

Prevalence, Ethnicity and Other Risk Factors

by

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Abstract

Background: Youth overweight is a growing problem in Denmark, and previous European studies point to immigrant populations as having a particular risk. The prevalence of overweight among immigrants and their children varies vastly depending on place of origin, country of destination as well as behavioural and cultural characteristics.

Objective: To evaluate the association between ethnicity and overweight among Danish 9th graders, as well as to analyze behavioural and attitude differences potentially related to the development of youth overweight.

Methods: Using three years of survey responses and anthropometric measurements from nine municipalities in the Danish School Preventative Health Care Program, odds ratios were calculated for overweight among different ethnicities. Multivariate logistic regression analysis and stratification were employed to control for confounders and investigate the pathways by which overweight develops differently among different ethnic groups. Mean BMI percentile-for-age values were compared using t-tests, ANOVA and Tukey tests.

Conclusions: In the crude analysis of prevalence, those most at risk for overweight were youth of Middle Eastern ethnicity (OR = 2.58, P = <0.001) and South Asian ethnicity (OR = 1.57, P = 0.04); youth of Central Asian (OR = 2.02, P = 0.07) and Eastern European (OR = 1.57, P = 0.13) ethnicity also had a higher risk of overweight compared to Danish, but these differences bordered statistical significance. When controlling for alcohol consumption, working status and perceived wellbeing, however, the importance of ethnicity was further highlighted: students of all non-Danish ethnicities were shown to be at higher risk of overweight. Finally, in the means comparison, youth of Middle Eastern were shown to have significantly higher BMI percentile-for-age than others (mean = 64.1 percentile).

Keywords: Overweight, Youth, Children, Immigration, Ethnicity, Denmark, Obesity

List of Abbreviations and Acronyms

BMI - Body Mass Index

CDC - United States Centers for Disease Control and Prevention

CI - 95% Confidence Interval

DF - Degrees of Freedom

DM - Difference in Means

HSD - Honestly Significant Difference

OR - Odds Ratio

POR - Prevalence Odds Ratio

SD - Standard Deviation

SES - Socioeconomic Status

US - United States of America

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1. Introduction

1.1. Background

The scale of the problem: Overweight and obesity among children is a growing problem in both developed and developing countries. Being overweight or obese as a child is associated with adult overweight (Whitaker, Wright, Pepe, Seidel, & Dietz, 1997), which is linked to long-term risks such as heart disease, high blood pressure, diabetes, decreased quality of life, premature illness and death (Herouvi, Karanasios, Karayianni, & Karavanaki, 2013) (Bozzola, Bozzola, Abela, & Amato, 2012) (De Onis, Blossner, & Borghi, 2010). In addition, childhood adiposity also entails short-term health consequences like Metabolic Syndrome, learning disorders, muscle and joint pain, asthma, allergies, headaches and decreased quality of life (Dannemann et al., 2011) (Noal et al., 2012) (Halfon, 2013). Evidence suggests that obese teenagers have significantly worse mental health than their non-obese counterparts, suffer more from depression and perform worse academically (Halfon, Larson, & Slusser, 2013) (Pulgaron, 2013).

Overweight and obesity in Denmark: The childhood obesity epedimic has taken on global dimensions, with alarming growth rates in many countries (Wang & Lobstein, 2006). From 1990 to 2010, the estimated prevalence of worldwide childhood obesity increased from 4% to 7% (Wang & Lobstein, 2006); these figures were nearly twice as high in developed countries (De Onis et al., 2010). In Denmark, the epidimic of childhood overweight and obesity began to take off mid-century (Andersen, Baker, & Sorensen, 2012; Dannemann et al., 2011) (Thomsen, Ekstrom, & Sorensen, 1999), with a marked increase taking place in the last 25 to 30 years (Due, Heitmann, & Sorensen, 2007). Currently, approximately one in four Danish schoolchildren are overweight (Coolidge & Krue, 2010).

Risk factors - Immigration: However, as in other countries, overweight and obesity in Denmark is likely not distributed evenly throughout the population. Children of immigrants are at a particular risk for becoming overweight. German and Austrian

studies show immigrant children as having nearly double the overweight prevalence of German children (Lange, Plachta-Danielzik, Landsberg, & Muller, 2010) (Kirchengast & Schober, 2006). Swiss Preschool-aged children of migrant parents have higher body fat and less healthy eating habits than their native peers (Ebenegger et al., 2011 2).

Risk factors - The early years: Why and how children of immigrant families develop overweight and obesity are complex questions. A mother´s "feeding style" (which appears to be conditioned by place of origin) at a young age might make a child predisposed towards obesity later in life (Tovar et al., 2012). Feeding style is related to unhealthy individual eating habits, which appear to begin at a very young age (Ebenegger et al., 2010). Some studies even suggest that prenatal stress can increase a child´s predisposition to obesity (Li et al., 2010).

Risk factors - The family: Among immigrants, a family´s place of origin (and not necessarily the particular child´s place of birth) is one of the most important conditioning factors in whether or not a child becomes overweight or obese (Miguel-Gil et al., 2012) (Weker, 2006). A German study demonstrated the vast differences between eating habits and nutritional intake based on place of origin (Kleiser, Mensink, Neuhauser, Schenk, & Kurth, 2010). Multiple studies have confirmed the different lifestyles and obesity / overweight prevalences of children based on ethnicity and parents´ place of origin, with some immigrant children exhibiting far lower prevalences of overweight and obesity than native counterparts (Popkin & Udry, 1998) (Tzotzas et al., 2011). In the latter case, time in country often erases any protective effect that certain places of origin may have provided, affecting both diet and activity (Strickman-Stein et al., 2010) (Shi, van Meijgaard, & Simon, 2012).

Risk factors - Culture and Socioeconomic Status: In addition to the family environment, geography, culture and socioeconomic status play an important role in a child´s eating and exercise habits. Neighborhood characteristics, such as the availability of healthy food and the density of cars, are associated with children´s weight status (Lange et al., 2010) (Van Hook & Baker, 2010). Social class has been

demonstrated to be associated with obesity in various studies, both among immigrants and native populations (Buemann, Tremblay, & Bouchard, 1995) (Van Hook & Balistreri, 2007) (Buttenheim, Pebley, Hsih, Chung, & Goldman, 2013). In a US study on Hispanic immigrants, parental education and income were both negatively associated with BMI (Body Mass Index) in children (Balistreri & Van Hook, 2009). Some studies suggest that socioeconomic factors trump immigration in determining the likelihood of overweight (Kaushal, 2009).

Challenges in addressing the problem: Childhood obesity poses special risks for immigrant populations for three reasons. First, it is less likely to be noticed or taken seriously since the perception of obesity may be different among children of immigrants. In an Italian study, children of immigrant mothers had higher perceived "ideal" body weights and lower perceived perceptions of their own body weight (Gualdi-Russo et al., 2012). Second, social factors may prevent the implementation of effective preventative and reduction measures for overweight. In a family treatment program for childhood obesity in Copenhagen, the treatment was less effective in immigrant families and immigrants also had a higher dropout rate (Gronbaek, Madsen, & Michaelsen, 2009). Third, the physiological consequences of childhood obesity may be more severe for the children of immigrants. A Norwegian study showed that severely obese immigrants of Pakistani, Tamil and Turkish backgrounds had a greater predisposition to develop Metabolic Syndrome than severely obese Norwegian children (Kolsgaard et al., 2008). These results are further reinforced by a 2011 German study demonstrating that Turkish overweight children had a higher likelihood of developing Metabolic Syndrome than their overweight German counterparts (Dannemann et al., 2011). Since Turkey is the largest representative country of origin among immigrants in Denmark, these results are particularly relevant to this case (Nusche, Wurzburg, & Naughton, 2010).

1.2. Study Objective, Hypothesis and Importance

Objective: This study investigates the relationship between ethnicity and health among youth. The main research question is simple: which youth ethnic groups are

at greatest risk for overweight? The aim of this study, therefore, is two-fold: (1) evaluate the prevalence of overweight and obesity among Danish schoolchildren of different family places of origin, using language as a proxy for parents´ place of origin; and (2) assess the known risk factors for obesity (exercise, type of transportation to school, eating habits) as well as other factors of possible interest (perception of health, recent health problems, etc.) among these children in order to clarify the pathways by which overweight and obesity develop differently in populations.

Overview: Data was collected on nearly 10,000 students over the course of three years. A multivariate logistic regression model was used to analyze the importance of family place of origin and adjust for confounding factors. Finally mean BMI percentile-for-age values were compared among ethnicities.

Hypothesis: Since a family´s place of origin is associated with differing prevalences of overweight in other European studies, it should be expected that significant associations between these same places of origin and overweight would be found in Danish children.

Importance: This study contributes to a growing body of literature on immigration, overweight and child health in several ways: (1) it is larger in scope than most similar studies (9,622 students), (2) it takes into account a variety of health-related variables which many studies ignore, (3) the questionnaire response rate on behaviour and attitudes is exceptionally high (>90% for all three years) and (4) it contains a large number of sub-groups of different places of origin, which allows for the refining of the simplistic immigrant / non-immigrant paradigm.

2. Methods and Procedures

2.1. Setting and Data Collection

Under the auspices of Danish School Preventative Health Care Program (Lov om Forebyggende Sundhedsordninger for Born og Unge), data was collected from ninth grade students in three consecutive school years (2009/10 - 2011/12) using a standardised questionnaire. Between seven and nine municipalities participated each year:

Table 1: Municipalities participating in the study

Year	Participating Municipalities
2009/10	Albertslund, Faaborg - Midtfyn, Gladsaxe, Herlev, Helsingør, Lygby - Tårbæk, Rudersdal (and Ishøj, but only for BMI collection)
2010/11	Albertslund, Faaborg - Midtfyn, Gladsaxe, Herlev, Herning, Hørsholm, Ishøj, Lyngby - Tårbæk, Rudersdal
2011/12	Albertslund, Gladsaxe, Herlev, Herning, Hørsholm, Ishøj, Lyngby - Tårbæk,Rudersdal

The information from the questionnaire was supplemented by a medical examination for height and weight.

In some municipalities (Albertslund, Herlev and Lyngby - Tårbæk), students completed the questionnaire during the consultation, before the medical examination with the doctor (meaning that answers may not have been entirely anonymous), whereas in other municipalities (Gladsaxe, Herning, Hørsholm, Guildford and Rudersdal), information was submitted by the student in an anonymous questionnaire. In all cases, no information was collected that could be used for posterior identification of students. Information collected for the project belongs to the individual municipalities of the schools in question; all municipalities gave permission for the use of this data for this project.

Response rates for the questionnaire varied between 90% and 94%. Reasons for exclusion included a student´s absence, refusal to participate, or unclear data entry (Herner, Coolidge, & Keiser-Nielsen, 2012).

The questionnaire (viewable at www.skolsundhed.dk) contains questions pertaining to school welfare, perceived health, eating and exercise habits, type of transportation to school, employment, the language spoken at home and passive and active exposure to drugs (alcohol, hash, tobacco). The doctors who carried out the medical examination collected information on certain medical conditions as well as height and weight, allowing for the calculation of Body Mass Index and Body Mass Index Percentile-for-Age. Data was uploaded by data collectors to the Skolesundhed central database, from which data was later downloaded for this study.

The variables analyzed for this study were only those which a literature review revealed would be of relevance to the question of overweight and obesity: BMI, sex, family´s place of origin (as indicated by the proxy of the language spoken at home), drinking status, breakfast and lunch frequency, perception of school, kind of transportation to school, exercise frequency, perceived wellbeing, reported recent health problems, perception of health, and employment status.

2.1.1. Theoretical Framework and Language

Since information on students´ families´ immigration history was unavailable, this study treats the question of immigration tangentially through the lens of ethnicity. "Ethnicity," "family place of origin," and "language spoken at home" are used interchangeably despite the obvious differences in their normal use (see "Definition of Variables"). Furthermore, references to ethnicity and origin in this study ignore legal questions like that of citizenship; in the jargon of this paper, "Danish" children are simply those who speak only Danish at home and "Middle Eastern" children are those who speak Middle Eastern languages at home. It is recognized that many children of Danish nationality speak other languages at home and that children of non-Danish nationality may speak only Danish at home. It is also recognized that "ethnicity" does not align neatly with broad regional groups.

Nonetheless, language spoken at home is the best measure by which to gauge family place of origin in this particular data-set. It is a rough and problematic proxy

for family place of origin for two reasons: (1) immigrant families may choose to adopt the destination language (Danish) and (2) certain languages do not clearly reflect a specific region. For example, an English-speaking household could be from Singapore, Nigeria, Canada or any other of the 88 states where English is an official language. The above classification system seeks to avoid inaccuracy by basing the assignations on known immigration trends, though even doing this inevitably hides important groups such as Spanish-speaking Latin Americans, French and English-speaking Africans, etc.

Furthermore, the case of multilingualism complicates the classification system. In the case of multilingual households (of which there were 185), a household with any non-Western language spoken was classified as such. For example, a student at whose home English and Urdu are spoken would be classified as Urdu; likewise, a student at whose home Burmese and French were both spoken would be classified as Burmese.

By the same token, multilingual households in which Danish was spoken alongside another language (Western or non-Western) were classified according to the non-Danish language. Even though this might underestimate Danish in *some* cases, it is more probable that a multilingual household in which Danish and another language are spoken is constituted by one or even two immigrant parents (who may at times speak Danish) than by two Danish parents (who may at times speak a second language at home). Conceptually, this study treats non-Danish culture as an epidemiological "exposure" variable; though the "dose" might be less in a multilingual home, the exposure is still evident and therefore overrides the "non-exposure" (Danish language).

2.2. Definition of Variables

2.2.1. Study Variable

Family place of origin or **ethnicity**, as discussed, was devised using a rough proxy: language spoken at home. The latter was originally reported by individual language groups, of which there were 79. Initially, "corrections" were made for suspected spelling and coding mistakes, but in the case of a clear geographical area (speaking "Pakistani," for example) mistakes in the nomenclature of a language were left in place. Languages were then grouped regionally using the following rubric:

Table 2: Language classification by region

Language Spoken at Home	Languages included
Danish	Danish, Feroe, "Greenland," "Sealand" (4)
Middle Eastern	Arabic, Berber, Hebrew, Kurdish, Turkish (5)
West European	Dutch, English, Finnish, French, Gallician, German, Greek, Icelandic, Italian, Norwegian, Portuguese, Spanish, Swedish, Swiss(14)
East European	Albanian, Bosnian, Bulgarian, Chechnyan, Croatian, Estonian, Hungarian, Lithuanian, Montenegro, Polish, Romanian, Russian, Serbian, Ukranian (14)
Central Asia	"Afghani," Dari, Farsi, Pashto (4)
East Asia	Burmese, Cantonese, Chinese, Filipino, Indonesian, Japanese, Khmer, Malay, Tagalog, Thai, Vienamese (11)
South Asia	Hindi, "Indian," "Pakistani," Punjabi, Tamil, Urdu (6)
Africa	"African," "Eritrean," "Ethiopian," "Ghanean," Kinarwanda, Kiswahili, Lozi, Luganda, "Senegalese," Somali, Tigrinya, "Ugandan," Zuzu (13)
Other (excluded)	Creole, Masto, Regg, Scrhokratisk, Sign Language, Syg, Urlo (7)

Unidentifiable, unclassifiable or unclear entries ("other") were excluded from analysis.

2.2.2. Outcome Variable

Anthropometry: The outcome of "weight status" was assessed using height and weight to calculate the Body Mass Index. BMI, being the main outcome variable of interest, was calculated using the standard formula:

$$\text{BMI} = \text{weight (in kilograms)} / [\text{height (in meters)} * \text{height (in meters)}]$$

Since data was being used only on the national scale (within Denmark, not for

international comparison), the cut-offs for normal, overweight and obesity followed the United States Centers for Disease Control and Prevention (CDC) guidelines. Unless noted otherwise, all analysis combined overweight and obese into one category ("overweight"):

Normal = BMI for age < 85th percentile
Overweight = 85th percentile < BMI for age < 95th percentile
↑ Obese = BMI for age > 95th percentile

Age was only reported in a yearly format, and access to more specific data was unavailable. Accordingly, for the calculation of percentile-for-age values (which are monthly), all ages took on the form of A + 6.5 months, where A is the students age given in whole years. For example, a 15 year-old´s BMI percentile-for-age percentile was calculated using the figure of 186.5 months (approximately 15 years, 6.5 months).

Following the calculation of individual BMI for each student for whom data was available, corresponding median (M), generalized coefficient of variation (S) and Box-Cox transformation values (L) were assigned using the CDC´s guidelines (Flegal & Cole, 2013). Z-scores were calculated using the following formula:

$$Z = (((X/M)^{**}L) - 1) / LS$$

Finally, individual Z-scores were converted to percentile using the standard normal distribution equivalencies.

Cole´s cut-off values were also calculated and compared to the CDC values (Cole, Bellizzi, Flegal, & Dietz, 2000) (Appendix 7.7). The values are slightly different in that Cole´s cut-offs produced less obese and more overweight classifications. These differences can be expected, given that Cole´s values are based on international data screened for “healthy” mothers only. In any case, in the binary analysis of normal/overweight, the results were similar (K. M. Flegal & Ogden, 2011).

2.2.3. Other Variables of Interest

Sex is a binary category of male or female, as reported in the data.

Drinking status is derived from a question regarding how many times the student had been drunk in the last month. For analysis, it was simplified to “not drunk in the last month” (zero times) and “drunk in the last month” (one or more times).

Meal Frequency (breakfast and lunch) was coded as “frequently” if the student ate the meal in question either “3 to 4 times per week” or “daily.” It was coded as “infrequently” if the student reported eating said meal “1 to 2 times per week,” “rarely,” or “never.” The reason for choosing to classify 3-4 weekly meals as "frequent" was simply to highlight students who skip meals most of the time.

Perception of School and **Perception of Health** were classified as “good” if the student considered school and their personal health as “very good,” “good,” or “somewhat good.” In the case of a “bad” or “very bad” response, the binary classification was “bad.” The words "positive" and "negative" are used interchangeably with "good" and "bad" (respectively).

Transportation to School was simplified into two kinds, those that involve exercise (bicycle, walking, skates/skateboard) and those that do not involve exercise (train, bus, car, other).

Exercise Frequency was coded as as “frequent” if the student exercised either “daily” or “3 to 4 times weekly” or “infrequent” if the student exercised “1 to 2 times weekly,” “rarely” or “never.”

Perceived Wellbeing referred to whether a student considered himself or herself to be happy (“very happy” or “good enough”) or unhappy (“not very happy” or “not happy at all”). The words "positive" and "negative" are used interhcangeably with "happy" and "unhappy" (respectively).

A student was coded for having **Health Problems in the Last Two Weeks** if he or she reported having experienced any one or more of the following in the previous fourteen days: headache, mood swings, stomach-ache, back pain, sleeping problems or other pain.

Working Status is based on a question regarding workly weeking hours. Students who reported any number of weekly working hours were classified as "workers" whereas as those who did not were classified as "nonworkers."

2.3. Overview of Data

Table 3: Summary of data (all students)

Characteristic	Absolute Frequency	Relative Frequency
Weight Status		
Normal	4764	84.14
Overweight	898	15.86
Language Spoken at Home		
Danish	8245	85.9
Middle Eastern	448	4.67
West European	453	4.72
East European	111	1.16
Central Asian	77	0.8
East Asian	67	0.70
South Asian	159	1.66
African	32	0.33
Other	7	0.01
Health problems in last 2 weeks		
Yes	7633	82.69
No	1598	17.31
Drunk in Last Month		
No	2412	40.17
Yes	3593	59.83
Perception of health		
Good	9255	98.1
Bad	179	1.9
Perception of School		
Good	8902	94.66
Bad	502	5.34

Sex		
Male	4839	51.59
Female	4541	48.41
Perceived Wellbeing		
Happy	3825	96.01
Unhappy	159	3.99
Working Status	9255	98.1
Worker	4029	43.22
Nonworker	5294	56.78
Breakfast Frequency		
Frequently	8109	86.32
Infrequently	1285	13.68
Lunch Frequency		
Frequently	8643	92.28
Infrequently	723	7.72
Exercise Frequency		
Frequently	6968	77.76
Infrequently	1993	22.24
Transportation to School		
Involves exercise	6746	81.16
Doesn´t involve exercise	1566	18.84
School Year		
2009/2010	3680	38.24
2010/2011	2938	30.53
2011/2012	3005	31.23
	Median	**Mean**
Age	15	14.98

2.3.1 Missing Data

Overall, data was available for most students for most variables. The number of non-answers, unclassifiable answers (such as “other” type of transportation) or irrelevant answers, however, was high for wellbeing, weight status, drinking status and type of transportation to school. In the case of weight status, the causes for missing information were multiple and included at least one of the following: unavailable age, unavailable height, unavailable weight or unavailable sex.

Table 4: Missing data

Characteristic	Missing Responses	%
Weight Status	3961	41.16
Language Spoken at Home	28	0.29
Health problems in last 2 weeks	1131	11.75
Drunk in Last Month	3618	37.6
Perception of health	219	2.28
Perception of School	392	4.07
Sex	243	2.53
Perceived Wellbeing	5639	58.6
Working Status	300	3.12
Breakfast Frequency	229	2.38
Lunch Frequency	257	2.67
Exercise Frequency	662	6.88
Transportation to School	1311	13.62
School Year	0	0
Age	339	3.52

Lifestyle and health profiles are summarized in the results to compare different ethnic groups in an effort to clarify and qualify different overweight prevalences. To determine whether or not it was appropriate to consider lifestyle, health characteristics for individuals for whom outcome data (BMI percentile for age) was not available, comparisons were made between those on whom anthropometric data was available and those on whom anthropometric data was unavailable.

Table 5: ORs of missing anthropometric data

Characteristic	Unavailable Anthropometry	Available Anthropometry	OR of Unavailable Anthropometry	P-value
Language Spoken at Home				
Danish	3465	4780	1 (reference)	
West European	217	236	1.27 (1.05 - 1.53)	0.01
East European	40	71	0.78 (0.52 - 1.14)	0.20
Central Asia	42	35	1.66 (1.05 - 2.61)	0.03
East Asia	27	40	0.93 (0.56 - 1.51)	0.78
Middle Eastern	98	350	0.39 (0.31 - 0.49)	<0.001
South Asian	36	123	0.40 (0.27 - 0.58)	<0.001
African	18	14	1.77 (0.88 - 3.65)	0.10
Other	3	2	2.1 (0.31 - 17.4)	0.42
Health problems in last 2 weeks				
No	620	978	1 (reference)	
Yes	3145	4488	1.105 (0.99 - 1.23)	0.08

Drunk in Last Month					
	No	1052	1360	1 (reference)	
	Yes	1140	2153	0.68 (0.61 - 0.76)	<0.001
Perception of health					
	Good	3692	5533	1 (reference)	
	Bad	87	92	1.42 (1.05 - 1.91)	0.02
Perception of School					
	Good	3547	5355	1 (reference)	
	Bad	227	275	1.25 (1.05 - 1.5)	0.01
Sex					
	Female	1836	2705	1 (reference)	
	Male	1882	2957	0.84 (0.86 - 1.02)	0.13
Perceived Wellbeing					
	Happy	1202	2623	1 (reference)	
	Unhappy	59	100	1.29 (0.92 - 1.79)	0.13
Working Status					
	Nonworker	2147	3147	1 (reference)	
	Worker	1592	2437	0.96 (0.88 - 1.04)	0.31
Breakfast Frequency					
	Frequently	3253	4856	1 (reference)	
	Infrequently	519	766	1.01 (0.90 - 1.14)	0.85
Lunch Frequency					
	Frequently	3450	5193	1 (reference)	
	Infrequently	309	414	1.12 (0.96 - 1.31)	0.14
Exercise Frequency					
	Frequently	2856	4112	1 (reference)	
	Infrequently	748	1245	0.87 (0.78 - 0.96)	0.01
Transportation to School					
	Involves exercise	3026	3720	1 (reference)	
	Doesn´t involve exercise	583	983	0.79 (0.65 - 0.82)	<0.001

Significant differences between students for whom anthropemetric data was available and those for whom it was not are evident in language, drinking status, perception of school, transportation to school, exercise frequency and perception of health.

2.4. Data Analysis

Data was analyzed in four steps. First (2.4.1), crude and adjusted odds ratios for overweight were calculated using logistic regression analysis. Second (2.4.2), data was segregated by ethnicity to outline the associations between certain confounders

and mediators (attitudes and behaviours) and family ethnicity. Third (2.4.3), the odds ratios for overweight were calculated based based on behaviour, again stratifying by ethnicity. Finally (2.4.4), raw BMI percentile-for-age scores were analyzed through comparisons of means.

Table 6: Overview of analysis models

		"Exposure" Variables	"Outcome" Variables
Section	**Crude Analysis**		
2.4.1	Unadjusted ORs for Overweight	Ethnicity, Confounders, Mediators	Binary CDC Weight Status
	Logistic Regression Models		
2.4.1	(i) Adjusted Analysis	Ethnicity, Confounders	Binary CDC Weight Status
2.4.1	(ii) "Overadjusted" Analysis	Ethnicity, Confounders, Mediators	Binary CDC Weight Status
2.4.1	(iii) Adjusted Analysis	Ethnicity and Purposefully Selected Confounders	Binary CDC Weight Status
	Analysis of Pathways and Risk Factors		
2.4.2	ORs for characteristics by ethnicity	Ethnicity	Confounders and Mediators
2.4.3	ORs for overweight by characteristics, stratified by ethnicity	Confounders and Mediators (segregated by ethnicity)	Binary CDC Weight Status
	Comparison of Means		
2.4.4	T-test; ANOVA; Tukey test	Ethnicity	BMI percentile-for-age

2.4.1. Crude and Adjusted Odds Ratios for Overweight

In the first phase of the analysis, the association between lifestyle factors and youth overweight was analysed simply. Crude odds ratios and confidence intervals were calculated using overweight as the outcome variable, and ethnicity and all other variables as the exposure.

Following crude analysis, three logistic regression models were constructed to contextualize and qualify the previously calculated ORs.

(i) The first includes ethnicity as well as potential confounders (without any systematic variable exclusion / inclusion criteria).

(ii) In order to shed light on the shortcomings of this study and direct further research, the second multivariate logistic regression model was constructed to treat

even behavioural variables as potential "confounders." In other words, this model purposefully includes all variables, whether exposure, confounding or mediating. Although this may appear as overadjustment and therefore methodologically unsound at first glance (Enrique F. Schisterman, 2009), by treating variables in the causal pathway as confounders and controlling for them, the remaining differences in overweight prevalence between different ethnicities can be assigned to behavioural, attitude, nutritional or genetic variables *not* analysed in this study. In other words, if this study included all relevant behavioural variables in the causal pathway towards overweight, controlling for these variables would effectively eliminate prevalence odds ratio differences between ethnicity (leaving only differences in genetic predisposition, which are assumed to be relatively minor). The logistic regression, in this sense, does not "correct" for differences between ethnicities, but rather sheds light on other unexamined behaviours.

(iii) The final logistic model eliminates mediators and employs stepwise variable selection to refine the actual risk of overweight by ethnicity and behaviour. This produces figures adjusted for potential confounders.

2.4.2. Risk Factors by Ethnicity

To determine the differing attitudes and practices of children of different origins, ORs of presenting risk factors which were significantly associated with overweight in the crude analysis were calculated for each ethnicity.

2.4.3. Stratification

The third phase of the analysis aimed at illustrating the pathways by which overweight develops differently among different ethnic groups. First, to understand the cultural paradigms which may facilitate or protect against overweight, ORs were calculated for each ethnicity´s risk of behaviours and characteristics suspected to be associated with overweight. Second, the ethnically stratified odds of overweight for each behavioural and characteristic group were calculated. This involved the division of data into strata by ethnic group to assess the relative impact of potential

behaviors and characteristics on the development of overweight within different sub-populations

2.4.4. BMI Percentile-for-age Analysis

In the final phase of analysis, Z-scores and corresponding BMI percentile-for-age values were calculated according to the CDC´s guidelines (K. Flegal & Cole, 2013) (Goldberg, 2010). ANOVA testing was performed to compare mean BMI percentile-for-age through all ethnicities, and post hoc Tukey testing allowed for the specification of significant differences.

2.4.5. Software

A majority of the data analysis was carried out using R version 2.14.2 (R, 2012). Parts of the logistic regression analysis and data manipulation were carried out using R Commander (Fox, 2005), with the accompanying R script separately executed for confirmation. At times, certain analytical procedures were replicated in SAS software, Version 9.3, but this was done in only a confirmatory and secondary manner (SAS, 2013). Data cleaning and recoding for analysis was carried out in OpenOffice Calc (Apache, 2010) as well as R. For stratified analysis, confidence intervals and chi-squared p-values were calculated using OpenEpi (Dean, Sullivan, & Soe, 2013). Figures were generated using OpenOffice Calc and R.

3. Results

This section outlines descriptive and analytical results for the relationships between behaviour, ethnicity and overweight.

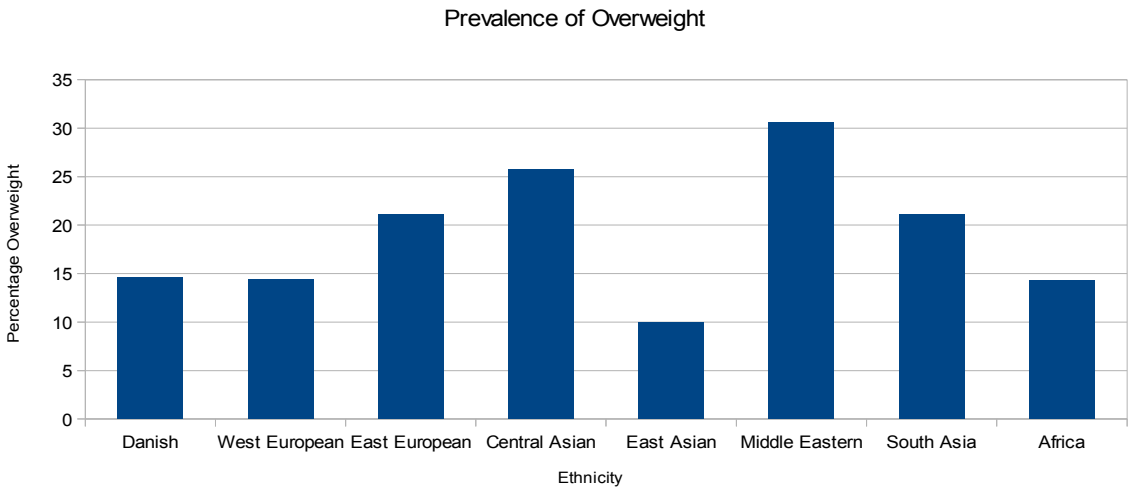
3.1 Prevalence of Overweight

Students of different ethnic origin showed drastically different prevalences of overweight in this sample. Students of East Asian background had a low prevalence of overweight (10%). Students of African (14.3%) and West European (14.4%) origin showed similar patterns in overweight as Danish students (14.6%). Middle Eastern (30.6%), Central Asian (25.7%), South Asian (21.1%) and Eastern European (21.1%) students, however, had much higher prevalences of overweight.

Table 7: Prevalence of overweight by ethnicity

Ethnicity	Normal Weight	Overweight	95% Confidence Interval
Danish	4082 (85.4%)	698 (14.6%)	13.63 - 15.63
Western European	202 (85.6%)	34 (14.4%)	10.5 - 19.46
Eastern European	56 (78.9%)	15 (21.1%)	13.25 - 31.98
Central Asian	26 (74.3%)	9 (25.7%)	14.16 - 42.06
East Asian	36 (90%)	4 (10%)	3.96 - 23.05
Middle Eastern	243 (69.4%)	107 (30.6%)	25.98 - 35.59
South Asian	97 (78.9%)	26 (21.1%)	14.85 - 29.17
African	12(85.7%)	2 (14.3%)	4.01 - 39.95

Figure 1: Prevalence of overweight by ethnicity



3.2. Crude and Adjusted Odds Ratios for Overweight

For the calculation of prevalence odds ratios, the hypothesized protective factors (based on the literature review) were used as the reference. In general, prevalence odds ratios for overweight were in line with already published literature on the subject, albeit in some cases these associations were not strong enough to be considered statistically significant ($p < 0.05$). The exception was working status; in this sample, being a worker was a protective factor against overweight. Since working status is also tangentially an indicator of social integration, however, it is difficult to isolate "working" itself as a protective factor against overweight.

3.2.1. Crude Odds Ratios for Overweight

Seven characteristics were significantly associated with overweight or were on the border of statistical significance: (1) being of central Asian (OR = 2.02, P = 0.06), Middle Eastern (OR = 2.58, P < 0.001) or South Asian (OR = 1.57, P = 0.04) ethnicity, (2) eating breakfast infrequently (OR = 1.81, P < 0.001), (3) eating lunch infrequently (OR = 1.47, P = 0.002), (4) having a bad perception of school (OR = 1.42, P = 0.02), (5) using a mode of transportation to school that does not involve exercise (OR = 1.39, P < 0.001) and (6) being a boy (OR = 1.18, P = 0.02). (7) Being a worker (OR = 0.79, P = 0.002) was inversely associated with overweight. Of these, only meal frequency and type of transportation to school can be considered in the causal pathway to overweight and obesity.

In addition to the significant ethnic differences previously mentioned, the crude odds ratios for overweight exhibited vast differences between nearly all ethnicities (though these differences were not always significant). Children of West European and African origin had nearly identical prevalence odds ratios for overweight as those of Danish origin. East Asian children had a much lower prevalence of overweight (OR of 0.65). Due to small population sizes, it is unsurprising that the odds ratios for East Asian and African children were concluded to be statistically no different than those of Danish children.

Surprisingly in this sample, and contrary to the results of other studies, considering oneself "happy" was associated with overweight, albeit insignificantly. Having been drunk in the last month, exercising infrequently and having had any health problems in the last two weeks were also associated with overweight, albeit in a non-significant way.

Table 8: Unadjusted ORs of overweight

Characteristic	Crude OR of Overweight	P-value
Language Spoken at Home		
Danish	1 (reference)	
West European	0.98 (0.68 - 1.43)	0.93
East European	1.57 (0.88 - 2.79)	0.12
Central Asian	2.02 (0.94 - 4.34)	0.06
East Asian	0.65 (0.23 - 1.83)	0.41
Middle Eastern	2.58 (2.02 - 32.7)	<0.001
South Asia	1.57 (1.0 - 2.43)	0.04
Africa	0.97 (0.22 - 4.36)	0.97
Health problems in last 2 weeks		
No	1 (reference)	
Yes	1.10 (0.91 - 1.34)	0.32
Drunk in Last Month		
No	1 (reference)	
Yes	1.15 (0.96 - 1.40)	0.14
Perception of health		
Good	1 (reference)	
Bad	2.636 (1.67 - 4.06)	<0.001
Perception of School		
Good	1 (reference)	
Bad	1.42 (1.04 - 1.88)	0.02
Sex		
Female	1 (reference)	
Male	1.18 (1.02 - 1.36)	0.02
Perceived Wellbeing		
Happy	1 (reference)	
Unhappy	0.92 (0.51 - 1.56)	0.77
Working Status		
Nonworker	1 (reference)	
Worker	0.7899 (0.68 - 0.91)	0.001

Breakfast Frequency			
	Frequently	1 (reference)	
	Infrequently	1.81 (1.5 - 2.17)	<0.001
Lunch Frequency			
	Frequently	1 (reference)	
	Infrequently	1.47 (1.14 - 1.88)	0.001
Exercise Frequency			
	Frequently	1 (reference)	
	Infrequently	1.07 (0.90 - 1.27)	0.46
Transportation to School			
	Involves exercise	1 (reference)	
	Doesn´t involve exercise	1.39 (1.15 - 1.66)	<0.001

3.2.2. Adjusted Odds Ratios (Ethnicity and Confounders)

The second analysis consisted of a logistic regression model which included ethnicity as well as potential confounders.

In this model, the overall trends for overweight are directionally similar but much stronger. When controlling for all potential confounders, both Middle Eastern (OR = 3.21, P = 0.003) and Central Asian (OR = 5.19, P = 0.01) children show significantly higher ORs for overweight than Danes. Unlike in the unadjusted model, West Europeans (OR = 1.46, P = 0.17), Africans (OR = 4.44, P = 0.11) and East Asians (OR = 2.29, P = 0.31) have a higher risk of overweight than Danes (though not significantly so). The East European risk of overweight changed little after adjustment. As with the other adjusted models, the OR for South Asians was incalculable due to little variance in several non-ethnicity variables among the 159 students.

Interestingly, in the case of ethnicity and confounding behaviours sharing a model, all ORs for overweght for non-ethnicity variables approached 1 (or equality with Danes). In other words, adjustment lessened the importance of non-ethnic variables and emphasized the impact of ethnicity.

Table 9: ORs adjusted for all potential confounders

Characteristic	Adjusted Odds Ratio (95% CI)	P-value
Language spoken at home		
Danish	1 (reference)	
West Europe	1.46 (0.83 - 2.44)	0.17
East Europe	1.66 (0.37 - 5.31)	0.44
Central Asia	5.19 (1.34 - 21.2)	0.01
East Asia	2.29 (0.33 - 10.08)	0.31
Middle East	3.21 (1.42 - 6.8)	0.003
South Asia	<0.001 (NA)	0.98
Africa	4.44 (0.58 - 27.15)	0.11
Health problems in last two weeks		
No	1 (reference)	
Yes	1.08 (0.74 - 1.61)	0.68
Drinking status		
Not drunk in the last month	1 (reference)	
Drunk in the last month	1.15 (0.86 - 1.53)	0.35
Perception of Health		
Good	1 (reference)	
Bad	1.19 (0.34 - 3.27)	0.76
Perception of School		
Good	1 (reference)	
Bad	1.09 (0.60 - 1.87)	0.76
Sex		
Girl	1 (reference)	
Boy	1.02 (0.76 - 1.37)	0.88
Perceived Wellbeing		
Happy	1 (reference)	
Unhappy	1.03 (0.48 - 2.02)	0.93
Working Status		
Nonworker	1 (reference)	
Worker	0.80 (0.60 - 1.07)	0.13

3.2.3. Overadjusted Odds Ratios (Ethnicity, Confounders and Mediators)

For the third logit model, an "overadjusted" logistic regression was performed. All variables were treated as confounders, regardless of their potential location in the causal pathway to overweight and obesity ("mediation"). The ORs produced here are not meant to be interpreted on their own; rather, in comparison with the crude ORs, the direction and strength of the differences indicate the extent to which the

variables here fully grasp significant determinants of overweight. In other words, strong or directionally different ORs in this model illustrate that many risk factors for overweight, including the most important ones, are outside the realm of this study.

If controlling correctly for all non-ethnic variables associated with obesity, the adjusted odds ratios for overweight among different ethnic groups should approach the reference (1). As the actual results show, however, the opposite happens: in most cases, the adjusted odds ratios are inflated by the model. This indicates that if Danish and non-Danish shared more behaviours (even those in the causal pathway towards obesity), the likelihood of overweight would be even higher for many non-Danish ethnicities. The most likely reason for this is that the most important determinants for overweight are not analyzed in this study (nutritional content and social class, for example).

Table 10: "Overadjusted" ORs of overweight

Characteristic	Adjusted Odds Ratio (95% CI)	P-value
Language spoken at home		
Danish	1 (reference)	
West Europe	1.53 (0.85 - 2.60)	0.13
East Europe	2.01 (0.44 - 6.92)	0.30
Central Asia	5.60 (1.27 - 24.59)	0.18
East Asia	2.36 (0.34 - 10.46)	0.30
Middle East	2.82 (1.19 - 6.22)	0.01
South Asia	<0.001 (NA)	0.98
Africa	2.67 (0.12 - 30.89)	0.44
Any Health Problems in the Last Two Weeks		
No	1 (reference)	
Yes	0.97 (0.66 - 1.46)	0.89
Drinking status		
Not drunk in the last month	1 (reference)	
Drunk in the last month	1.16 (0.86 - 1.58)	0.32
Perception of Health		
Good	1 (reference)	
Bad	1.02 (0.23 - 3.22)	0.98
Perception of School		
Good	1 (reference)	
Bad	0.74 (0.35 - 1.41)	0.39
Sex		
Girl	1 (reference)	
Boy	1.06 (0.77 - 1.45)	0.73
Perceived Wellbeing		
Happy	1 (reference)	
Unhappy	1.19 (0.52 - 2.44)	0.66
Working Status		
Worker	1 (reference)	
Nonworker	0.76 (0.59 - 1.04)	0.09
Breakfast Frequency		
Frequently	1 (reference)	
Infrequently	1.59 (1.04 - 2.39)	0.03
Lunch Frequency		
Frequently	1 (reference)	
Infrequently	0.77 (0.41 - 1.38)	0.41
Exercise Frequency		
Frequently	1 (reference)	
Infrequently	1.12 (0.76 - 1.62)	0.57
Transportation to School		
Involves exercise	1 (reference)	
Doesn´t involve exercise	1.26 (0.87 - 1.80)	0.21

3.2.4 Stepwise Adjusted Odds Ratios (Purposeful Selection)

Finally, a multivariate logistic regression model was constructed to determine the relative weight and influence of certain factors on the likelihood of developing overweight. Variables determined in the literature review to potentially be in the "causal pathway" to overweight were excluded from adjustment (mode of transportation, skipping meals, etc.). All non-pathway variables with an alpha level of less than 0.15 were initially included; the model was then modified following the steps for the "Purposeful selection of covariates" (Bursac, Gauss, Williams, & Hosmer, 2008):

Variables were removed if they satisfied two conditions: (1) non-significance (adjusted p-value > 0.10) and (2) non-confounding (upon removal, other ORs did not change by more than 15%).

Originally excluded variables were re-introduced one-by-one and again tested for non-significance and non-counfounding. The "iterative" process continued with the inclusion, testing, and subsequent exclusion of variables until a model was constructed to include all non-pathway variables which were significant or confounders.

Following the construction of the multivariate logistic regression model, the adjusted odds ratios largely confirmed the patterns demonstrated by the crude values. Middle Eastern (OR = 3.1, P = 0.004) and Central Asian (OR = 5.61, P = 0.1) children still had the highest prevalence odds ratios for overweight as well as the most statistically significant differences from Danish children; African children´s risk for overweight was also shown to be drastically higher (OR= 4.43, P = 0.1), but a small sample size meant non-significance. Adjustment showed increased risk of overweight for all other groups, with the exception of South Asian children (for whom the data was unable to be correctly adjusted due to lack of sufficient data per category).

In the purposeful selection of variables, the majority of potential confounders were eliminated. After adjustment, the remaining three non-ethnic variables showed lessened importance than in their crude form: being a drinker (OR = 1.15, P = 0.32), being unhappy (OR = 1.08, P = 0.84) and working (OR = 0.8, P = 1.2) were statistically confounding, but their effects were overshadowed by the importance of ethnicity.

Table 11: ORs of overweight following purposeful selection of variables

Characteristic	Adjusted Odds Ratio (95% CI)	P-value
Language spoken at home		
Danish	1 (reference)	
West Europe	1.47 (0.84 - 2.45)	0.159
East Europe	1.65 (0.37 - 5.28)	0.441
Central Asia	5.61 (1.37 - 21.52)	0.011
East Asia	2.31 (0.34 - 1.01)	0.309
Middle East	3.10 (1.38 - 6.51)	0.004
South Asia	<0.001 (NA)	0.984
Africa	4.43 (0.58 - 26.95)	0.105
Drinking status		
Not drunk in the last month	1 (reference)	
Drunk in the last month	1.15 (0.87 - 1.53)	0.322
Perceived Wellbeing		
Happy	1 (reference)	
Unhappy	1.08 (0.51 - 2.06)	0.836
Working Status		
Nonworker	1 (reference)	
Worker	0.80 (0.60 - 1.06)	0.124

3.3. Behavioural and Attitude Differences by Ethnicity

What follows below are odds ratios for the eleven behaviours and characteristics hypothesized to be associated with overweight, stratified by ethnicity (using Danish as the reference). Full results (absolute and relative frequencies per ethnicity as well as all graphs for all behaviours and attitudes and tables for behaviours and attitudes found to be statistically insignificant) can be found in the appendix (7.2).

The question of "significance" here is misleading due to a small size in a number of

strata (greater than 20% of cell expected totals are less than 5 in multiple cases). Accordingly Mantel-Haenszel odds ratios were *not* calculated; instead, trends are simply described in detail with notable potential patterns outlined. In some cases, particularly with the less numerous ethnic groups (African and East Asian), seemingly drastic differences are not highlighted in detail due to their insignificance. Table 12 shows the OR of each behaviour (using Danish students as the reference); Tables 13 through 18 reflect the and Chi-squared P-values and confidence intervals for those variables for which significant differences between ethnicities were found.

Table 12: ORs of behaviours and attitudes by ethnicity

	Odds Ratios of Following Characteristic										
	Recent Health Problems	Having Been Drunk in the Last Month	Negative Perception of Health	Negative Perception of School	Being a Boy	Negative Perceived Wellbeing	Being a Worker	Skipping Breakfast Frequently	Skipping Lunch Frequently	Exercising Infrequently	Non-Exercise Transportation
Danish	1 (reference)										
Western European	1.29	1	1.08	0.61	1.09	0.88	0.98	1.18	1.20	1.25	0.91
Eastern European	1.13	1.55	0.99	0.31	1.04	1.44	0.59	1.64	1.26	1.34	1.55
Central Asian	1.76	1.03	0.71	0.22	0.78	0.86	0.42	2.16	0.69	1.4	1.16
East Asian	0.6	1.2	0.81	0.25	1.02	0.00	0.69	0.45	0.38	1.54	0.9
Middle Eastern	0.96	2.65 *	1.35	0.38	0.84	0.73	0.54	2.64	1.74	1.77	0.96
South Asian	0.84	17.5	1.75	0.99	1.14	0.32	0.40	1.78	1.42	2.68	1.12
African	0.51	0.78	0.00	1.1	0.623	0.00	0.29	2.72	1.79	1.88	0.66

*Shaded cells indicate statistical significance (p<0.05).

Of the eleven risk factors in question, no significant differences were found between ethnicities in five: having had any health problems in the last two weeks, having a negative perception of health, being a boy, being unhappy, and the type of transportation taken to school. In the case of detecting statistically significant (p-value <0.05) differences between ethnicities, six behaviours and characteristics were

associated with ethnicity; the details are outlined below.

3.3.1. Having Been Drunk in the Last Month

With the exception of Africans (for whom the result was opposite but insignificant), all students of non-Danish origin were surprisingly more likely to have been recently drunk than Danish students. South Asians were far more likely to have been drunk in the last month than any other group (only 2 of 52 respondents had not been drunk in the last month). When compared with Danish students, South Asians were more than 17 times as likely to have been drunk in the last month ($P < 0.001$). Middle Easterners also had a significantly higher risk of recent drunkenness (OR = 2.65, $P < 0.001$).

Table 13: ORs of having been drunk in the last month

Ethnicity	OR of Being Drunk in the Last Month	P-Value
Danish	1 (reference)	
West Europe	1 (0.79 – 1.27)	0.99
East Europe	1.55 (0.90 – 2.78)	0.12
Central Asia	1.03 (0.58 – 1.88)	0,92
East Asia	1.2 (0.63 – 2.38)	0.59
Middle East	2.65 (1.85 – 3.87)	<0.001
South Asia	17.5 (5.42 – 107.03)	<0.001
Africa	0.78 (0.3 – 2.1)	0.62

3.3.2. Negative Perception of School

Most non-Danes had a poorer perception of school than their Danish counterparts. These differences were significant in the case of Middle Easterners (OR = 0.38, $P = 0.003$), and on the border of significance in the case of non-Danish Europeans.

Table 14: ORs of having a poor negative perception of school

Ethnicity	OR of Poor Perception of School	P-Value
Danish	1 (reference)	
West Europe	0.61 (0.35 - 0.98)	0.06
East Europe	0.31 (0.05 - 0.98)	0.10
Central Asia	0.22 (0.01 - 0.99)	0.13
East Asia	0.25 (0.01 - 1.15)	0.17
Middle East	0.38 (0.19 - 0.66)	0.002
South Asia	0.99 (0.47 - 1.84)	0.98
Africa	1.1 (0.18 - 3.66)	0.9

3.3.3. Being a Worker

Danish children worked more than any of their non-Danish counterparts. West Europeans exhibited similar working patterns, whereas children of all the other ethnicities were far less likely to work.

Table 15: ORs of being a worker

Ethnicity	OR of Being a Worker	P-Value
Danish	1 (reference)	
West Europe	0.98 (0.81 - 1.19)	0.85
East Europe	0.59 (0.39 - 0.88)	0.01
Central Asia	0.42 (0.24 - 0.69)	0.001
East Asia	0.69 (0.41 - 1.13)	0.15
Middle East	0.54 (0.44 - 0.66)	<0.001
South Asia	0.40 (0.27 - 0.57)	<0.001
Africa	0.29 (0.11 - 0.65)	0.006

3.3.4. Skipping Breakfast Frequently

Only East Asians appear to skip breakfast less frequently than the Danes, whereas all other ethnicities skip breakfast more frequently. Middle Easterners (OR = 2.64, P < 0.001), Central Asians (OR = 2.16, P = 0.01), South Asians (OR = 1.78, P < 0.001) and Africans (OR = 2.27, P = 0.01) are significantly more likely to skip breakfast than the Danish. Non-Danish Europeans also exhibit more of a proclivity towards skippìng breakfast, though this difference is less marked.

Table 16: ORs of skipping breakfast frequently

Ethnicity	OR of Skipping Breakfast Frequently	P-Value
Danish	1 (reference)	
West Europe	1.18 (0.89 – 1.54)	0.22
East Europe	1.64 (0.99 – 2.6)	0.04
Central Asia	2.16 1.23 – 3.6)	0.01
East Asia	0.45 (0.14 – 1.09)	0.12
Middle East	2.64 (2.12 – 3.28)	<0.001
South Asia	1.78 (1.18 – 2.60)	<0.001
Africa	2.72 (1.19 – 5.7)	0.01

3.3.5. Skipping Lunch Frequently

Compared to breakfast frequency, lunch frequency is more uniform among different ethnicities. Nonetheless, children of Middle Eastern origin have a significantly higher likelihood of not eating lunch regularly compared with their Danish counterparts (OR = 1.74, P < 0.001).

Table 17: ORs of skipping lunch frequently

Ethnicity	OR of Skpping Lunch Frequently	P-Value
Danish	1 (reference)	
West Europe	1.20 (0.84 - 1.66)	0.29
East Europe	1.26 (0.61 - 2.31)	0.49
Central Asia	0.69 (0.21 - 1.68)	0.48
East Asia	0.38 (0.06 - 1.23)	0.18
Middle East	1.74 (1.28 - 2.32)	<0.001
South Asia	1.42 (0.81 - 2.32)	0.19
Africa	1.79 (0.53 - 4.58)	0.28

3.3.6. Exercising Infrequently

Students of non-Danish ethnicity get less frequent exercise than their Danish counterparts, significantly so in the case of Middle Easterners (OR = 1.77, P < 0.001) and South Asians (OR = 2.67, P < 0.001).

Table 18: ORs of infrequent exercise

Ethnicity	OR of Exercising Infrequently	P-Value
Danish	1 (reference)	
West Europe	1.25 (0.99 - 1.55)	0.06
East Europe	1.34 (0.84 - 2.05)	0.20
Central Asia	1.4 (0.80 - 2.34)	0.21
East Asia	1.54 (0.86 - 2.62)	0.13
Middle East	1.77 (1.42 - 2.18)	<0.001
South Asia	2.68 (1.91 - 3.74)	<0.001
Africa	1.88 (0.80 - 4.09)	0.12

3.4 Stratification

In the crude analysis, six non-ethnic characteristics were significantly associated with overweight: (3.4.1) eating breakfast infrequently, (3.4.2) eating lunch infrequently, (3.4.3) having a bad perception of school, (3.4.4) using a mode of transportation to school that does not involve exercise, (3.4.5) being a worker and (3.4.6) being a boy. Additionally, two further characteristics were identified as significant or confounding in the final adjusted analysis: (3.4.7) drinking status and (3.4.8) perceived wellbeing (working´s association with overweight was found to be significant in both the crude and adjusted analyses). Given these associations, odds ratios for overweight were constructed for each of these eight characteristics, stratified by ethnicity. Having recent health problems, having a negative perception of health and exercising infrequently were not associated with overweight in either the crude or adjusted models, and were therefore not included in the stratified analysis.

"Interaction," in a non-traditional sense of the word, posed an issue in that certain behaviours were both part of the causal pathway to obesity as well as an indicator of other obesity-related characteristics. Eating breakfast infrequently, for example, is both a cultural characteristic (and therefore an indicator of a broad array of other behaviours) but also also has metabolic consequences. Accordingly, stratified analysis was chosen as the best course of path to analyze the effect of certain behaviours and characteristics on the likelihood of overweight within supposedly different cultural groups.

What follows are results for odds ratios for overweight given a certain behaviour or characteristic, stratified by ethnicity. The complete tabled results (chi-squared P-values, confidence intervals, etc.) can be found in the appendix (7.3).

Table 19: ORs of behaviours and attitudes by ethnicity

	OR of Overweight if Presenting Following Characteristic							
	Infrequent Breakfast	Infrequent Lunch	Negative Perception of School	Non-Exercise Transporation	Being a Worker	Being a Boy	Having Been Drunk in Last Month	Negative Perceived Wellbeing
Alll Ethnicities	1.81 (1.5 - 2.17)*	1.47 (1.14 - 1.88)	1.42 (1.04 - 1.88)	1.39 (1.15 - 1.66)	0.79 (0.68 - 0.91	1.18 (1.02 - 1.36)	1.15 (0.96 - 1.40)	0.92 (0.51 - 1.56)
Danish	1.62 (1.3 - 2.02)	1.23 (0.9 - 1.66)	1.54 (1.11 - 2.12)	1.45 (1.19 - 1.78)	0.85 (0.72 - 1.0)	1.13 (0.96 - 1.33)	1.13 (0.92 - 1.39)	1.16 (0.63 - 2.13)
West European	1.07 (0.37 - 3.0	1.04 (0.29 - 3.77)	0.65 (0.08 - 5.3)	0.77 (0.27 - 2.16)	0.69 (0.33 - 1.48)	1.34 (0.65 - 2.79)	1.65 (0.66 - 4.12)	2.02 (0.37 - 11.07)
East European	1.66 (0.44 - 6.3)	3.25 (0.64 - 16.47)		0.85 (0.20 - 3.59)	1.73 (0.53 - 5.71)	2.95 (0.84 - 10.4)	2.4 (0.25 - 23.23)	
Central Asian	0.78 (0.13 - 4.67)			2.88 (0.56 - 14.94)	0.54 (0.09 - 3.16)	1.28 (0.28 - 5.93)	1 (0.16 - 6.25)	
East Asian		11.67 (0.57 - 237.2)		2.08 (0.16 - 26.96)	0.59 (0.06 - 6.27)			
Middle Eastern	2.15 (1.31 - 3.51)	2.67 (1.37 - 5.22)	0.65 (0.13 - 3.17)	1.08 (0.56 - 2.07)	0.63 (0.37 - 1.08)	1.2 (0.76 - 1.89)	1.05 (0.4 - 2.77)	
South Asian	2.95 (1.57 - 5.5)	0.68 (0.14 - 3.29)	3.03 (0.63 - 14.5)	2.13 (0.73 - 6.2)	1.06 (0.40 - 2.83)	1.93 (0.78 - 4.75)		
African				4.5 (0.19 - 106.8)		5 (0.21 - 117.9)		

*Shaded cells indicate statistical significance (p<0.05).

3.4.1. Eating breakfast infrequently

With the exception of Central and East Asians (for whom the results were inverse, but insignificant), eating breakfast infrequently was a clear predictor of overweight among different ethnicities. Particularly at risk are South Asians, whose risk for overweight (OR = 2.95, P < 0.001) is nearly three times as high for those who skip breakfast when compared to those who eat it frequently. At the opposite end of the spectrum, West Europeans who often skipped breakfast showed very little difference from those who ate it frequently (appendix 7.3.1).

3.4.2. Eating lunch infrequently

Skipping lunch frequently seems to have the same ethnically differentiated impact as skipping breakfast, with few exceptions. Danish and Western European children who skip lunch have similar overweight prevalences to those who do not. East European (OR = 3.25, P = 0.14) and especially Middle Eastern (OR = 2.67, P = 0.003) children who skip lunch have a much higher risk of overweight than their lunch-eating counterparts. Unlike breakfast frequency, lunch frequency did not portend a statistically significant association with overweight for South Asian children (appendix 7.3.2).

3.4.3. Having a bad perception of school

Associations between school perception and overweight were of varying impact and direction, with most associations being not being of significance due to few respondents per strata. Nonetheless, a significant association was found between poor school perception and overweight among Danish schoolchildren (OR = 1.54, P = 0.008) (appendix 7.3.3).

3.4.4. Using a non-exercise mode of transportation to school

Surprisingly, among non-Danish Europeans, using an exercise-oriented mode of transportation to school was inversely associated with overweight (though these figures were inside the realm of statistical insignificance). Among other ethnic groups, and significantly among Danes, taking a bus, car or train to school was associated with overweight (OR = 1.45, P < 0.001) (appendix 7.3.4).

3.4.5. Being a worker

Working appears to be a protective factor from overweight for all ethnicities except for South Asians and Eastern Europeans. In general, however, working appears to be only loosely and somewhat randomly associated with overweight, with a low variance in odds ratios among ethnicities and wide margins of error (appendix 7.3.5)

3.4.6. Being a boy

Being a boy was associated with overweight among all ethnic groups, though significantly so among none (appendix 7.3.6).

3.4.7. Having Been Drunk in the Last Month

In no ethnicity did students who had been drunk in the last month have significantly higher risk of overweight than those who had not. Nonetheless, as with being a boy, the trend is weak but clearly directional (appendix 7.3.7).

3.4.8. Negative Perceived Wellbeing

Sufficient data for stratified analysis was only available for Danes and Western Europeans. Neither presented significant differences in the risk of overweight between "happy" and "unhappy" students (appendix 7.3.8).

3.5 Comparison of BMI Percentile-for-age Scores

Having established the at-risk groups for overweight, and following previous studies on the same population, ethnicity was recoded into a binary variable: Western and Non-Western (Western being Danish or Western European languages, Non-Western being all others) (Herner et al., 2012). For the comparison of means between the two groups, a t-test was conducted. Accordingly, both groups were assessed for normality of distribution and homogeneity of variance. Neither group qualified as having a normal distribution in a Shapiro-Wilk test, but the large group sizes (8696 and 899, respectively) allows for the assumption of normality (Mordkoff, 2011). Furthermore, neither group was assessed as having homogeneous variance ($F = 10.75$ (1, 5680), $P = 0.001$). Accordingly, a Welch´s t-test was performed (in lieu of a Student´s t-test).

Table 20: Welch´s two sample t-test results: Western and Non-Western

	Western	Non-Western	P-Value
Mean BMI Percentile-for-age	52.5	58.4	<0.001

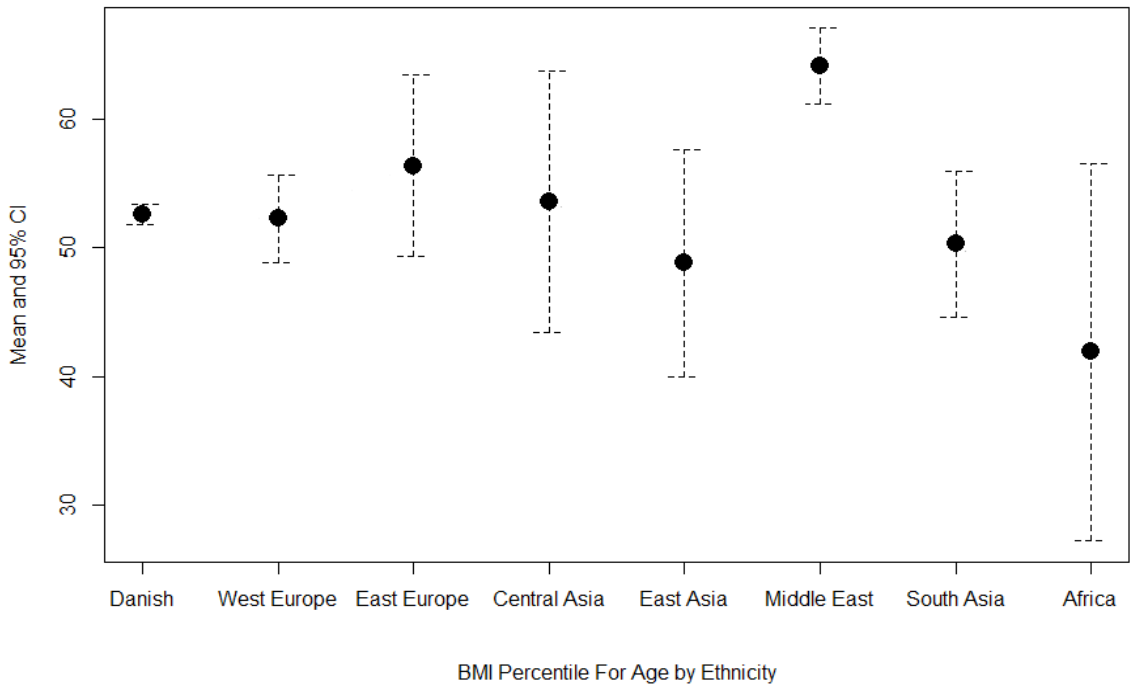
Since the crude analysis showed vast differences within the Non-Western ethnicities, further segregation of data was performed at the regional level. East Asians and Africans were found to have normal distributions for BMI percentile-for-age according to a Shapiro-Wilk test (respective P-Values of 0.17 and 0.28) (Appendix 7.6). In the cases of non-normal distributions for BMI percentile-for-age, ethnicities´ distributions had large enough sizes as to warrant the assumption of normality (n > 30). For homogeneity of variance, a "rule of thumb" test called for dividing the largest factor level´s SD (31.46) by the smallest (25.41); since the result was less than two, homogeneity was assumed (Penn State, 2013).

Table 21: ANOVA for BMI percentile-for-age and ethnicity

Language Spoken at Home	Median	Mean	Standard Deviation	n (missing)
Danish	53.59	52.53	27.62	4809 (3436)
West European	51.73	52.22	26.77	238 (215)
East European	57.73	56.33	29.76	71 (40)
Central Asia	54.44	53.56	29.62	(35 (42)
East Asia	50.28	28.79	27.62	40 (27)
Middle Eastern	71.35	64.1	27.8	352 (96)
South Asia	54.99	50.28	31.47	122 (37)
Africa	37.77	41.88	25.41	14 (18)

Having found statistically significant differences among the means, a post hoc test was called for to compare the mean BMI percentile-for-age of each ethnicity. Post hoc comparisons of means using a Tukey HSD test indicated significant differences in the means of Middle Eastern children´s BMI percenitle-for-age with four other ethnicities (DM, CI): Danish (11.56, 6.97 - 16.15), East Asian (15.31, 1.44 - 29.18) , South Asian (13.82, 5.09 - 22.56) and Western European (11.87, 4.9 - 18.85). These results suggest that youth who speak Middle Eastern languages at home are at a particularly high risk for overweight. Other groups found to be at risk in the OR analysis also generally showed higher median and mean BMI percentile-for-age values than their Danish counterparts, but due to high variance and low sample sizes, these differences were not found to be significant.

Figure 2: Means and CIs of BMI percentile-for-age by ethnicity



4. Discussion

4.1 Summary of Findings

Ethnicity and Overweight: The association between youth overweight and ethnicity is strong. At the 0.05 significance level, youth of Middle Eastern and South Asian ethnicity had a significantly higher risk of overweight than Danes in crude analysis; youth of Central Asian and Eastern European ethnicity also had higher prevalences of overweight than their Danish counterparts, but these differences bordered statistical significance. When controlling for other factors, however, the importance of ethnicity was further highlighted: students of all non-Danish ethnicities, with the exception of South Asians, were shown to be at higher risk of overweight. The reason for the South Asian exception is not because of a lower risk of overweight, but rather because South Asians presented high levels of uniformity in confounding factors, making it impossible to "adjust" for those factors in the logistic regression model. In quantitative analysis of BMI percentile-for-age, youth of Middle Eastern origin were shown to have significantly higher scores than other ethnicities, and therefore the highest risk for overweight. In short, non-ethnic Danish youth are at an elevated risk for overweight when compared to their Danish counterparts, and those of Middle Eastern, South Asian, Central Asian and Eastern European ethnicity present the highest risk.

Other Risk Factors: As far as risk factors associated with overweight, perhaps the most important finding of this study is what it did not find. The "overadjusted" logistic regression model indicates that the risk factors studied here only capture a small part of the true social and physiological determinants of overweight.

Nonetheless, certain conclusions can be drawn regarding some of the possible risk factors examined here. It is clear that the relative frequencies of behaviours and characteristics associated with overweight vary widely based on ethnicity. Accordingly, the relative burden of harmful behaviours is affected by their frequency within that population. Of the ten characteristics shown to be associated with

overweight in this study, being of Middle Eastern origin is significantly associated with four of them, being of South Asian origin is associated with three, being of Eastern European origin is associated with two, and being of Central Asian and African origin is associated with only one. Being of Western European origin is associated with none. It should come as no surprise, therefore, that the risk for overweight follows the same order as the aforementioned ethnicities. Though this study´s analysis of risk factors only captures a part of the picture, that part is important.

In the double-analysis of harmful behaviours and high frequencies of those behaviours within ethnic groups, skipping meals should be highlighted for South Asians and Middle Easterners. Not only do they have a higher likelihood to skip breakfast (ORs of 1.78 and 2.64, respectively, compared to Danes), as well as lunch (1.42 and 1.74, respectively), the association between overweight and meal skipping is more pronounced for South Asians and Middle Easterners, even when compared with those of the same ethnicity. In other words, in the realm of meal skipping, the data indicates a double threat: the most at-risk population has a higher likelihood of practicing the most risky behaviour, which in turn, even when controlling for other variables, seems to have a more pronounced effect on that population.

In terms of general health, it should be noted that in this sample, a students´ self perception of health or wellbeing may not be a reliable indicator of their actual health. 98.1% of students considered their health to be good and 96% of students considered themselves to be happy. Nonetheless, 82.7% of students reported having had a health problem in the last two weeks. Among students who had recent health problems, only 2.3% considered their health to be poor, and only 4.9% considered their sense of wellbeing to be poor.

4.2 Limitations

The limitations to this study are numerous and the application of this study´s conclusions should take into account the shortcomings in both design and data.

The validity of "adjusting" for behaviours and characteristics such as perception of school is debatable; there is no way to splice ethnicity from the behavioural and attitude characteristics in this study (which can be construed as an integral part of culture) (see Figure 3). The adjusted logistic models presented herein should be understood as only partially indicative of pathways to overweight. The full spectrum of attitudes and practices that lead to overweight are beyond the scope of the variables studied. Because of the questionable validity of "adjusting" for what could be construed as cultural beliefs and practices, crude values could be interpreted and applied with the same level of detail and confidence as adjusted values. To the extent that one could interpret *all* confounding variables as "culturally" associated (and therefore mediating), the analysis of crude ORs for overweight and raw means comparisons of BMI percentile-for-age should be given extra weight. In the same vein, the large number of study participants further confirms the validity of studying crude values alone.

BMI is an imperfect measure and does not always reflect body fat robustly in children (Forsum, Flinke Carlsson, Henriksson, Henriksson, & Lof, 2013). Furthermore, because of small strata for certain ethnicity, BMI values were simplified into the binary "normal" and "overweight" categories, further simplifying and masking what might have proven to be more subtle differences.

In the framework of crude analysis, Middle Eastern youth stand out as having a high risk for overweight. Still, the "insignificant" differences found between the mean BMI percentile-for-age values of other ethnicities should not be interpreted as sameness. One reason for the "significance" of the Middle Eastern distinction is the high mean; the other reason is the large *n* (relative to other Non-Western ethnicities); all other Non-Western ethnicities presented less anthropometric measurements.

The most important limitation is the measurement of "ethnicity." Language spoken at home is a more useful reflection of ethnicity for languages with general regional restrictions (Amharic, for example, which is only spoken in East Africa) than for

languages spoken on multiple continents by multiple ethnicities (such as French, which is spoken globally). The classification of international languages like French as "Western European" artificially groups together ethnicities of likely very different characteristics, masking the true risk for overweight for the sub-groups therein. Most students of North American, South American and African origin are likely "hidden" into other groups by this study´s overgeneralizing linguistic classifications. The association between language and ethnicity is further weakened by individual household decisions to speak or not speak certain languages.

A perhaps more important shortcoming than the problematic variable of ethnicity are the variables not examined in this study. These include time in country and level of acculturation (Kaushal, 2009), further nutritional habits, family income (Costa, Daher, & Queiroz, 2013), living conditions, urbanization (Raychaudhuri & Sanyal, 2012), genetics (Cheng, 2012), as well as a myriad of other variables. This study ignores the different kinds of immigration to Denmark, and the ethnically distinct social and economic implications of them. The social realities of the child of a skilled technology worker from West Europe and that of a refugee of a Central Asian conflict are different; simplifying these differences into 11 attitude and behavioural variables likely brushes over some of the far more important underlying determinants of health. The role of these non-examined factors in the development of overweight was partially quantified in the final logisitic model, but not qualified to show the actual weight of each characteristic, and the ways these characteristics affect different ethnicities differently. In other words, findings from this study´s "overadjusted" model suggest a vast array of health determinants not examined here; these findings do not suggest, however, *which* other factors are important to overweight.

Results were further constrained by high values of missing anthropometry, and incomplete questionnaire responses to inquiries regarding drinking status and perceived wellbeing. All non-Danish ethnicities reportedly a surprisingly high frequency of drunkenness, with the exception of Africans; Middle Easterners and South Asians reported significantly higher drunkenness frequency than the Danish. It is plausible that the unexpected ethnic differences in alcohol drinking could be

related to these low response rates. Still, why ethnic minorities, particularly those from areas with large Muslim populations, would be likely to artificially inflate their drinking or why non-drinking minorities would refuse to respond is beyond the realm of this paper´s explanations.

Likewise, the high rate of perceived happiness (96%) should not be considered without taking into account the high rate of missing responses for the question (58.6%). It is suspected that a large number of "unhappy" students simply did not answer, limiting the applications of the wellbeing variable, and tarnishing the results, particularly in the adjusted analysis (3.2.4).

Missing anthropometry was the most challenging shortcoming in the data. Students of Central Asian, South Asian and Western European origin were most likely to not present weight, height or age measurements. Other groups likely to not present anthropometry were students with recent health problems, students who were not drunk in the last month, students who had poor perceptions of health and school, students who exercised infrequently and students whose mode of transportation to school did not involve exercise. With the exception of drinking status, these figures suggest that the sample for whom anthropometric data was available is likely thinner and healthier than the actual population.

It was decided to include in the behavioural and attitude analysis questionnaire respondents for whom BMI was not available (Table 5), as their exclusion would have made stratification difficult in the case of the less numerous ethnic groups. Nonetheless, these differences in available anthropometry should be noted for two reasons: (1) the results of the final analysis are weaker and perhaps somewhat distorted due to the necessary exclusion of students on whom anthropometry was unavailable and whose behaviour was significantly different in certain areas, and (2) to emphasize the importance of anthropometric data collection of future studies of this kind. Of particular noteworthiness is the fact that, in general, unhealthy behaviours are associated with high rates of missing anthropometric data; the students on whom information is most important are precisely those on whom

information is unavailable. Furthermore, vastly different rates of responses for anthropometry by ethnicity means a weakened possibility to conclude significant and accurate associations between health behaviours and place of origin.

4.3 Conclusions and Implications

A child´s ethnicity is an important determinant of health. The most significant findings of this study confirm troubling patterns in youth overweight across much of the developed world. Even with this study´s limited size and period (three years), the trends over time in youth overweight are similar. The results of this study should be highlighted and given importance for the context and time in which they are presented. The flow of immigrants into Denmark is constant, and the prevalence of overweight continues to creep slowly upwards (DIS, 2012) (appendix 7.5). Particularly, immigrants and their children from poorer countries tend to have a higher prevalence of overweight than those native to rich countries. Though the genetic component of overweight is plausibly present in these results (Raychaudhuri & Debmalya, 2012), as well as other less possible components, such as prenatal stress (Li J., 2010), the more important causal roots appear to be behavioural and are likely largely intertwined with social class.

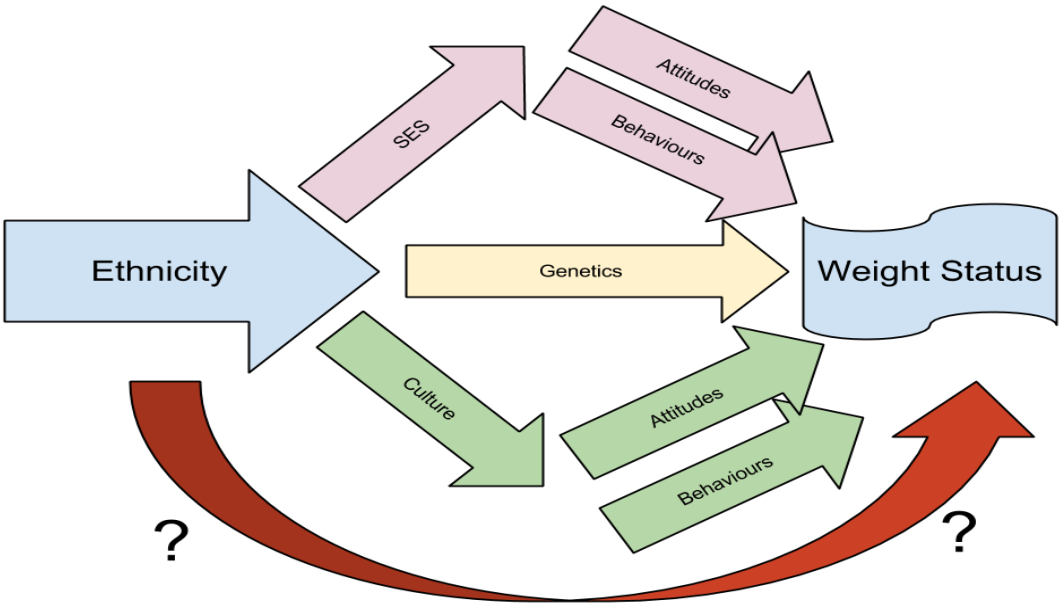
Other studies suggest that youth overweight and ethnicity are linked closely, largely due to cultural practices related to energy intake (nutrition) and expenditure (exercise). Thanks to the language element in this project, it was possible to pinpoint both the differences in overweight prevalence between ethnicities (which were vast) as well as the important behaviours and dispositions which certainly influence ethnic prevalence differences. These results are in line with other European studies (Lange et al., 2010) (Kirchengast & Schober, 2006) (Ebenegger et al., 2011 2) (Kleiser et al., 2010; Popkin & Udry, 1998; Tzotzas et al., 2011) as well as studies in the United States (Strickman-Stein et al., 2010) (Shi et al., 2012) (Popkin & Udry, 1998).

Future studies in the domain of youth overweight in Denmark should better assess

ethnicity and immigration. Self-identified ethnicity or parents´ place of origin would likely provide a better framework in which to work than language spoken at home. Additionally, socioeconomic status should be measured, directly when possible or through proxies when necessary, in order to clarify and segregate the cultural causes for overweight from the social causes. Finally, if possible, additional efforts should be made to attain anthropometric measurements from all students.

For the conceptual framework of this study, ethnicity is considered to be inseparable from culture and socioeconomic status, both which portend certain behaviours and attitudes demonstrated to be associated with overweight (Figure 3). In the "overadjusted" logistic regression model, controlling for some of these behaviours and attitudes surprisingly inflated the risk of overweight for non-Danish ethnicities. The implication of this result is that the main determinants of overweight are beyond the scope of the variables studied here. The results of this study may point towards the specific urgency of targeted intervention in meal skipping, drinking and transportation, but more generally suggest the need for further research. For interventions in childhood overweight to be successful, the ways by which overweight develop differently among different ethnicities need to be better understood.

Figure 3: Conceptual framework - pathways to overweight



In other words, this study is diagnosis without prognosis. The ethnically differential risks for overweight are robustly clear, thanks to this study´s large size. The understanding of the roots of these differences, unfortunately, is far less clear.

Uncertainty regarding the *why* of overweight, however, should not distract from the *what*. In this relatively large study, Middle Eastern and Central Asian children were more than twice as likely to be overweight than Danish children. With relative overweight prevalences of 30.6% and 25.7%, schools should not wait to find out what is not known before acting on what is known. In other words, targeted campaigns using known effective measures should begin as soon as possible, concurrent with further research (Davison, Jurkowski, Li, Kranz, & Lawson, 2013).

The findings underline the important social dimensions of general health. For reasons known and some unknown, children of Middle Eastern, South and Central Asian and Eastern European origin are at higher risk for overweight than Danish children. Differential prevalences of overweight call for differential action. These findings are important not only for the current health of these students, but also for the future health of Denmark as a whole; with rising human and economic costs of obesity, quick action should be taken both to further diagnose the root of the causes of overweight as well as address these problems at an early age.

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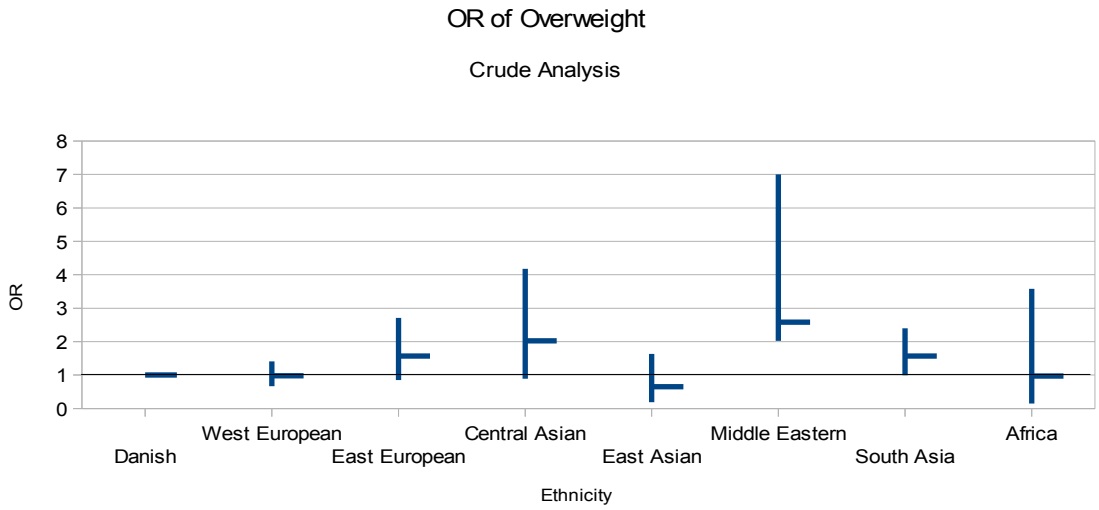
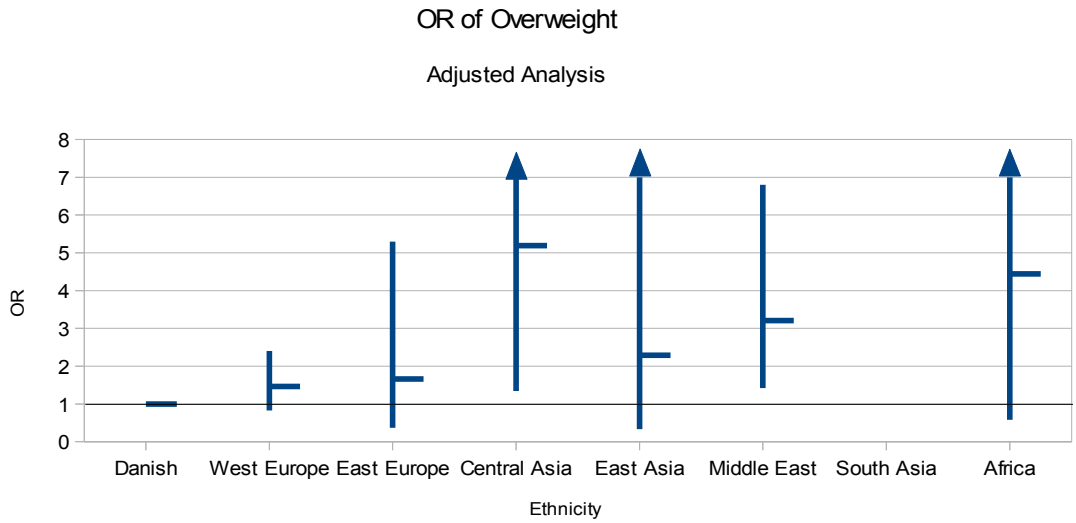
7. Appendices

7.0 Crude and Adjusted ORs for Overweight by Ethnicity

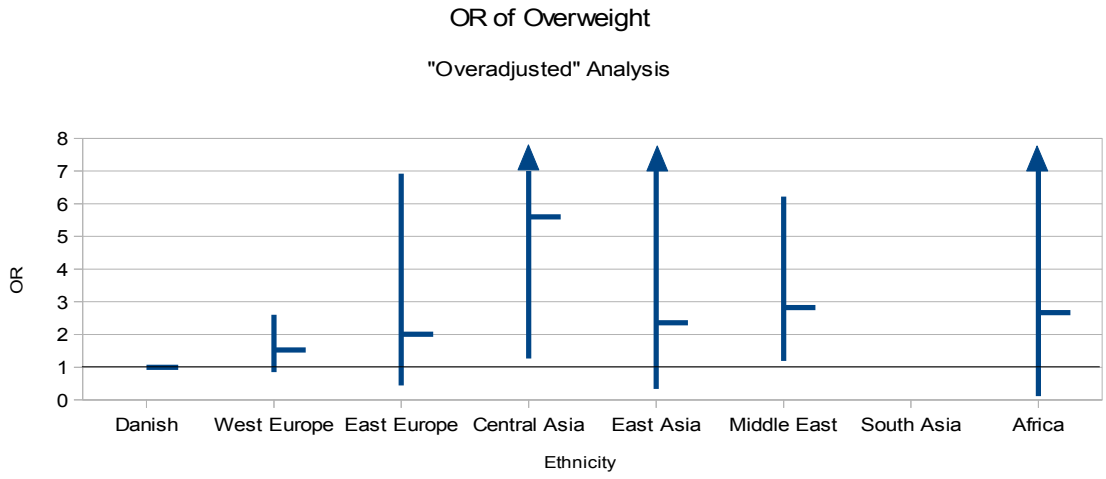
7.0.1. Unadjusted ORs of overweight by ethnicity



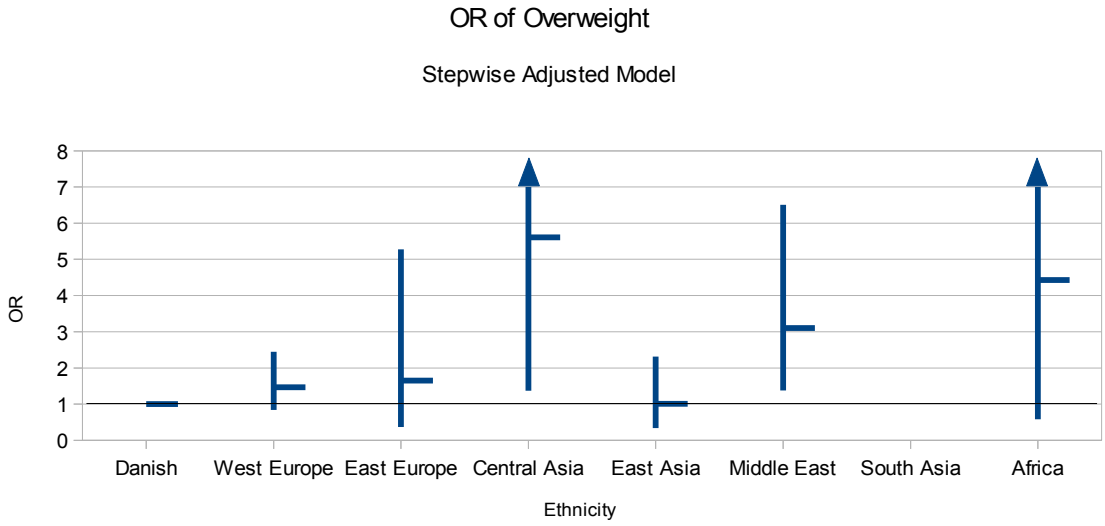
7.0.2. Adjusted ORs of overweight by ethnicity



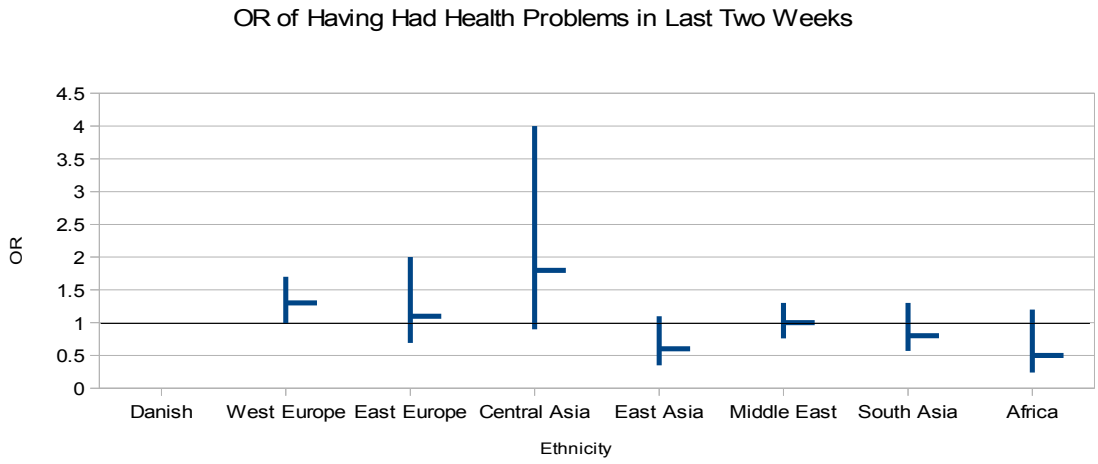
7.0.3. "Overadjusted" ORs of overweight by ethnicity

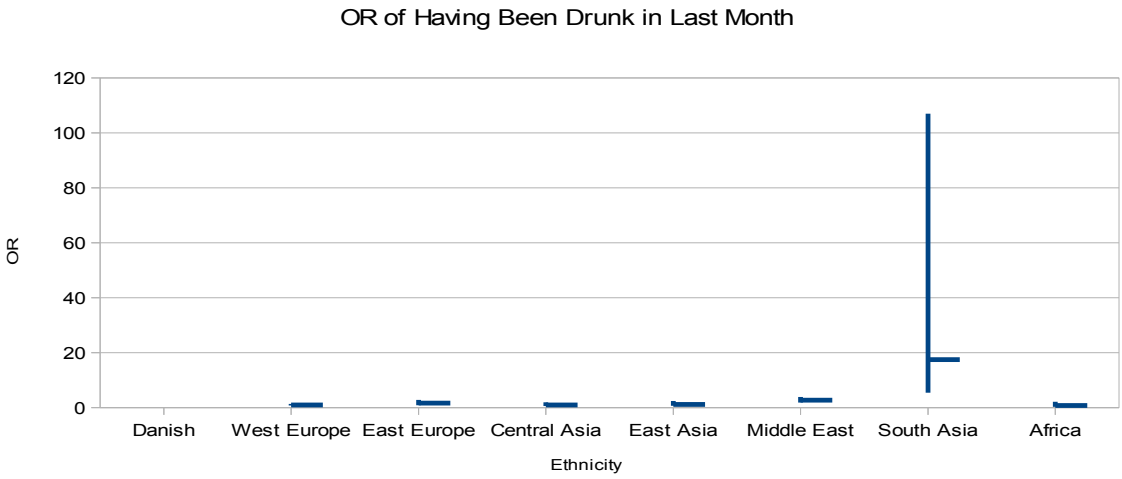


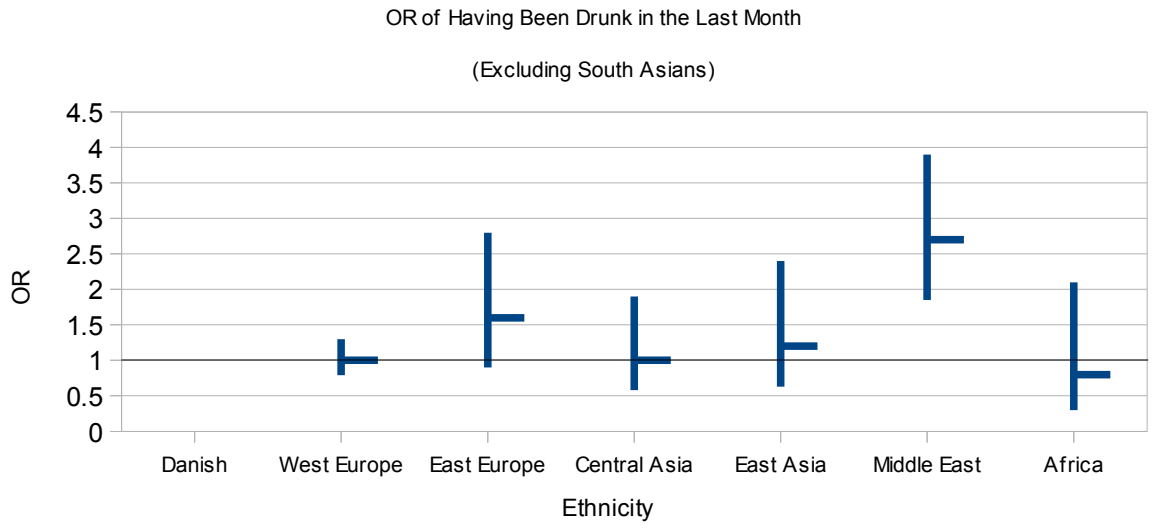
7.0.4. ORs of overweight following purposeful selection of variables

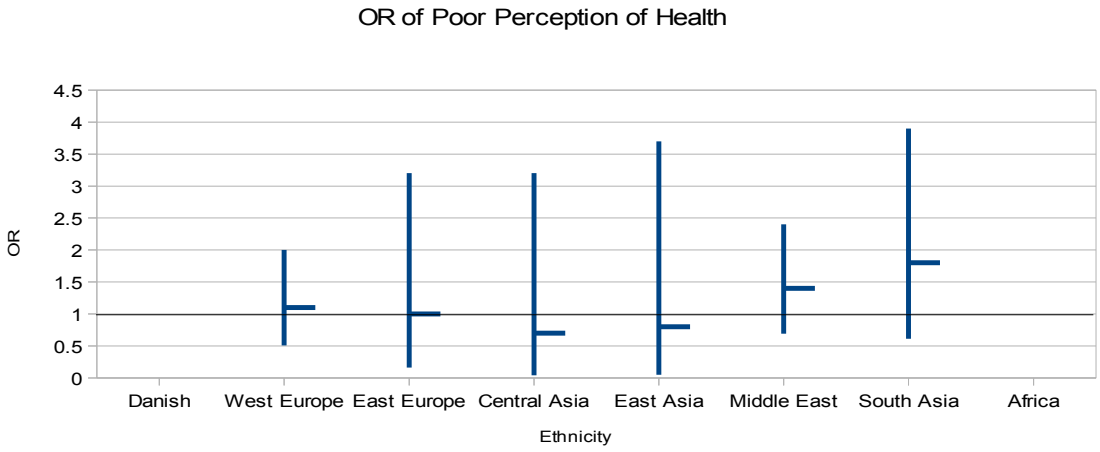


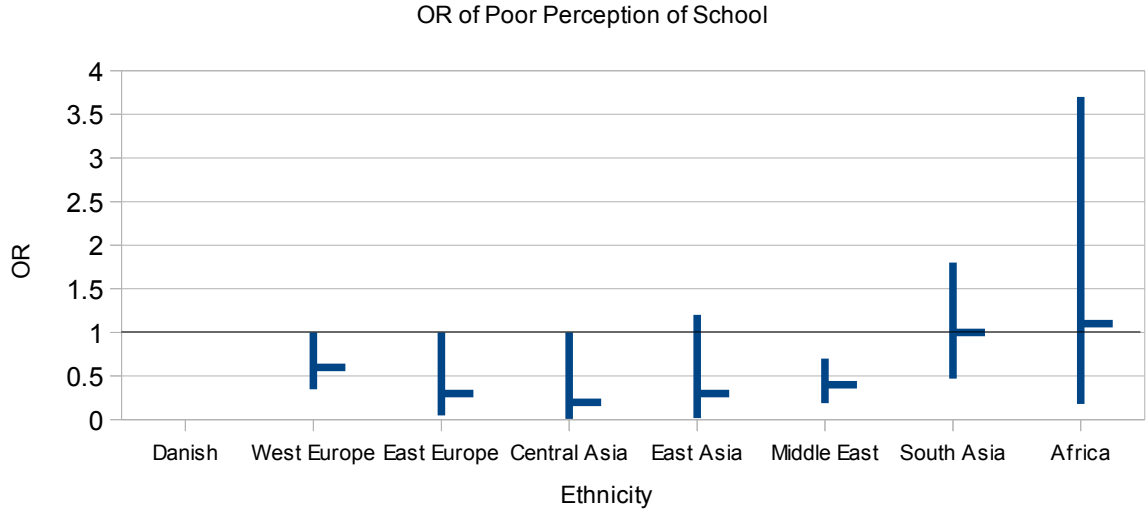
7.1. Figures of ORs for Behaviours and Characteristics

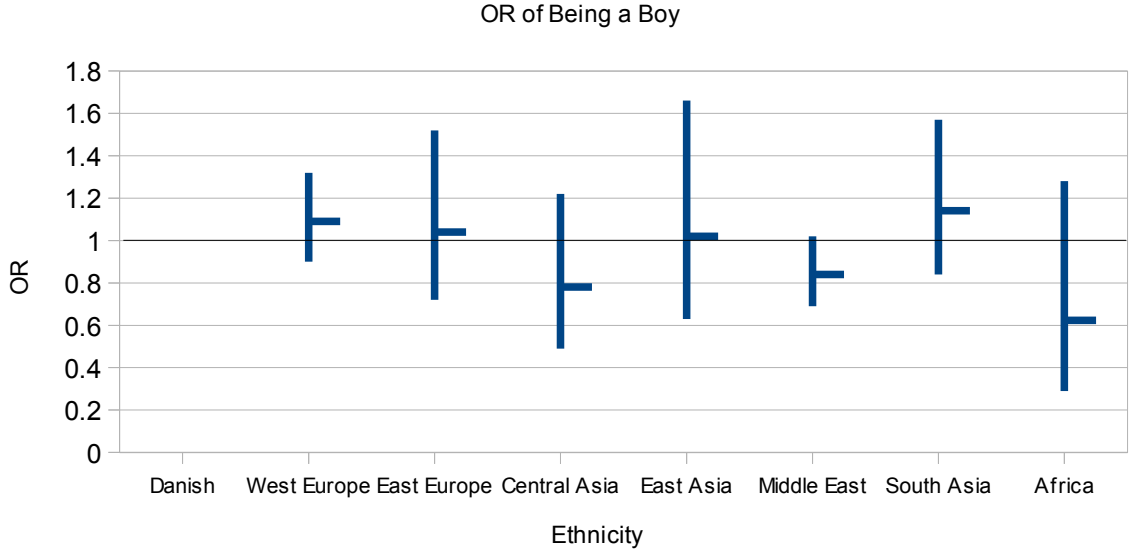







OR of Poor Perception of Health
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
OR
Danish
West Europe
East Europe
Central Asia
East Asia
Middle East
South Asia
Africa
Ethnicity


OR of Poor Perception of School
4
3.5
3
2.5
2
1.5
1
0.5
0
OR
Danish
West Europe
East Europe
Central Asia
East Asia
Middle East
South Asia
Africa
Ethnicity


OR of Being a Boy
1.8
1.6
1.4
1.2
1
0.8
0.6
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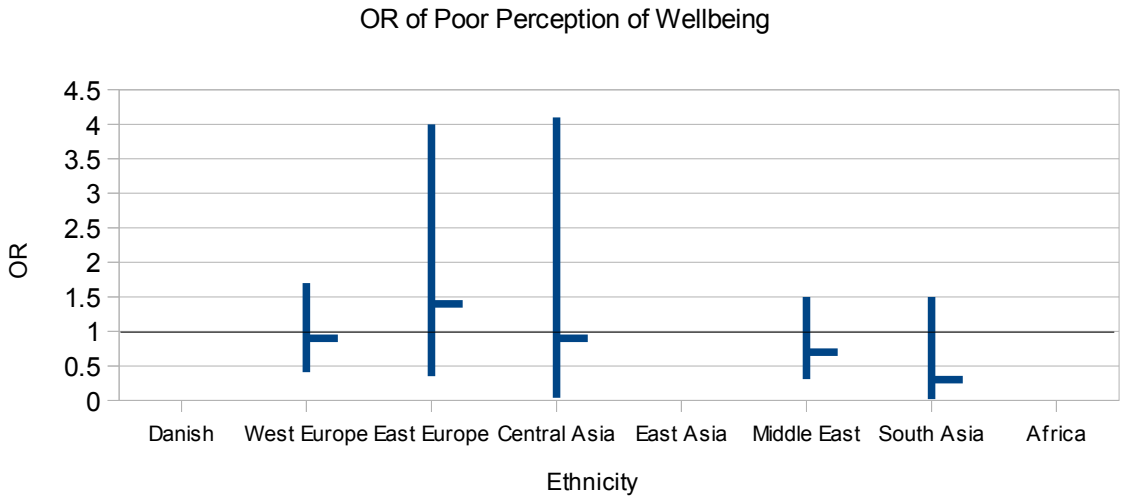
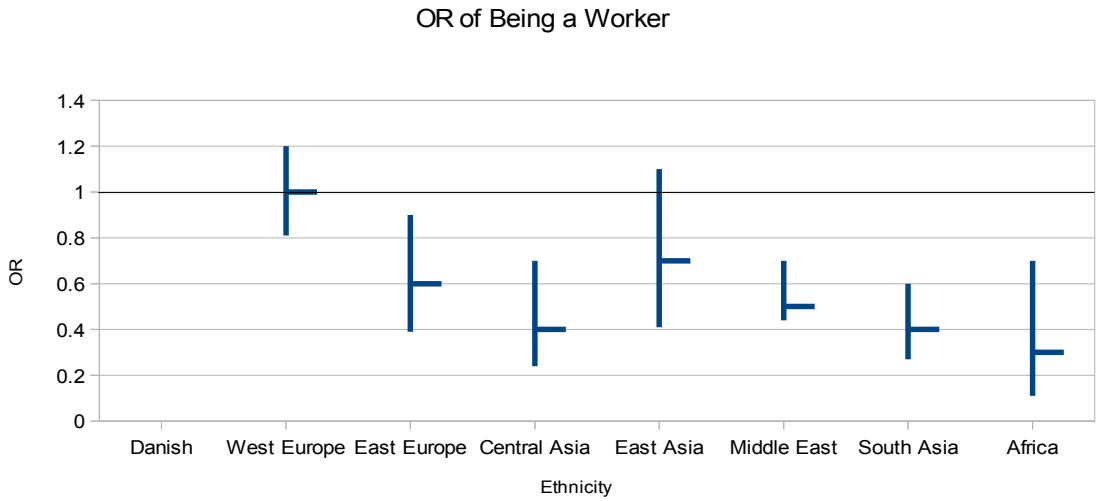
0.2
0
OR
Danish
West Europe
East Europe
Central Asia
East Asia
Middle East
South Asia
Africa
Ethnicity


OR of Poor Perception of Wellbeing
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
OR
Danish
West Europe
East Europe
Central Asia
East Asia
Middle East
South Asia
Africa
Ethnicity


OR of Being a Worker
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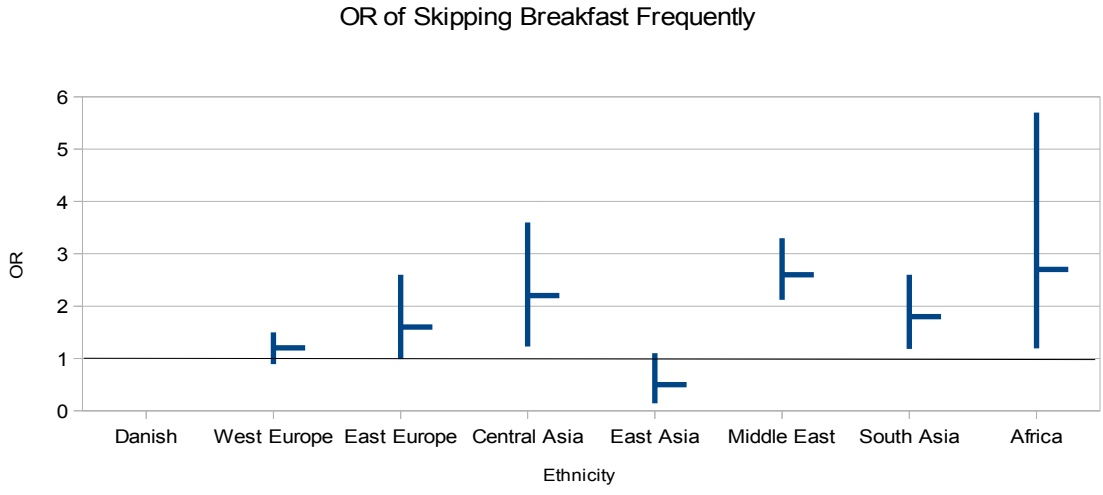
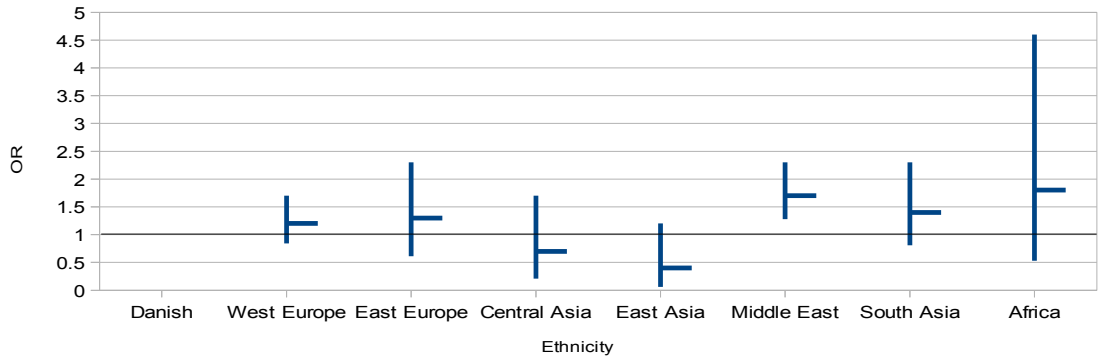
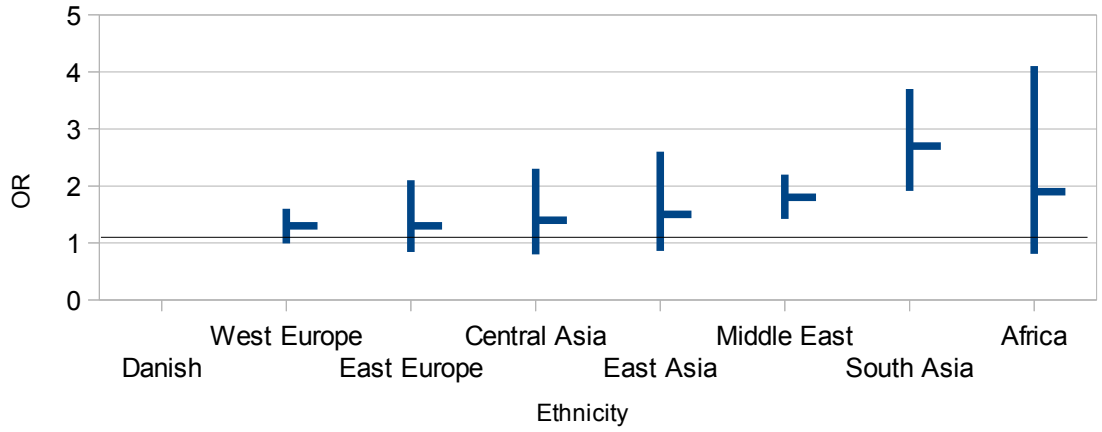
1.2
1
0.8
0.6
0.4
0.2
0
OR
Danish
West Europe
East Europe
Central Asia
East Asia
Middle East
South Asia
Africa
Ethnicity


OR of Skipping Breakfast Frequently
6
5
4
3
2
1
0
OR
Danish
West Europe
East Europe
Central Asia
East Asia
Middle East
South Asia
Africa
Ethnicity

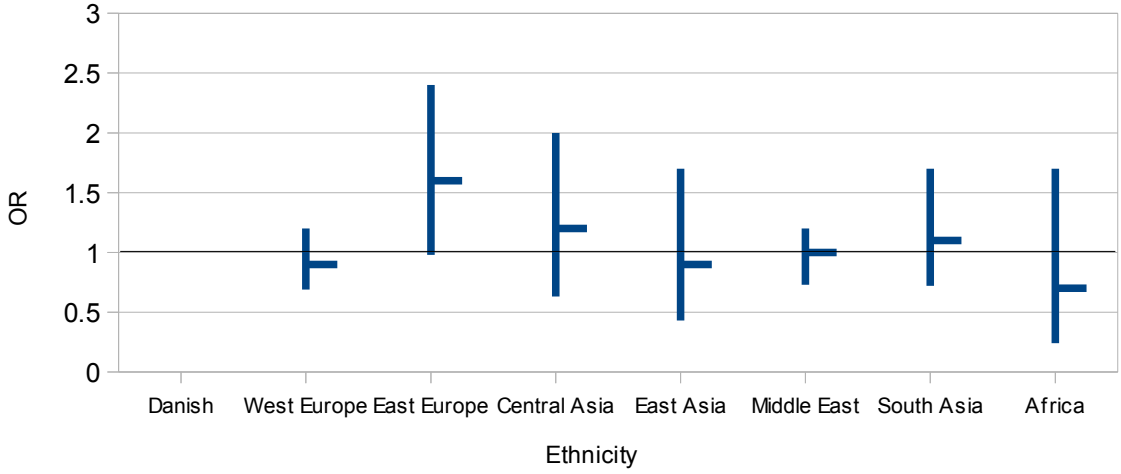
OR of Skipping Lunch Frequently



OR of Excercising Infrequently



OR of Non-Excercise Transportation to School



7.2. Odds of Behaviours and Characteristics by Ethnicity

7.2.1. Recent Health Problems

Ethnicity	OR of Any Health problems in the last two weeks	P-Value
Danish	1 (reference)	
West Europe	1.29 (0.99 – 1.72)	0.0715
East Europe	1.13 (0.69 – 1.96)	0.6650
Central Asia	1.76 (0.9 – 3.99)	0.1312
East Asia	0.6 (0.35 – 1.1)	0.0848
Middle East	0.96 (0.76 – 1.26)	0.8077
South Asia	0.84 (0.57 – 1.29)	0.4
Africa	0.51 (0.24 – 1.18)	0.0937

7.2.2. Negative Health Perception

Ethnicity	OR of Poor Perception of Health	P-Value
Danish	1 (reference)	
West Europe	1.08 (0.51 - 2.02)	0.818
East Europe	0.99 (0.16 - 3.17)	0.991
Central Asia	0.71 (0.04 - 3.22)	0.732
East Asia	0.81 (0.05 - 3.73)	0.841
Middle East	1.35 (0.69 - 2.40)	0.338
South Asia	1.75 (0.61 - 3.9)	0.228
Africa	0.00 (0 - 297.7)*	0.976

7.2.3. Being a Boy

Ethnicity	OR of Being a Boy	P-Value
Danish	1 (reference)	
West Europe	1.09 (0.90 - 1.32)	0.384
East Europe	1.04 (0.72 - 1.52)	0.83
Central Asia	0.78 (0.49 - 1.22)	0.274
East Asia	1.02 (0.63 - 1.66)	0.929
Middle East	0.84 (0.69 - 1.02)	0.071
South Asia	1.14 0.84 - 1.57)	0.402
Africa	0.623 (0.29 - 1.28)	0.205

7.2.4. Negative Wellbeing

Ethnicity	OR of Negative Perceived Wellbeing	P-Value
Danish	1 (reference)	
West Europe	0.88 (0.41 - 1.66)	0.721
East Europe	1.44 (0.35 - 4.0)	0.540
Central Asia	0.86 (0.04 - 4.1)	0.880
East Asia	0.00 (0.00 - 4276)**	0.976
Middle East	0.73 (0.31 - 1.47)	0.430
South Asia	0.32 (0.018 - 1.45)	0.256
Africa	0.00 (0 - infinity**)**	0.985

7.2.5. Non-Exercise Transport

Ethnicity	OR of Taking a Non-Exercise Mode of Transportation to School	P-Value
Danish	1 (reference)	
West Europe	0.91 (0.69 - 1.18)	0.473
East Europe	1.55 (0.98 - 2.39)	0.052
Central Asia	1.16 (0.63 - 1.99)	0.621
East Asia	0.9 (0.43 - 1.71)	0.759
Middle East	0.96 (0.73 - 1.24)	0.747
South Asia	1.12 (0.72 - 1.68)	0.602
Africa	0.66 (0.2 - 1.7)	0.446

7.3 Stratified Analysis Tables

7.3.1. Infrequent Breakfast

Danish

Breakfast frequency	Normal Weight	Overweight	OR of Overweight	P-value
Often	3598 (86.3%)	571 (13.7%)		
Rarely	462 (79.5%)	119 (20.5%)	1.62 (1.3 - 2.02)	<0.001

West European

Breakfast frequency	Normal Weight	Overweight	OR of Overweight	P-value
Often	174 (85.7%)	29 (14.3%)		
Rarely	28 (84.8%)	5 (15.2%)	1.07 (0.37 - 3.0	0.896

East European

Breakfast frequency	Normal Weight	Overweight	OR of Overweight	P-value
Often	46 (80.7%)	11 (19.3%)		
Rarely	10 (71.4%)	4 (28.6%)	1.66 (0.44 - 6.3)	0.446

Central Asian

Breakfast frequency	Normal Weight	Overweight	OR of Overweight	P-value
Often	19 (73.1%)	7 (26.9%)		
Rarely	7 (77.8%)	2 (22.2%)	0.78 (0.13 - 4.67)	0.78

East Asian

Breakfast frequency	Normal Weight	Overweight	OR of Overweight	P-value
Often	34 (89.5%)	4 (10.5%)		
Rarely	2 (100%)	0 (0%)	0	0.629

Middle Eastern

Breakfast frequency	Normal Weight	Overweight	OR of Overweight	P-value
Often	184 (74.5%)	63 (25.5%)		
Rarely	57 (57.6%)	42 (42.4%)	2.15 (1.31 - 3.51)	0.002

South Asian

Breakfast frequency	Normal Weight	Overweight	OR of Overweight	P-value
Often	80 (80%)	20 (20%)		
Rarely	57 (73.9%)	42 (26.1%)	2.95 (1.57 - 5.5)	<0.001

African

Breakfast frequency	Normal Weight	Overweight	OR of Overweight	P-value
Often	9 (100%)	0 (0%)		
Rarely	3 (60%)	2 (40%)	na (0.57 - na)	0.04

7.3.2. Infrequent Lunch

Danish

Lunch frequency	Normal Weight	Overweight	OR of Overweight	P-value
Often	3778 (85.6%)	633 (14.4%)		
Rarely	272 (82.9%)	56 (17.1%)	1.23 (0.9 - 1.66)	0.177

West European

Lunch frequency	Normal Weight	Overweight	OR of Overweight	P-value
Often	183 (85.%)	31 (14.5%)		
Rarely	17 (85%)	3 (15%)	1.04 (0.29 - 3.77)	0.95

East European

Lunch frequency	Normal Weight	Overweight	OR of Overweight	P-value
Often	52 (81.2%)	12 (18.8%)		
Rarely	4 (57.1%)	3 (42.9%)	3.25 (0.64 - 16.47)	0.138

Central Asian

Lunch frequency	Normal Weight	Overweight	OR of Overweight	P-value
Often	24 (72.7%)	9 (27.3%)		
Rarely	2 (100%)	0 (0%)	0	0.392

East Asian

Lunch frequency	Normal Weight	Overweight	OR of Overweight	P-value
Often	35 (92.1%)	3 (7.9%)		
Rarely	1 (50%)	1 (50%)	11.67 (0.57 - 237.2)	0.053

Middle Eastern

Lunch frequency	Normal Weight	Overweight	OR of Overweight	P-value
Often	222 (72.8%)	83 (27.2%)		
Rarely	20 (50%)	20 (50%)	2.67 (1.37 - 5.22)	0.003

South Asian

Lunch frequency	Normal Weight	Overweight	OR of Overweight	P-value
Often	86 (78.9%)	23 (21.1%)		
Rarely	11 (84.6%)	2 (15.4%)	0.68 (0.14 - 3.29)	0.629

African

Lunch frequency	Normal Weight	Overweight	OR of Overweight	P-value
Often	12 (100%)	0 (0%)		
Rarely	0 (0%)	2 (100%)	NA	<0.001

7.3.3. Poor School Perception

Danish

Percep. of School	Normal Weight	Overweight	OR of Overweight	P-value
Good	3866 (85.7%)	644 (14.3%)		
Bad	195 (79.6%)	50 (20.4%)	1.54 (1.11 - 2.12)	0.008

West European

Percep. of School	Normal Weight	Overweight	OR of Overweight	P-value
Good	193 (85.4%)	33 (14.6%)		
Bad	9 (90%)	1 (10%)	0.65 (0.08 - 5.3)	0.685

East European

Percep. of School	Normal Weight	Overweight	OR of Overweight	P-value
Good	55 (80.9%)	13 (19.1%)		
Bad	1 (100%)	0 (0%)	0	0.627

Central Asian

Percep. of School	Normal Weight	Overweight	OR of Overweight	P-value
Good	26 (76.5%)	8 (23.5%)		
Bad	0 (0%)	1 100%)	NA	0.085

East Asian

Percep. of School	Normal Weight	Overweight	OR of Overweight	P-value
Good	36 (90%)	4 (10%)		
Bad	0 (na)	0 (na)	NA	NA

Middle Eastern

Percep. of School	Normal Weight	Overweight	OR of Overweight	P-value
Good	236 (69.4%)	104 (30.6%)		
Bad	7 (77.8%)	2 (22.2%)	0.65 (0.13 - 3.17)	0.59

South Asian

Percep. of School	Normal Weight	Overweight	OR of Overweigh t	P-value
Good	93 (80.2%)	23 (19.8%)		
Bad	4 (57.1%)	3 (42.9%)	3.03 (0.63 - 14.5)	0.147

African

Percep. of School	Normal Weight	Overweight	OR of Overweight	P-value
Good	11 (84.6%)	2 (15.4%)		
Bad	1 (100%)	0 (0%)	0	0.672

7.3.4. Non-Exercise Transport

Danish

Mode of Transport	Normal Weight	Overweight	OR of Overweight	P-value
Involves Exercise	2720 (86.4%)	427 (13.6%)		
Without Exercise	679 (81.4%)	155 (18.6%)	1.45 (1.19 - 1.78)	<0.001

West European

Mode of Transport	Normal Weight	Overweight	OR of Overweight	P-value
Involves Exercise	123 (84.2%)	23 (15.8%)		
Without Exercise	35 (87.5%)	5 (12.5%)	0.77 (0.27 - 2.16)	0.610

East European

Mode of Transport	Normal Weight	Overweight	OR of Overweight	P-value
Involves Exercise	37 (78.7%)	10 (21.3%)		
Without Exercise	13 (81.2%)	3 (18.8%)	0.85 (0.20 - 3.59)	0.829

Central Asian

Mode of Transport	Normal Weight	Overweight	OR of Overweight	P-value
Involves Exercise	18 (78.3%)	5 (21.7%)		
Without Exercise	5 (55.6%)	4 (44.4%)	2.88 (0.56 - 14.94)	0.20

East Asian

Mode of Transport	Normal Weight	Overweight	OR of Overweight	P-value
Involves Exercise	25 (92.6%)	2 (7.4%)		
Without Exercise	6 (85.7%)	1 (14.3%)	2.08 (0.16 - 26.96)	0.568

Middle East

Mode of Transport	Normal Weight	Overweight	OR of Overweight	P-value
Involves Exercise	167 (70.2%)	71 (29.8%)		
Without Exercise	35 (68.6%)	16 (31.4%)	1.08 (0.56-2.07)	0.828

South Asian

Mode of Transport	Normal Weight	Overweight	OR of Overweight	P-value
Involves Exercise	64 (82.1%)	14 (17.9%)		
Without Exercise	15 (68.2%)	7 (31.8%)	2.13 (0.73 - 6.2)	0.159

African

Mode of Transport	Normal Weight	Overweight	OR of Overweight	P-value
Involves Exercise	9 (90%)	1 (10%)		
Without Exercise	2 (66.7%)	1 (33.3%)	4.5 (0.19 - 106.8)	0.326

7.3.5. Being a Worker

Danish

Working Status	Normal Weight	Overweight	OR of Overweight	P-value
Non-Worker	2165 (84.4%)	399 (15.9%)		
Worker	1864 (86.5%)	292 (13.5%)	0.85 (0.72 - 1.0)	0.051

West European

Working Status	Normal Weight	Overweight	OR of Overweight	P-value
Non-Worker	112 (83.6%)	22 (16.4%)		
Worker	88 (88%)	12 (12%)	0.69 (0.33 - 1.48)	0.343

East European

Working Status	Normal Weight	Overweight	OR of Overweight	P-value
Non-Worker	39 (81.2%)	9 (18.8%)		
Worker	15 (71.4%)	6 (28.6%)	1.73 (0.53 - 5.71)	0.363

Central Asian

Working Status	Normal Weight	Overweight	OR of Overweight	P-value
Non-Worker	17 (70.8%)	7 (29.2%)		
Worker	9 (81.8%)	2 (18.2%)	0.54 (0.09 - 3.16)	0.49

East Asian

Working Status	Normal Weight	Overweight	OR of Overweight	P-value
Non-Worker	23 (88.5%)	3 (11.5%)		
Worker	13 (92.9%)	1 (7.1%)	0.59 (0.06 - 6.27)	0.659

Middle Eastern

Working Status	Normal Weight	Overweight	OR of Overweight	P-value
Non-Worker	167 (67.3%)	81 (32.7%)		
Worker	75 (76.5%)	23 (23.5%)	0.63 (0.37 - 1.08)	0.093

South Asian

Working Status	Normal Weight	Overweight	OR of Overweight	P-value
Non-Worker	69 (78.4%)	19 (21.6%)		
Worker	24 (77.4%)	7 (22.6%)	1.06 (0.40 - 2.83)	0.909

African

Working Status	Normal Weight	Overweight	OR of Overweight	P-value
Non-Worker	9 (81.8%)	2 (18.2%)		
Worker	3 (100%)	0 (0%)	0	0.425

7.3.6. Being a Boy

Danish

Sex	Normal Weight	Overweight	OR of Overweight	P-value
Girl	1948 (86.2)	312 (13.8%)		
Boy	2134 (84.7%)	386 (15.3%)	1.13 (0.96 - 1.33)	0.14

West European

Sex	Normal Weight	Overweight	OR of Overweight	P-value
Girl	104 (87.4%)	15 (12.6%)		
Boy	98 (83.8%)	19 (16.2%)	1.34 (0.65 - 2.79)	0.427

East European

Sex	Normal Weight	Overweight	OR of Overweight	P-value
Girl	29 (87.9%)	4 (12.1%)		
Boy	27 (71.1%)	11 (28.9%)	2.95 (0.84 - 10.4)	0.083

Central Asian

Sex	Normal Weight	Overweight	OR of Overweight	P-value
Girl	16 (76.2%)	5 (23.8%)		
Boy	10 (71.4%)	4 (28.6%)	1.28 (0.28 - 5.93)	0.752

East Asian

Sex	Normal Weight	Overweight	OR of Overweight	P-value
Girl	19 (100%)	0 (0%)		
Boy	17 (81%)	4 (19%)	NA	0.044

Middle Eastern

Sex	Normal Weight	Overweight	OR of Overweight	P-value
Girl	129 (71.3%)	52 (28.7%)		
Boy	114 (67.5%)	55 (32.5%)	1.2 (0.76 - 1.89)	0.439

South Asian

Sex	Normal Weight	Overweight	OR of Overweight	P-value
Girl	49 (84.5%)	9 (15.5%)		
Boy	48 (73.8%)	17 (26.2%)	1.93 (0.78 - 4.75)	0.15

African

Sex	Normal Weight	Overweight	OR of Overweight	P-value
Girl	10 (90.9%)	1 (9.1%)		
Boy	2 (66.7%)	1 (33.3%)	5 (0.21 - 117.9)	0.289

7.3.7. Drunk in the Last Month

Danish

Drunk in the Last Month	Normal Weight	Overweight	OR of Overweight	P-value
No	1058 (86.2%)	170 (13.8%)		
Yes	1581 (84.6%)	287 (15.4%)	1.13 (0.92 - 1.39)	0.244

Western European

Drunk in the Last Month	Normal Weight	Overweight	OR of Overweight	P-value
No	62 (88.6%)	8 (11.4%)		
Yes	75 (82.4%)	16 (17.6%)	1.65 (0.66 - 4.12)	0.278

Eastern European

Drunk in the Last Month	Normal Weight	Overweight	OR of Overweight	P-value
No	8 (88.9%)	1 (11.1%)		
Yes	20 (76.9%)	6 (23.1%)	2.4 (0.25 - 23.23)	0.439

Central Asia

Drunk in the Last Month	Normal Weight	Overweight	OR of Overweight	P-value
No	6 (66.7%)	3 (33.3%)		
Yes	8 (66.7%)	4 (33.3%)	1 (0.16 - 6.25)	0.99

East Asia

Drunk in the Last Month	Normal Weight	Overweight	OR of Overweight	P-value
No	6 (75%)	2 (25%)		
Yes	14 (100%)	0 (0%)	NA	0.05

Middle East

Drunk in the Last Month	Normal Weight	Overweight	OR of Overweight	P-value
No	21 (75%)	7 (25%)		
Yes	74 (74%)	26 (26%)	1.05 (0.4 - 2.77)	0.915

South Asian

Drunk in the Last Month	Normal Weight	Overweight	OR of Overweight	P-value
No	2 (100%)	0 (0%)		
Yes	28 (77.8%)	8 (22.2%)	NA	0.453

African

Drunk in the Last Month	Normal Weight	Overweight	OR of Overweight	P-value
No	2 (50%)	2 (50%)		
Yes	5 (100%)	0 (0%)	NA	0.073

7.3.8. Poor Perceived Wellbeing

Danish

Perceived Wellbeing	Normal Weight	Overweight	OR of Overweight	P-value
Happy	1833 (86.1%)	297 (13.9%)		
Unhappy	69 (84.1%)	13 (15.9%)	1.16 (0.63 - 2.13)	0.625

Western European

Perceived Wellbeing	Normal Weight	Overweight	OR of Overweight	P-value
Happy	111 (83.5%)	22 (16.%)		
Unhappy	5 (71.4%)	2 (28.6%)	2.02 (0.37 - 11.07)	0.41

Eastern European

Perceived Wellbeing	Normal Weight	Overweight	OR of Overweight	P-value
Happy	33 (78.6%)	9 (21.4%)		
Unhappy	3 (100%)	0 (0%)	0	0.37

Central Asia

Perceived Wellbeing	Normal Weight	Overweight	OR of Overweight	P-value
Happy	14 (73.7%)	5 (26.3%)		
Unhappy	1 (100%)	0 (0%)	0	0.554

East Asia

Perceived Wellbeing	Normal Weight	Overweight	OR of Overweight	P-value
Happy	18 (90%)	2 (10%)		
Unhappy	0	0	NA	NA

Middle East

Perceived Wellbeing	Normal Weight	Overweight	OR of Overweight	P-value
Happy	128	68		
	(65.3%)	(34.7%)		
Unhappy	6 (100%)	0 (0%)	0	0.077

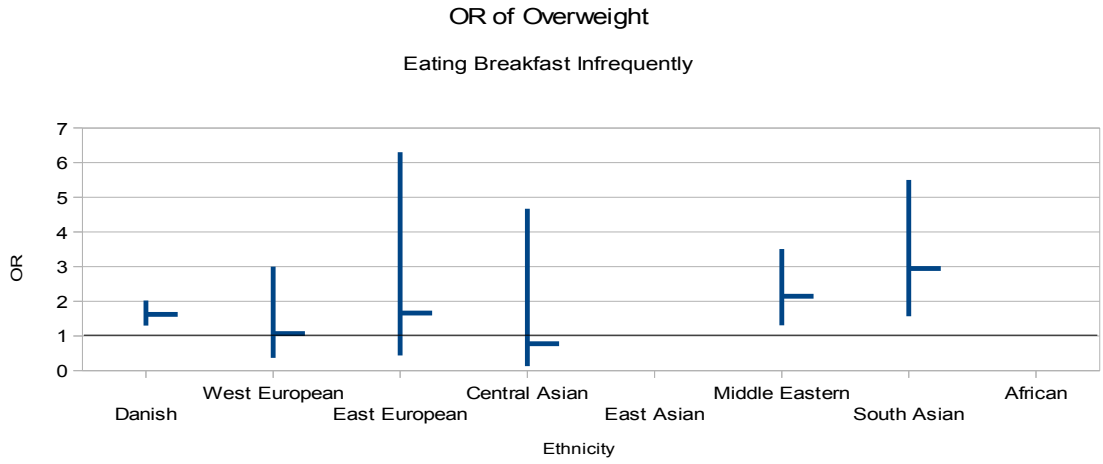
South Asian

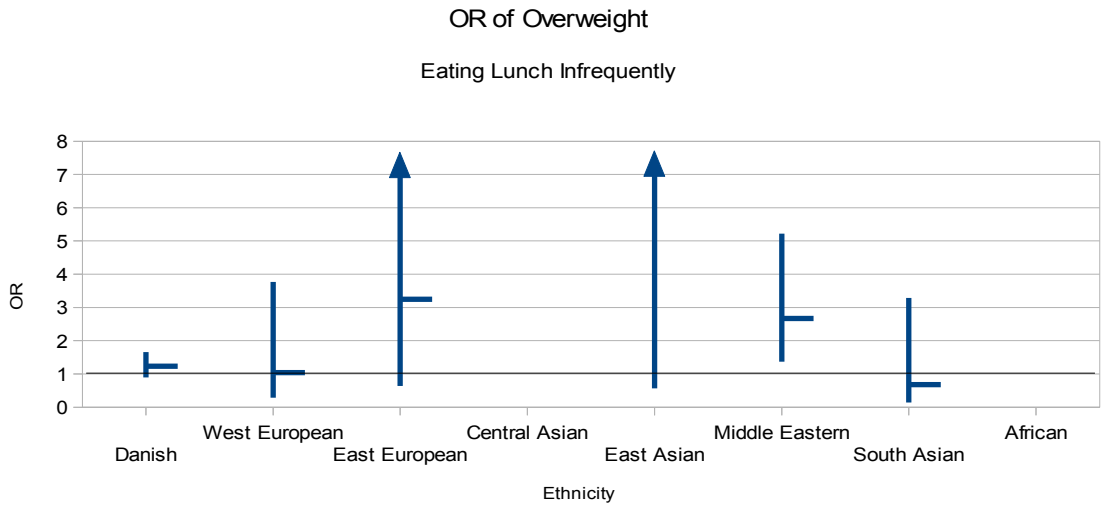
Perceived Wellbeing	Normal Weight	Overweight	OR of Overweight	P-value
Happy	53 (76.8%)	16 (23.2%)		
Unhappy	1 (100%)	0 (0%)	0	0.584

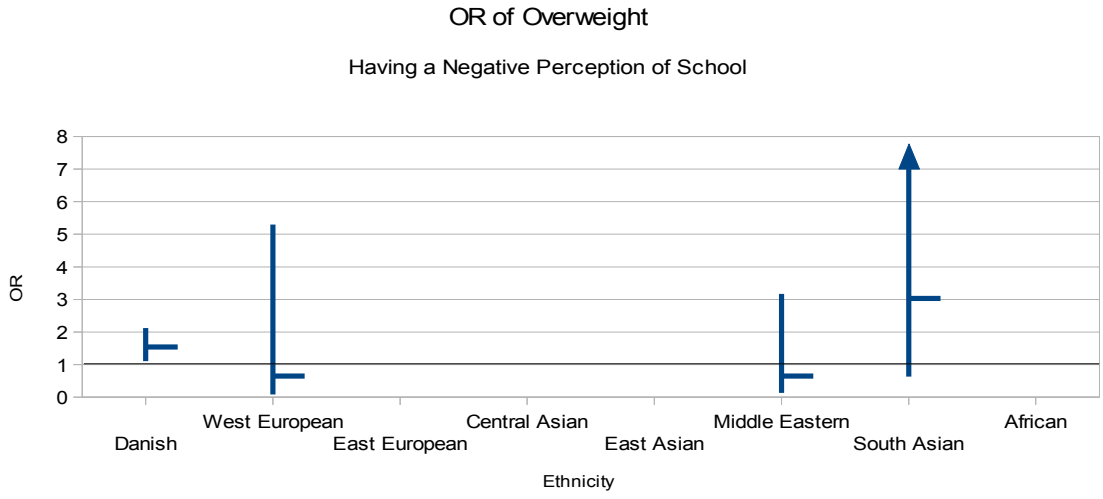
African

Perceived Wellbeing	Normal Weight	Overweight	OR of Overweight	P-value
Happy	7 (77.8%)	2 (22.2%)		
Unhappy	0	0	NA	NA

7.4 Figures for Stratified ORs for Overweight

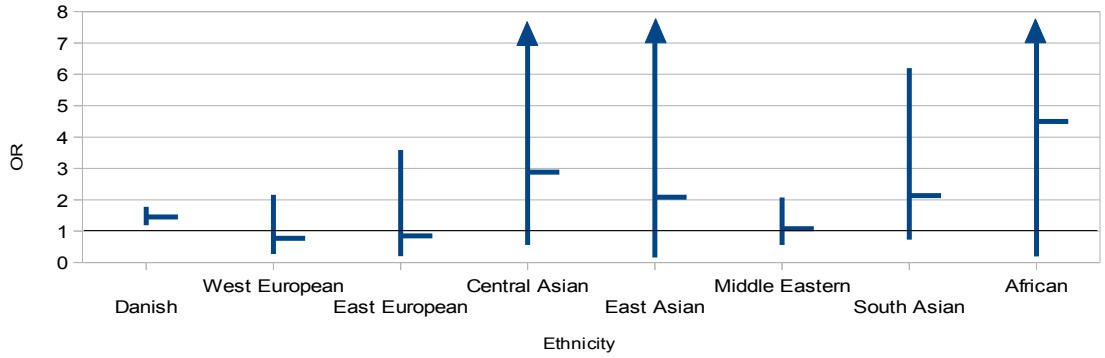






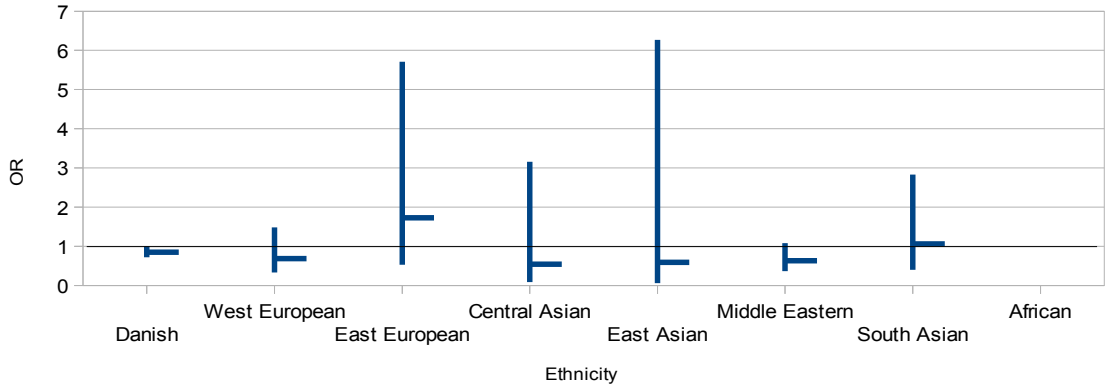
OR of Overweight

Using a Non-Exercise Mode of School Transportation



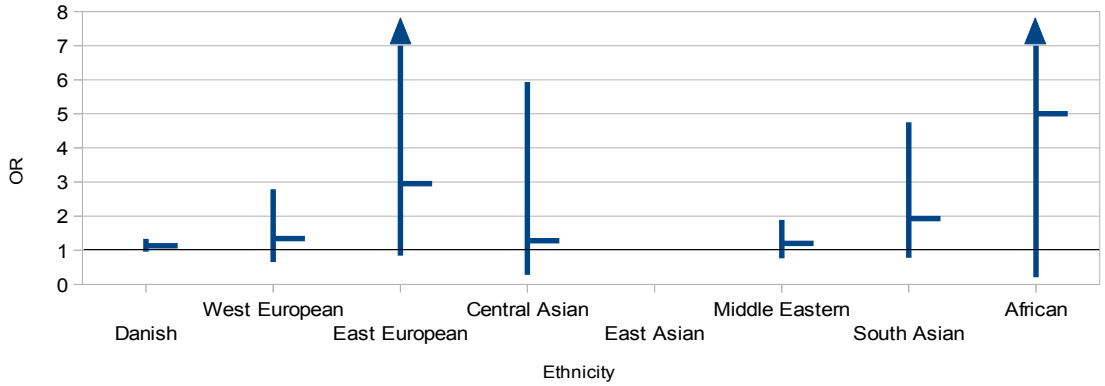
OR of Overweight

Being a Worker



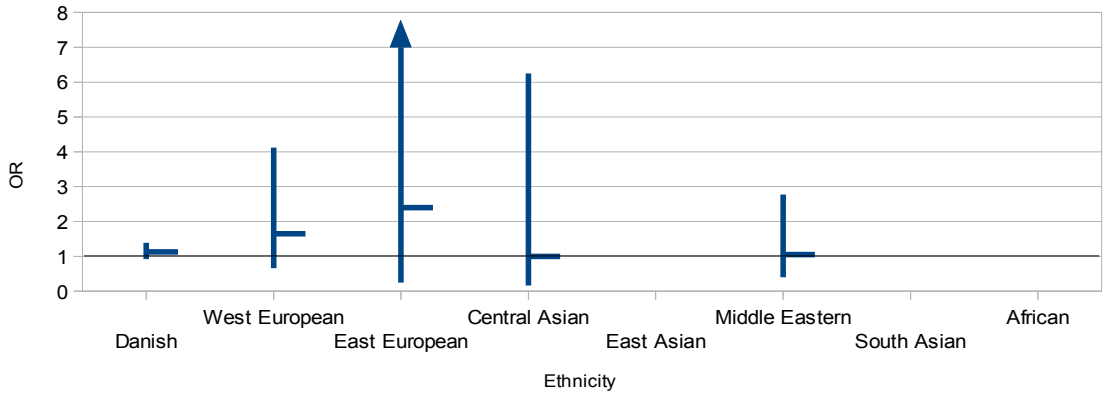
OR of Overweight

Being a Boy



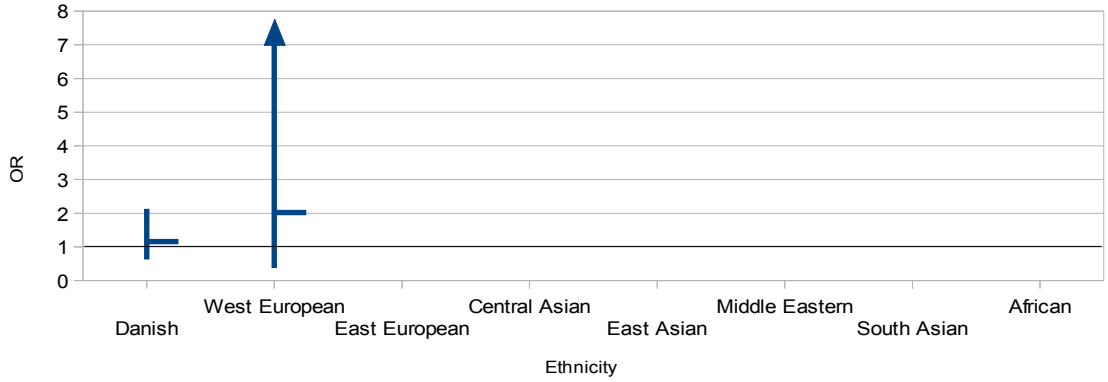
OR of Overweight

Having Been Drunk in the Last Month

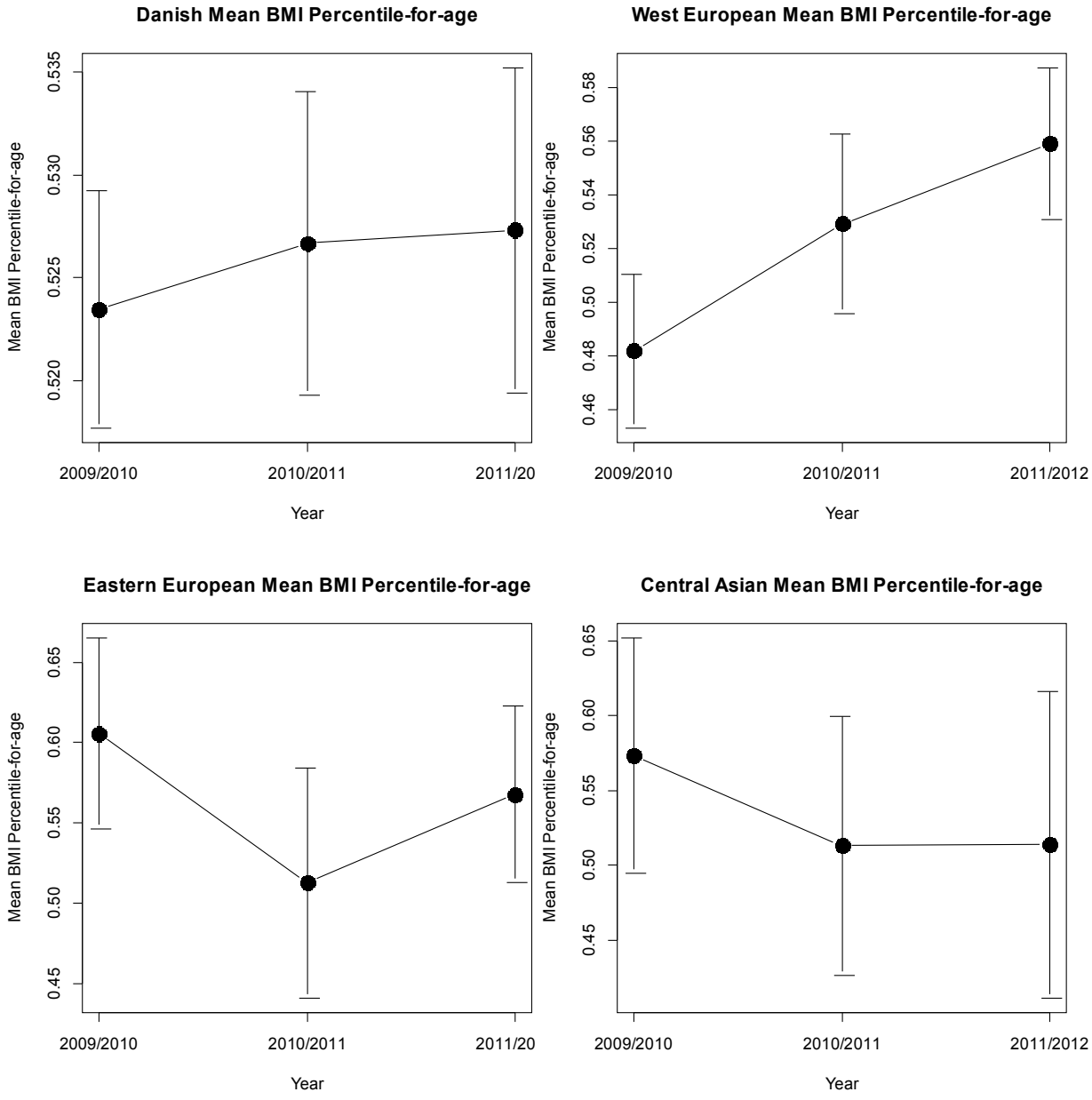


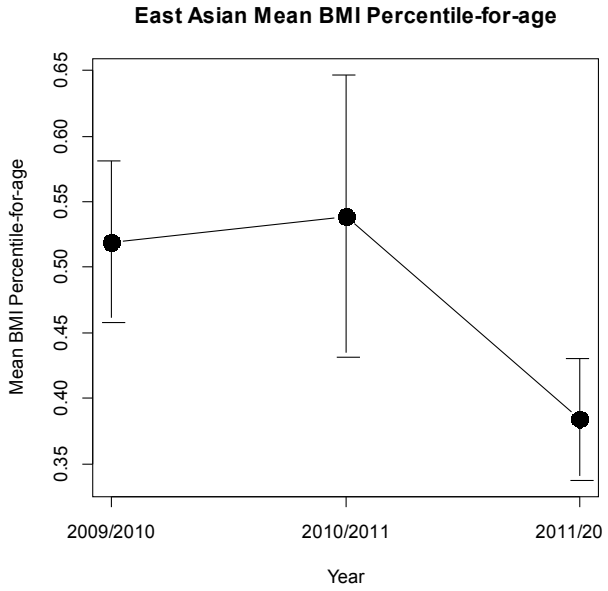
OR of Overweight

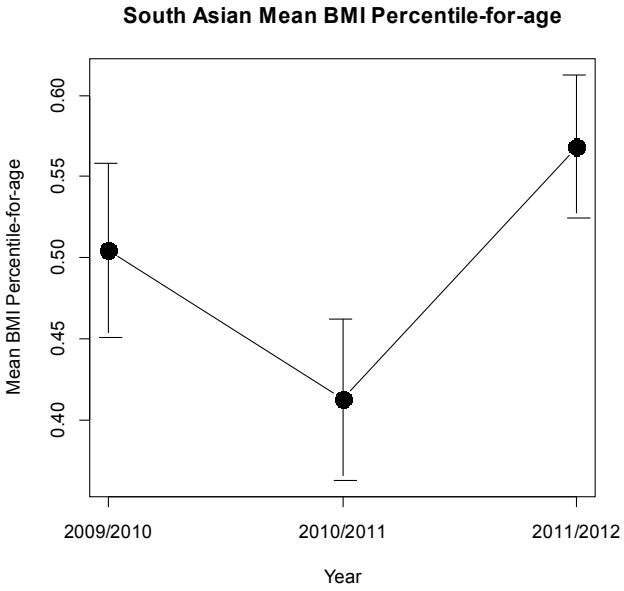
Poor Perceived Wellbeing

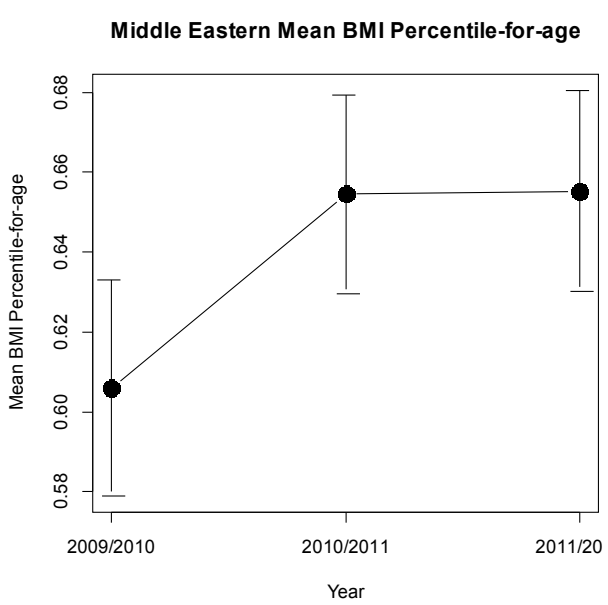


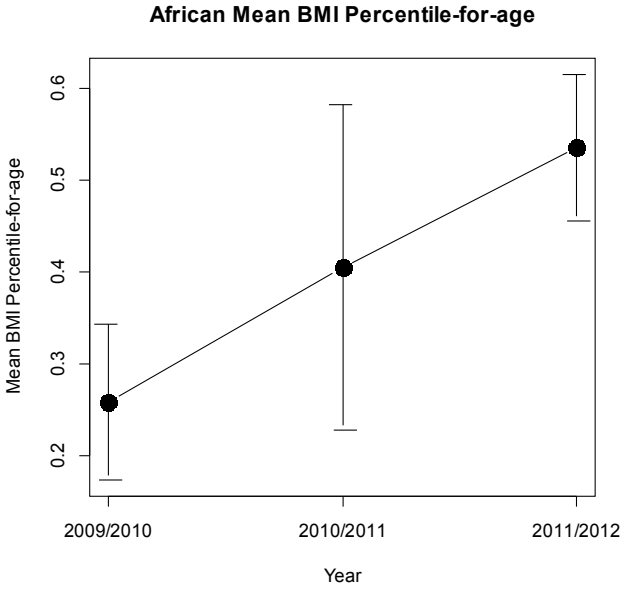
7.5 Mean BMI Percentile-for-age Over Time by Ethnicity



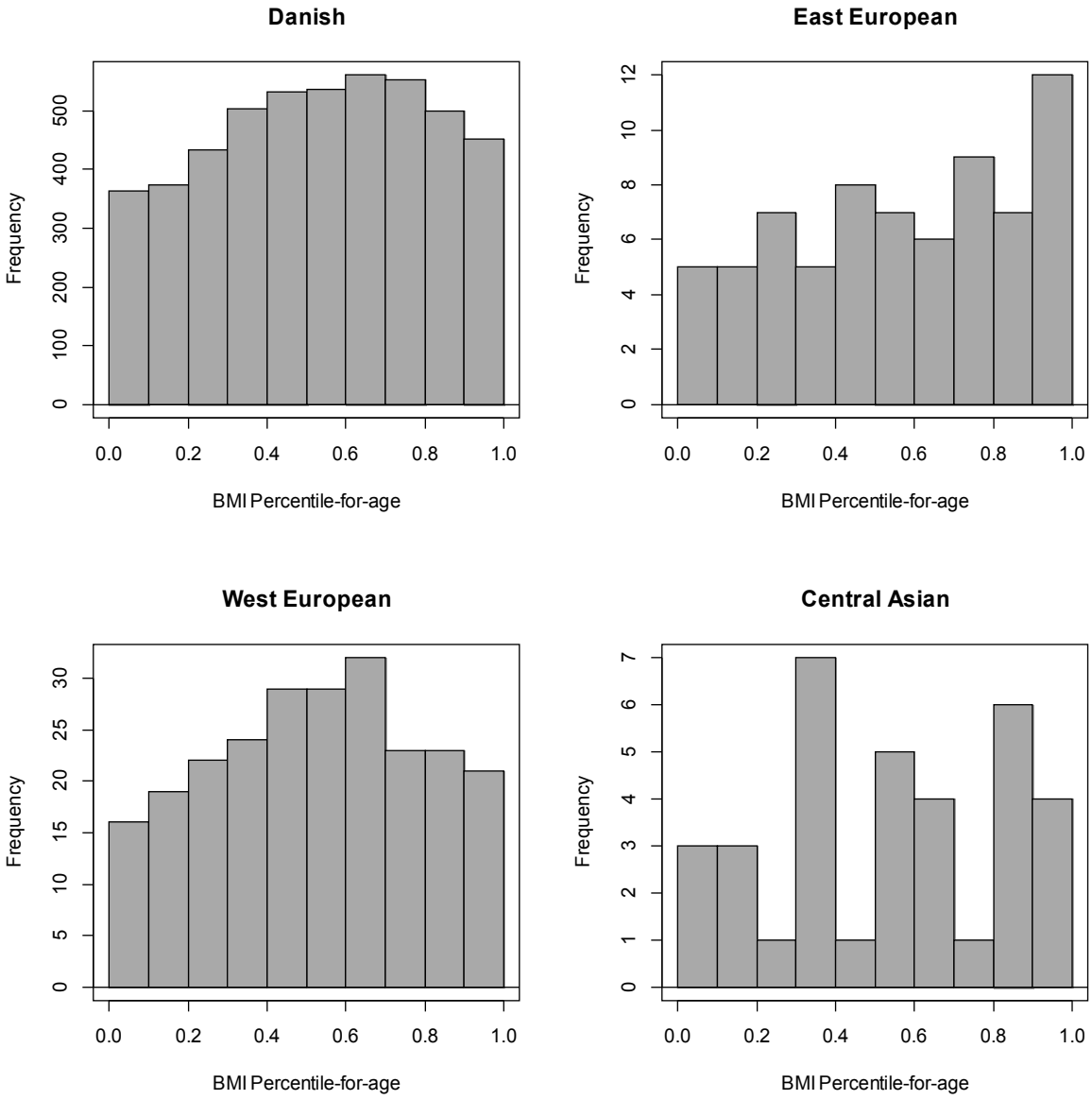

East Asian Mean BMI Percentile-for-age
Mean BMI Percentile-for-age
0.35
0.40
0.45
0.50
0.55
0.60
0.65
2009/2010
2010/2011
2011/20
Year

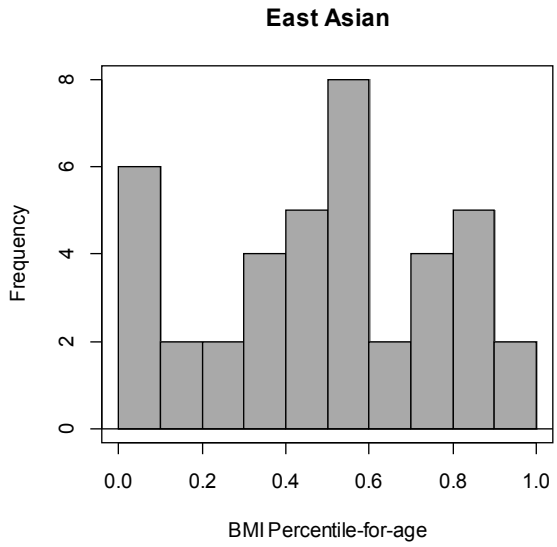

South Asian Mean BMI Percentile-for-age
Mean BMI Percentile-for-age
0.40
0.45
0.50
0.55
0.60
2009/2010
2010/2011
2011/2012
Year

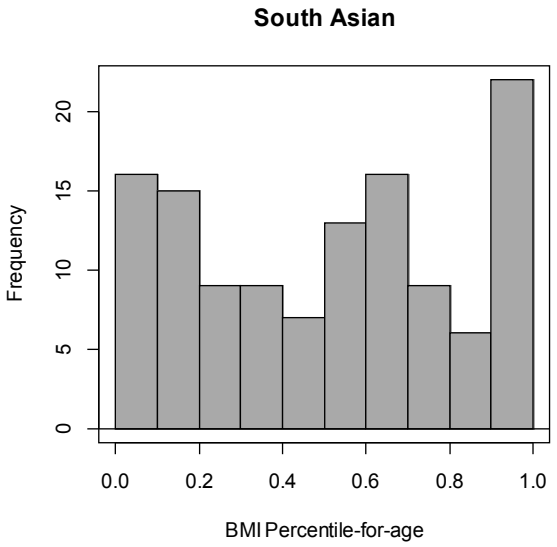

Middle Eastern Mean BMI Percentile-for-age
Mean BMI Percentile-for-age
0.58
0.60
0.62
0.64
0.66
0.68
2009/2010
2010/2011
2011/20
Year

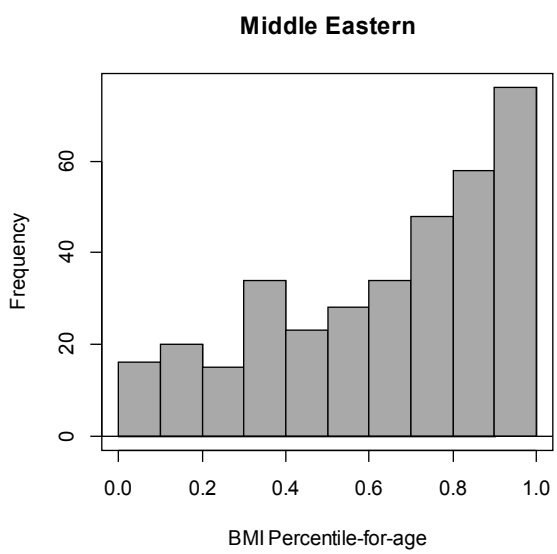

African Mean BMI Percentile-for-age
Mean BMI Percentile-for-age
0.2
0.3
0.4
0.5
0.6
2009/2010
2010/2011
2011/2012
Year

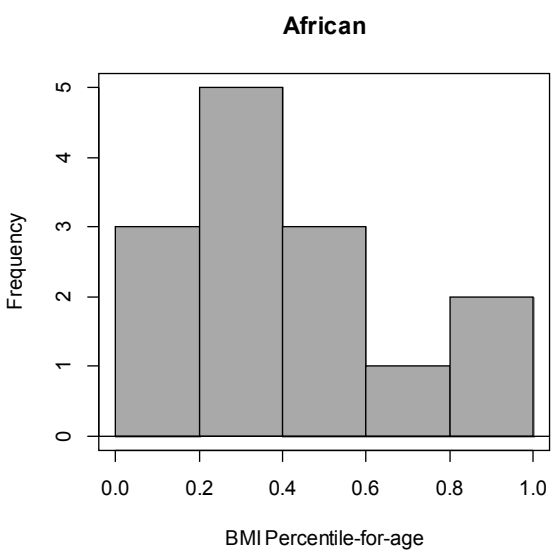
7.6 Distributions of BMI Percentile-for-age by Ethnicity




East Asian
Frequency
0
2
4
6
8
0.0
0.2
0.4
0.6
0.8
1.0
BMI Percentile-for-age


South Asian
Frequency
0
5
10
15
20
0.0
0.2
0.4
0.6
0.8
1.0
BMI Percentile-for-age


Middle Eastern
Frequency
0
20
40
60
0.0
0.2
0.4
0.6
0.8
1.0
BMI Percentile-for-age


African
Frequency
0
1
2
3
4
5
0.0
0.2
0.4
0.6
0.8
1.0
BMI Percentile-for-age

7.7 Overweight and Obesity Prevalence: Cole versus CDC

	Cole			CDC		
Language Spoken at Home	**Normal**	**Overweight**	**Obese**	**Normal**	**Overweight**	**Obese**
Danish	3957 (82.8%)	673 (14.1%)	150 (3.1%)	4082 (85.4%)	487 (10.2%)	211 (4.4%)
West European	198 (83.9%)	32 (13.6%)	6 (2.5%)	202 (85.6%)	25 (10.6%)	9 (3.8%)
East European	52 (73.2%)	13 (18.3%)	6 (8.5%)	56 (78.9%)	8 (11.3%)	7 (9.9%)
Central Asian	26 (74.3%)	9 (25.7%)	0 (0%)	26 (74.3%)	7 (20%)	2 5.7%)
East Asian	34 (85%)	5 (12.5%)	1 (2.5%)	36 (90%)	3 (7.5%)	1 (2.5%)
Middle Eastern	233 (66.6%)	84 (24%)	33 (9.4%)	243 (69.4%)	67 (19.1%)	40 (11.4%)
South Asian	96 (78%)	23 (18.7%)	4 (3.3%)	97 (78.9%)	2 (13.8%)	9 7.3%)
African	12 (85.7%)	2 (14.3%)	0 (0%)	12 (85.7%)	2 (14.3%)	0 (0%)