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Review

Importance of not skipping breakfast: a review

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Summary Breakfast is most important meal of the day and usually taken after night fast or after a long gap. Various health surveys and cross-sectional studies reported morning meal positive effect on memory recall, children performance, mood, work performance, cognitive function, women health like irregular mensuration and reduction in obesity and effect on body mass index. Still people skip breakfast throughout the world due to several reasons like lack of time, family environment, single-parent family, not feeling hunger in morning or having several misconceptions like thinking of being obese. Skipping morning meal has an adverse effect on health. This review focuses on awareness of breakfast and its positive impact on health as the breakfast skipping trend is increasing around the world and also drawing the attention of researchers to develop convenient, nutritious breakfast options and awareness programmes for significance of breakfast.

Keywords Breakfast, breakfast meal pattern, breakfast surveys, effect on health, skipping breakfast.

Introduction

Regular intake of breakfast is one of the key indicators of a healthy way of living (Rampersaud *et al.*, 2005). Breakfast is one of the significant meal for the human-beings, and good quality breakfast is indispensable for growing people such as children and adolescents, to uphold appropriate fitness. A person without breakfast will not have enough energy to start a morning task because it is the first meal taken after dinner with a long gap. A healthy breakfast should include three major food groups such as grains, milk and fruits. As per the United States Department of Agriculture (USDA) Food & Nutrition Service (2013), it should deliver an adequate amount of protein, fibre, minerals, vitamins and other micronutrients with nominal sugar and fat particularly from processed food groups (National Institute of Nutrition, 2011). Food consumption and hunger are regulated by the hypothalamus, where nucleus arcuatus (ARC) regulate all processes related to energy balance by interaction of peripheral hormonal and metabolic signals. Ghrelin is a peptide produced in stomach, which communicates modifications in food intake to the central nervous system as hunger-provoking hormone (Otto *et al.*, 2005). The influence of ghrelin is linked to the antagonism of the inhibitory effect of leptin on hypothalamic neuropeptide Y (NPY) production (Nakazato *et al.*, 2001; Shintani *et al.*, 2001; Seoane *et al.*, 2004). Breakfast consumption is linked with an array of benefits, comprising superior mental performance in adults and teenagers (Smith & Rees, 2000; O'Sullivan *et al.*, 2009); enhanced nourishment (Barton *et al.*, 2005; de la Hunty & Ashwell, 2007); successful reduction in weight (Lightowler & Henry, 2009) and noticeable hunger satisfaction, control of total calorie consumption in a day and healthy routine (Cho *et al.*, 2003; de la Hunty & Ashwell, 2007; Foster-Schubert *et al.*, 2008; O'Sullivan *et al.*, 2009; Clegg & Shafat, 2010). As per Baltar *et al.* (2018), for breakfast consumption, time is not the single consideration factor, a minimum 50 Kcal energy intake also required during this time; however, the general definition of breakfast is any consumption of meal after long gap of eating. Drewnowski *et al.* (2018) also defined for breakfast skippers as not eaten breakfast or consuming <50 kcal. Family structure is also one of the factors for consumption

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and skipping of breakfast (Levin *et al*., 2012). Children staying with 'both parent's' families were consuming more breakfast than from single-parent families, and mostly among those staying with their father. In recent times, the ratio of adults living in non-traditional family categories has increased and it has a direct impact on adolescent breakfast consumption by changing the family unit.

The frequency of missing breakfast was 33.1% in Brazilian adult study (Baltar *et al*., 2018), the USA found 23% higher values for adults (Song *et al*., 2005), 17.3% (Siega-Riz *et al*., 2000) and 20% (Kant *et al*., 2008), Republic of Korea 17.2% (Yoo *et al*., 2014) and Japan 16.6% (Lee *et al*., 2016). However, Taiwan survey reported ~ 8.0% off morning meal skippers (defined as those who eat breakfast on weekly basis, some of them never had breakfast or others not so often ate breakfast (Huang *et al*., 2010).

In developing countries, decreasing trends were observed for milk consumption by adolescents as well as children and the probable thought linked with the decreasing tendency in cereal-based breakfast consumption (Bowman, 2002; Lioret *et al*., 2010). Keski-Rahkonen *et al*. (2003) stated that avoiding breakfast is related with an increased possibility of having a smoker or consumer of alcohol, doing less exercise or having increased body mass index (BMI). The decline in breakfast consumption on the basis of gender bias also studied and found that girls skip morning meal more often than boys (Keski-Rahkonen *et al*., 2003; Barr *et al*., 2013). An age-related decrease in breakfast intake was also observed and found that generally older adolescents skip breakfast more (Gibson & Gunn, 2011). Reasons related to this were lack of time, loss of hunger in the morning, fatigue or drowsiness or individual habits (Raaijmakers *et al*., 2010). People who wish to lose weight and dieting are also one of the main cause of not eating morning meal (Shaw, 1998; Reddan *et al*., 2002). Some reports revealed that the effects of breakfast practices on energy intake and many reports stated that skipping breakfast causes a compensatory rise in energy intake in next day (Astbury *et al*., 2011). Betts *et al*. (2014) also described that regular breakfast consumption was related with the rise in energy spending during the morning of breakfast. Gibney *et al*. (2018) compiled various breakfast research programmes of different countries and nutrients intake by breakfast consumers and skippers. The aim of this review is to discuss on the importance of not skipping breakfast and positive effects on health and creating awareness among people, factors of avoiding morning meal and the negative health effects due to skipping, misbelief towards breakfast consumption, several reasons for skipping breakfast, and among these, family environment is one of the factor for breakfast intake and skipping.

Cereal-based breakfast

Starting the day with cereals influenced healthy food choices throughout the whole day. Eating cereals in breakfast, that is the first meal of the day in the morning was linked with increased intake of carbohydrates and fibre and reduced intake of fats during the day (Cho *et al*., 2003; Kafatos *et al*., 2005). Certainly, better agility was related to cereal-based breakfast. Eating of cereals was also related to increased intake of almost all micronutrients which in turn result in improved quality of breakfast (van den Boom *et al*., 2006). Isaksson *et al*. (2008) stated that those who ate whole-grain rye porridge in breakfast had extended satiety till 8 h. Table 1 gives a glimpse of popular breakfast used in different states of India and clearly explains the traditional culture of different states of India breakfast pattern consists of cereals and grains. As cereal-based breakfast is superior to other items like high fat, fried foods and high-calorie items (cold drinks, full-fat ice cream, etc.).

Breakfast meal pattern

A good breakfast should contain portions from different food groups such as milk, fruits or vegetables and cereals. Generally, a breakfast meal should contain one cup of milk, half cup of fruit and/or vegetable juice along with a portion of cereal which may consist of either a slice of bread or a serving of muffin/biscuit/roll or a three-quarter cup of cold dry cereal or a half cup of hot cooked cereal/pasta/noodles/grains etc. The pieces of bread should be prepared from whole-grain or enriched flour while the cereals should also be whole-grain or fortified (USDA, 2019).

As per the Schools meal patterns suggested by USDA (2017), schools should provide one cup of fruit in a day and five cups fruits in a week. Minimum two cups of starchy vegetables should be served in a week from the under-consumed subgroups (dark green, red/orange, legumes) and 'other vegetables' subgroups, during that same week. All grains should be whole-grain-rich. Schools may replace one ounce-equivalent (oz. eq.) of meat/meat alternate for one oz. eq. of grains after the minimum daily grains requirement is met. Calorie content should be 350–500 Kcal up to fifth-grade students, 400–550 Kcal for 6–8th grade students and 450–600 Kcal for 9–12th grade students. Saturated fat should provide <10% of total energy, and trans-fat should be <0.5 g per meal. Sodium content should be <540, 600 and 640 mg for up to 5th grade, 6–8th grade and 9–12th grade students, respectively. All liquid milk should be either skim milk or low fat (≤1% fat). Milk may be plain or flavoured. Table 2 comprises different breakfast patterns studied in different countries.

Table 1 Popular breakfast in different states of India

States	Popular varieties	Ingredients	References
Uttar Pradesh	Aloo Puri (Potato curry and oil fried small chapaties)	Cereals (Wheat, Barley) and vegetables	Vani *et al.* (2013)
Andhra Pradesh	Pesarattu Upma (Whole green lentil Dosa and stuffed with some Upma)	Cereals and pulses	Kannan (2011)
Bihar	Sattu Ka Parathe (toasted gram flour stuffed Indian bread)	Cereals and pulses	Manoharlal *et al.* (2020)
Gujarat.	Khaman Dhokla (Bengal gram fermented food), Khakhra (crispy type of roti)	Pulses (gram lentil or gram flour, Bajra) and cereals	Roy *et al.* (2009), Giridhar (2019)
Maharashtra.	Sabudana Khichdi (Sago spicy mix), poha (Rice flakes), Pav bhaji (Mixed vegetable along with bread)	sago seeds, rice, Cereals (Barley)	Lahari & Kumar (2019)
Madhya Pradesh	Poha and Jalebi (Traditional Indian sweet made up of refined flour)	Cereals (Sorghum, chickpea, flattened rice	Pagote & Rao (2012)
Karnataka	Neer Dosa (thin, fluffy dosa made using rice batter)	Cereals (Finger millet) and pulses	Tamang (2020)
Arunachal Pradesh	Khura (made roti using kuttu ka atta)	Buckwheat pancake, rice	Pandey *et al.* (2017)
Jharkhand	Dhuska (fermented rice lentil product prepared by deep fried and salty)	Cereals, rice	Tamang (2020)
Kerala	Puttu (Steamed rice cake), idli, dosa (Fermented rice products)	rice or buckwheat flour and coconut	Jacob & Pushpanath (2005), Tamang (2020)
West Bengal	Cholar Dal (gram lentil)	Cereal s and pulses	Joshi & Shinde, (2009), Saha (2014)
Odisha	Chura Bhaja (roasted or fried flattened rice flakes and potao chips)	Deep fried flattened rice	Mohanty & Sadual (2019)
Punjab	Gobi Paratha, Aloo Paratha and Paneer Paratha, Stuffed paratha (dough stuffed with potato/Cauliflower/paneer spiced mixture, rolled and cooked in hot tawa with ghee/ oil)	Cereals (Wheat) and vegetable	Vani *et al.* (2013), Bhosale *et al.* (2019)
Rajasthan	Pyaz kachori (fried pastry filled with a spicy onion filling) and dal kachori (round compressed ball prepared using refined flour and filled with mixture of moong and urad dal, spices stuffing and oil fried)	Cereals (Wheat, barley, Bajra) and pulses	Agrawal & Sengupta (2014)
Tamil Nadu	Idli (steamed fermented product made using rice, rava), dosa, vada (rice batter with a hole in the middle and fried)	Cereals (Rice, Gram) and pulses	Koh & Singh (2009), Shyam & Acharya (2019)
Sikkim	Momos (Wheat flour with meat or vegetable and steamed dumpling	Cereals and pulses	Tamang & Thapa (2014), Pandey *et al.* (2017)
Goa	Rice Bhakri (Round roti prepared using wheat, sorghum and coarser than wheat chapatti)	Rice and other cereals	Badgujar *et al.* (2017)

Powers *et al.* (2016) reported that consumption of cereals along with milk increases micronutrients like vitamin B, folate and Iron. This may be due to cereal may have evacuated fat-rich foods from the diet. Similar findings by Deshmukh-Taskar *et al.* (2010) stated that if children and adolescents consumed readily to eat breakfast cereals (RTEC) compared with non-consumers had a lower intake of fat and a higher intake of carbohydrate in their diet. A study with teenagers in New Zealand found that the person who skip breakfast had a greater frequency of snacking (Utter *et al.*, 2007). It is possible that the cereal and milk involvement in breakfast had direct impact on reducing the consumption of fat-rich snacks.

People who consumed cereal-based breakfast had lower body mass index (BMI) than non-consumers regardless the grains were whole or refined (Bazzano *et al.*, 2005). Smith *et al.* (1999) reported that participants who had taken cereal-based breakfast showed a more positive attitude while starting of test session, displayed better performance on a three-dimensional memory task and were more composed after completion of the examination compared to the participants who did not take breakfast.

Breakfast and health

Effect on memory

Better remembrance was related to improved glucose tolerance and the intake of food with a lower glycaemic index (Nabb & Benton, 2006), demonstrating that brain performance, particularly memory-related aspects, may be improved by increase in glucose level amount (Benton & Sargent, 1992). It has also been reported that memory is affected negatively by

Table 2 Survey on breakfast pattern in different countries

Study parameter	Breakfast Patterns	References
371 Korean adults (Three breakfast pattern)	'Rice, vegetables and kimchi (fermented cabbage, typical of Korean cuisine)', 'Potatoes, fruits and nuts' and 'Eggs, bread and processed meat'	Min *et al.* (2012)
A nationally representative survey in Korea (Two breakfast Pattern)	'Traditional Korean pattern' (composed by vegetables, seasonings and condiments, sugar, salt, fish, grains, potatoes and kimchi) 'Dairy-cereal pattern', (containing dairy items, cereals, breads, jellies and fruits)	Yoo *et al.* (2014)
Brazilian breakfast pattern (Two patterns)	Brazilian macro-region: (Brazilian Northern) Meats, making with corn, eggs, milk-based items, tubers/roots/potatoes, savoury snacks/crackers, fruit juices/fruit drinks/ soy-based South eastern Brazilian region – milk, Coffee, tea, cheese, bread and cold cut meats	Baltar *et al.* (2018)
Adolescents food choices at breakfast, Goteborg, Sweden	Sweet baked goods (i.e. cinnamon and danish, buns), ice cream, cakes, cookies, c and desserts, nuts, sweets, jam and sugar, popcorn, potato crisps, cheese doodles and soft drinks	Sjoberg *et al.* (2003)
Breakfast consumption in Spanish children and young people (3534 people aged 2–24 years), Barcelona, Spain	A distinctive morning meal contained milk with cocoa powder/soluble chocolate and sugar, a choice of either breakfast cereals around 34%, biscuits ~ 40%, bread (15%) or sponge, buns, croissants, etc. (10%). Among them 10% of the group usually took orange juice at morning time and ~ 5% different type of fruit or fruit salad	Aranceta *et al.* (2001)
France (2016): A study of 529 children aged 9–11 years in the city of Rennes	Four breakfast patterns were identified: Sweets breakfast ~ 40%, traditional French morning meal ~ 27%, ready-to-eat cereal with milk ~ 18% and dairy and juice at morning time (10%)	Lepicard *et al.* (2017), Gibney *et al.* (2018)
Mexican National Food Consumption Survey (3760 children), Mexico	Found six dietary patterns: cereal and milk ~ 6%, milk and sweetened breads ~ 38%, sweetened beverages ~ 10%, tortillas and beans ~ 12%, sandwiches and quesadillas ~ 9%, eggs ~ 8%, breakfast skippers (17%)	Afeiche *et al.* (2017)
United States: The 1994–1996 Continuing Survey of about 23 700 people among which 15 641 adults (aged 18–65 year),	Cereal, toast, Eggs, fruit, fruit juices, tea, coffee and soft drinks	Siega-Riz *et al.* (2000)
Survey from Chile among young (19–29 years), Chileans, Santiago, Chile	Four different breakfast patterns: 'Dairy and cereals', 'healthy', 'traditional salty' and 'traditional sweet'. Breakfast comprises of fruits nearly 54%, cereals (40.0%) and lower intake of dairy-based items (23.0%)	Ministry of Health of Chille (2010–2011), Díaz-Torrente & Quintiliano-Scarpelli (2020)
Nationally representative sample surveyed in the 1995 National Nutrition Survey of 13 858 Australians, Australia	Milk, cereals and bread were the most popular breakfast and < 10% of Australians ate a cooked breakfast	Williams (2002), Gibney *et al.* (2018)
Breakfast in the United States	Food consumed at morning time by US children and adults, the usually eaten foods were baked goods, sweets, whole-grain RTEC and milk, juice and whole fruit	Drewnowski *et al.* (2018), Gibney *et al.* (2018)

skipping breakfast (Benton & Parker, 1998; Smith *et al.*, 1999; Korol, 2002). Eating of breakfast is linked with improved spatial memory (Benton & Sargent, 1992), free recollection and late recognition memory (Smith *et al.*, 1994), but had very less impact on tasks related to attention. Benton *et al.* (2001) found that intake of breakfast was related to improved motivation. In their study, they did a survey on 150 young female adults both fasted and consumed breakfasts of 10 or 50 g corn flakes. They found that those who ate breakfast, and/or a snack, were feeling fuller. They reported that those who had consumed breakfast, as compared to fasting, spend longer trying to recall the words. It was interpreted that consumption of breakfast was related with better motivation. Others also reported that better glucose tolerance was linked with better memory.

Effect on obesity

Breakfast consumption has numerous positive impacts among youth including improved dietary competence, reduced risk of obesity and improvement in mental ability (Pearson *et al.*, 2009). As per Swinburn *et al.* (2004) obesity (defined as body mass index (BMI) >30 kg m^{-2}, daily consumption of breakfast is linked with diets of better nutritional quality and better self-reported health ratings in adults (Nicklas *et al.*, 1998; Williams, 2005) and also linked with a reduced risk of obesity among teenagers (Szajewska & Ruszczynski, 2010). Americans

who avoided breakfast or consumed a fat-rich, low-fibre breakfast showed higher BMI compared to those who consumed whole-grain foods after a long gap (Cho *et al*., 2003). By regular eating of breakfast, a decrease in BMI of adolescent girls was observed (Albertson *et al*., 2007). In Canada, a cross-sectional study (population-based and nationally representative) was conducted by taking >18 years women (non-pregnant and non-lactating) and data were collected and observed that BMI was lower among those consumed ready-to-eat cereal (RTEC)-breakfast than other types of morning meal eaters (Barr *et al*., 2016). Women who consumed RTEC in breakfast were less obese (BMI 25 kg m^{-2}) as compared to non-consumers. RTEC breakfast consumption was interrelated with desired macronutrient availability for reducing obesity and predicted weight status for females but not for males. Still, there is no relationship between total and RTEC breakfast consumption on weight gain and health-related behaviours (Song *et al*., 2005). The glycaemic index of cereal-based breakfast is low which results in the slow release of glucose in the bloodstream. An inverse relationship between the size of breakfast and BMI of male respondents was noticed but the same was not true for female respondents (Kent & Worsley, 2010). The BMI of male vegetarian respondents was less than that of non-vegetarians. Baltar *et al*. (2018) also studied the relationship between breakfast type and BMI and reported that those ate ready-to-eat cereal, cooked cereal or slices of bread for breakfast had lower BMI as compared to breakfast skippers and meat and eggs eaters. The probable reason for this is with a good sources of protein and lower level of fat and sugar and calcium, nutrients currently related with a lower weight gain (Pasiakos *et al*., 2015; Pannu *et al*., 2016).

Effect on cognitive function

Breakfast consumption improves mental performance in a teenage population as compared to breakfast exclusion (Cooper *et al*., 2011). Smith *et al*. (2002) reported that stress was linked with increased cortisol levels while regular consumption of cereal-based breakfast was linked with reduced cortisol levels. Youngsters, who regularly consume breakfast, have reported better exercise patterns (Keski-Rahkonen *et al*., 2003) and reasoning or intellectual performance (Hoyland *et al*., 2009). Breakfast intake is reported to help in improving mental performance related to memory, performance in examinations and school attendance (Rampersaud *et al*., 2005). A better-quality breakfast can impact positively on youngsters' mental health (O'sullivan *et al*., 2009) and improve whole diet quality (Matthys *et al*., 2007; Raaijmakers *et al*., 2010). Eating a larger breakfast was also concomitant with better presentation on a test of speaking fluency (Wyon *et al*., 1997). There were numerous encouraging impacts on mood after breakfast consumption, viz. increase in self-report awareness. Breakfast consumption showed no impact on attention and had a favourable effect on the accuracy of visual and three-dimensional memory (Widenhorn-Müller *et al*., 2009). Breakfast, as a determining factor of body image satisfaction and its eating, had an acute impression on temperament (Lloyd *et al*., 1996).

Effect on performance of children

Breakfast consumption is believed to be linked with nutritional fulfilment, optimum body weight and educational performance in teenagers as well as children (Albertson *et al*., 2009; Szajewska & Ruszczynski, 2010). Several other reports also stated that breakfast influenced the output presentation of school-children (Owens *et al*., 1997; Wyon *et al*., 1997). Variations in physical activity were also observed for those who had cereal-based breakfast or as an evening meal and found better performance. If breakfast is provided at school, it has a positive effect on nutritional status of the children as well as the effect on children's weight and height gain, positive effect on attendance, school performance like the interaction between programmes (Cueto, 2001). The relationship between the aptitude of children towards their school work and the size of breakfast as well as the need for mid-morning snacks has been evaluated. The students who has a smaller breakfast of around 61 kcal significantly worked for less time than the students who had consumed higher calorie meals. The contrary effect of a low-calorie breakfast was overturned by the consumption of a mid-morning snack (Benton & Jarvis, 2007).

In Sweden, 9- to 12-year-old schoolgoing children who consumed high-calorie breakfasts and exercised for a longer time in a morning physical exercise class and also scored better in speaking fluency test (Wyon *et al*., 1997). In 9- to 12-year-old children, breakfast instead of fasting improved mental performance (Mahoney *et al*., 2005). The academic performance of 9- to 12-year-old well-nourished American students was improved when they consumed breakfast (Pollitt *et al*., 1981, 1982). Breakfast considerably enhanced academic performance and lowered non-attendance and sluggishness (Benton *et al*., 2001). In 12- to 13-year-old children, consumption of breakfast cereals reduced the drop in attention and recall which transpired after 3 h when children fasted or had a glucose drink (Wesnes *et al*., 2003).

Effect on women health

Fujiwara (2003) observed that young women who generally tend to miss breakfast have a considerably more occurrence of indications of dysmenorrhoea compared to young women who regularly consume breakfast,

which suggests a positive association between skipping breakfast and menstrual syndromes. Generally, irregular menstruation and dysmenorrhoeal and premenstrual syndrome are measured as representative menstrual disorders (Deligeoroglou, 2000). Fujiwara & Nakata (2010) reported the relationship between breakfast skipping and reproductive function. They surveyed among 18- to 21-year-old female college-going students. The five surveys on annual basis showed that the incidence of dysmenorrhoea was considerably higher among the students who skipped breakfast. The outcome of the survey suggested that breakfast skipping is linked with menstrual disorders and influences the physical state of college-going female students who were undergoing post-adolescent maturation. These menstrual ailments may impact the quality of life of young women in the present as well as in the future.

Breakfast habits and family environment

The identification of the effects of regular consumption of breakfast is essential for developing the interventions intended at encouraging healthier food behaviours among the young population. Habits affecting health are developed in the family, by the attitudes and beliefs of parents, behaviours significantly affecting the health behaviours of children (Tinsley, 2003). Moreover, observations suggest that food preferences as well as food behaviours developed at a young age may strengthen with increasing age (Mikkila *et al*., 2004). Latest reviews have noticed that parental food consumption patterns are persistently and positively linked with both healthy (Pearson *et al*., 2009) and unhealthy (Horst *et al*., 2007) food choices of children as well as teenagers. Moreover, there is substantial indication that family background is a key parameter for influencing the food preferences of children as well as teenagers (Crockett & Sims, 1995; Story *et al*., 2002; Patrick & Nicklas, 2005; Shepherd *et al*., 2006). Parents should be inspired to become a positive examples for their child by improving their food behaviours and the whole family as a single unit should be considered while designing programmes to encourage healthy breakfast patterns (Pearson *et al*., 2009). Family structure was certainly linked with the breakfast consumption behaviour of girls above 10 years (Franko *et al*., 2008). A German study carried out in children and teenagers observed that RTEC is preferred over bread (Alexy *et al*., 2010). A study conducted in Scotland from 1994 to 2010 explains alterations in daily breakfast consumption patterns among teenagers. They observed that the habit of daily breakfast consumption in teenagers improved between these years but the teenagers who are aged more than 14.5 years shown a reduction in breakfast consumption and the increased tendency was found in teenage girls than boys. The habit of daily breakfast consumption was more predominant among teenagers who were living with both the parents, while the lowest prevalence among those who were living with a single parent. Scotland surveyed in Scottish Health Behaviour in School-aged Children (HBSC) having an age of girls and boys between 11 and 15 years by taking data of the year 1994, 1998, 2002, 2006 and 2010 and found that daily breakfast consumption increased among adolescents between 1994 and 2010, but variances were observed based on age and sex. Children above 14.5 years observed decreases in morning meal intake and girls were skipping more than boys. Daily breakfast consumption patterns from 1994 to 2010 also influenced by family structure. The largest section of the people and frequency of regular breakfast consumption were greater than before among those living with both parents, and frequency decreased with time among teenagers of single-parent families, and particularly among those teenagers who were living with their father (levin *et al*., 2012). A French study reported that approximately 35% of French children preferred RTEC, while around 40% preferred bread (Bellisle & Rolland-Cachera, 2007). European multicentre Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) Study with two 24 h dietary recalls of 3137 teenagers were offered food items such as RTEC/bread, milk/yogurt and fruit and macro- as well as micro-nutrient intakes at breakfast and observed that compared to bread breakfasts (39%), RTEC breakfast (19.5%) and all other breakfasts (41.5%) were linked with the enhanced nutrient intake (less sucrose as well as fat; more fibre, more protein and micronutrients like calcium, magnesium, phosphorus and vitamin B) at the breakfast among European teenagers, RTEC consumers exhibited a more favourable nutrient intake than those who consumed bread or other breakfasts, except for simple sugars (Michels *et al*., 2016).

Effects of skipping breakfast

Breakfast is always considered as the most essential meal of the day; however, the young population is more likely to skip breakfast (Dwyer *et al*., 2001) with approximately 50% of young persons aged between 6 and 11 regularly consume breakfast (Mahoney *et al*., 2005). Missing breakfast is very common among many teenagers in developed countries with the incidence of skipping breakfast ranging from 3% (Dialektakou & Vranas, 2008) to 34% (Rampersaud *et al*., 2005). Furthermore, the frequency of missing breakfast in children and teenagers is increasing (Siega-Riz *et al*., 1998). The various studies conducted by different countries related to skipping breakfast are given in Table 3.

Consumption of carbohydrate, fibre, calcium, iron, folic acid, thiamine, riboflavin and vitamins A, C and

Table 3 Breakfast skipping and its study parameter

Country	Study parameter	Breakfast skipping	References
United States (2001–2008)	NHANES data (Children 4057)	19%	O'Neil *et al.* (2014)
United States (2001–2008)	NHANES data (adults 10 431)	19.7%	O'Neil *et al.* (2014)
Mexico (2017)	National Food Consumption Survey (Children 3760)	17%	Afeiche *et al.* (2017)
Australia (2017): National Nutrition and Physical Activity Survey (2011–2012) by 24-h recall method	Breakfast patterns with children and young people (aged 2–18 years) = total 2821	9%	Fayet-Moore *et al.* (2017)
Brazil (2017): National Dietary Survey (2008–2009) using two 24-h recalls	Sample size = 34 003 (among that children 7276 and youngsters aged 10–19 years)	7%	Pereiraa *et al.* (2017)
Canada (2004): Nationally representative Canadian Community Health Survey	Children (aged 4–18 year) = 12 281 and youngsters above 19 year = 19 913	Children = 10% and adults = 11% skippers	Barr *et al.* (2013), Barr *et al.* (2014)
Korea (2009): National Health and Nutrition Survey (2001) using 24-h recall	Children = 1600 teenagers aged between 7 and 18 years	<10%	Yeoh *et al.* (2009)
UK (2017): National Diet and Nutrition Survey Rolling Programme using a 4-day diary	breakfast consumption and nutrient patterns of children (1686) and teenagers aged between 11 and 18 years	17%	Coulthard *et al.* (2017)
United States (1994–1996): Survey of food consumption by people	About 23 700 persons among that 15 641 adults (aged from 18 to 65)	23.0%	Siega-Riz *et al.* (2000)

E was higher in people consuming regular breakfast than breakfast skippers. Fibre, calcium, iron and folate intake was about 33%, 37%, 47% and 68% higher respectively for regular breakfast consumers. The average folate intake for breakfast consumers was 68% higher than that of the skippers. Farshchi *et al.* (2005) reported that skipping breakfast weakens fasting lipids and postprandial insulin sensitivity and could result in an increase in weight if the higher energy intake was persistent.

Approximately 25% of the total Australian adults and children and several other countries skip breakfast (Williams, 2002; Keski-Rahkonen *et al.*, 2003). Such breakfast consumption behaviours may pose a major public health problem. Moreover, a nutritious breakfast is consumed among just 10% or fewer of adolescents from Belgium (Matthys *et al.*, 2007) and the Netherlands (Raaijmakers *et al.*, 2010).

In Brazil (2005), a study was conducted to illustrate the nutritional quality of Brazilian teenagers focusing on their breakfast habits. In this cross-sectional study, 1133 schoolgoing children (10–14 years old) were selected, in Niterói, Brazil, and information about breakfast consumption was collected using 24 h dietary recall. From this study, it was found that 16% had not consumed breakfast on the day of survey while omitting breakfast was more common among obese than among non-obese children and among those students studying in the morning shift than those studying in the afternoon shift. The average daily energy, macronutrient, calcium as well as vitamin A consumptions were considerably more among individuals who regularly consumed breakfast than those who skipped breakfast frequently. They also observed that breakfast contribution was around 18% to the daily energy intake. The food profile analysis revealed that breakfast can be categorised by the type of beverage consumed in the meal, and five different consumption patterns were recognised: tea or coffee, milk or milk-based beverages, sweetened beverages, no beverage consumption and two or more type of beverages. The study discovered that the dietary breakfast varieties of Brazilian adolescents were associated with the daily energy and nutrient intake and the type of beverage consumed during breakfast. Sugar-based beverages increased obesity and considered low-quality diet while milk and milk-based beverages resulted in increased intake of calcium and vitamin A throughout the day. Such outcomes can encourage healthy eating behaviour and reduce the consumption of sugar-based drinks, as they increase obesity and other related diseases across the globe (dos Santos Correa *et al.*, 2016).

The school breakfast program (SBP)

The School Breakfast Program (SBP) is a centrally assisted meal programme operating in public and non-profit private schools and residential child care institutions. The SBP started in the year of 1966 as a pilot project and was made a permanent entitlement programme by Congress in 1975. The Food and Nutrition Service (FNS) of the United States Department of Agriculture (USDA) governs the Program at the central level.

Involvement in the SBP has increased steadily over the years from 0.5 million children in 1970 to 3.6

million children in 1980; 4.0 million children in 1990; 7.5 million children in 2000; 11.67 million children in 2010; and 14.57 million children in 2016 (USDA, YEAR). Under this programme, schools having a higher share of low-income students (a minimum of 40% children receive free or low-price lunch) are considered *severe need* schools and are eligible for a higher reimbursement rate. Under this programme, a conventional, cafeteria-based breakfast model, schools may also consider or an alternative breakfast model. For example, *Breakfast in the Classroom* involves serving the breakfast to children during a morning class, often while the teacher is taking attendance or giving classroom announcements. Schools operating *Grab & Go Breakfast* serve children a breakfast *to go*, often in a plastic or paper bag, before school or during a morning break (USDA, 2017; https://www.fns.usda.gov/sbp/sbp-fact-sheet).

Conclusions

Breakfast has a positive effect on health such as improved daily routine activity, cognitive function, memory recall, improve children's performance and women's health. However, skipping breakfast increases obesity, body mass index and reduces activity and performance during a day. A healthy breakfast should contain more fibre and protein, less sugar and fat and rich in vitamin A, vitamin B, minerals (Calcium, iron, magnesium) for the positive effect on health, cereal-based breakfast increase glycaemic load and glycaemic index. By knowing significance of breakfast, breakfast was included in various school programmes. Among the family environment patterns, the breakfast skipping pattern was found more in single parent-child. More awareness is required to focus on breakfast consumption and more research required for the development of convenient, 'grab and go' breakfast options so people can consume those have problems like lack of time in the morning, single parent, nuclear family. Ready-to-eat cereal-based breakfast (RTEC) can be considered as a decent breakfast choice due to a diverse and stable diet.

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Author contribution

Rekha Rani: Conceptualization (equal); Data curation (equal); Writing-original draft (lead); Writing-review & editing (equal). **Chetan N Dharaiya:** Conceptualization (equal); Writing-review & editing (equal). **Bhopal Singh:** Conceptualization (equal); Data curation (equal); Resources (equal); Writing-review & editing (equal).

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There is no conflict of interest among authors.

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Ethics approval was not required for this research.

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Data availability statement

The breakfast skipping data of different countries covered related to title. The authors are encouraged for data sharing, mandates for data sharing and peer review of data.

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