Childhood Overweight/Obesity and Food Environment Around Schools: Global Review of Evidence, South Asian Policy Analysis and Critique of the Indian Food Regulation 2019

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To my parents,
Smt. Kailashi Bhargava and Shri. Ashok Kumar Bhargava
for giving me the two precious gifts: birth and education.

Abstract

Background Indian government recently passed food regulations to promote healthy eating among school children. A part of these regulations prohibits sale and marketing of unhealthy foods high in fat, sugar and salt within 50m of schools. It is not clear to what extent the buffer distance of 50m is evidence based or how it compares to the evidence related to food outlet proximity to schools. Therefore, this study seeks to assess the evidence-base for restricting the distance to which fast food outlets can be established, explore the policies addressing overweight/obesity the South Asia region and analyse the adequacy of the regulation in light of these two pieces of research.

Objectives

1. To review the past and current nutrition-related policies aimed at reducing overweight/obesity directly or indirectly in South Asia.
2. To examine how proximity of food outlets to schools affects the overweight/obesity risk among school students.
3. To review the 50m buffer distance between food outlets and schools specified in the Indian food regulations 2019.

Methods A review and critical analysis of policies relating to nutrition and overweight/obesity in South Asian region was carried out. A scoping review was conducted to appreciate and analyse the existing evidence relating to proximity of schools to food outlets and overweight/obesity and dietary intake/behaviour among children. Indian food regulations' clause on 50m distance of food outlets around schools was critically analysed based on the findings of the first two.

Results The policy review found that the South Asian region lacks nutrition-focused policies to address the rising burden of overweight/obesity. The scoping review found that shorter distance between unhealthy food outlets and schools is associated with overweight/obesity and poor dietary behaviour among students. From these two results it was clear that Indian government's response to the rising burden of overweight/obesity in the country was not evidence-based and the 50m distance specified in the Indian food regulation 2019 needs to be urgently reviewed for its efficacy prior to implementation.

Keywords: Childhood overweight/obesity, Dietary intake, Dietary behaviour, Unhealthy food, Food high in Fat, Salt and Sugar (HFSS), South Asia.

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Abbreviations

CDC Center for Disease Control

DBM Double Burden of Malnutrition

FBO Food Business Operators

FEAS Food environment around school

FFR Fast food restaurant

HFSS High in fat, sugar and salt

SAR South Asian Region

Chapter 1

Introduction

Childhood overweight/obesity problem Childhood overweight/obesity is one of the major public health challenges of the 21st century (Lobstein et al., 2015; 2004; Shivpuri et al., 2012). According to the World Health Organization (WHO), 340 million children aged 5-19 years were overweight/obese in 2016 and in 2019 about 38 million children below the age of 5 years were overweight/obese (World Health Organization, 2020). Member states of the WHO in the "Comprehensive Implementation Plan for Maternal, Infant and Young Child Nutrition" have endorsed "no increase in childhood overweight by 2025" as one of the six nutrition targets (World Health Organization, 2014). Childhood overweight/obesity is particularly worrisome due to its short-term and long-term impact on children's health (Table I).

Table I: Table showing the short-term and long-term consequences of childhood obesity.

Short term effect of obesity	Long term effect of Obesity
Psychological comorbidities: low self-esteem, anxiety and depression, emotional and behavioural disorders (Quek et al., 2017; Rankin et al., 2016). Increased cardiovascular risk factors high blood pressure (Brady, 2017), dyslipidaemia (Cook and Kavey, 2011)	Increased risk of developing cardiovascular diseases (Bridger, 2009), diabetes (Pulgaron and Delamater, 2014), musculo-skeletal disorders (Krul et al., 2009) and some cancers (Weihrauch-Blüher et al., 2019).

South Asian Context Particularly in the South Asian region (SAR) childhood overweight/obesity has been rising (Mistry and Puthuserry, 2015), which is a cause for concern because underweight, low-birth weight, chronic energy deficiency, protein and micro-nutrient deficiency are still highly prevalent in the region (Sadana et al., 2004; Akhtar,

2016). The double burden of malnutrition (DBM) is well-documented for each of these World Bank identified countries in South Asia (World Bank, 2020): Afghanistan (Saeed, 2015; 2016), Bangladesh (Das et al., 2013; Khan and Talukder, 2013; Kamal et al., 2015), Bhutan (Atwood et al., 2014; Wangmo, 2019), India(Ranjani et al., 2016; Ahluwalia, 2015; Unnikrishnan et al., 2012), Maldives (World Bank, 2011; Pengpid and Peltzer, 2020), Nepal (Gupta, 2015; Karki et al., 2019; Acharya et al., 2014), Pakistan (Aziz et al., 2009; Tanzil and Jamali, 2016; Hashmi et al., 2013; Warraich et al., 2009; Mushtaq et al., 2011; Ahmed et al., 2013) and Sri Lanka (Hettiarachchi et al., 2018; Shinsugi et al., 2020).

Double Burden of Malnutrition Table II shows that the prevalence of undernutrition (wasting and stunting) is above 15% for all countries in the South Asian region and the prevalence of overweight among adults exceeds 20% for each country. These data show that the double burden of malnutrition (DBM) is quite significant in South Asia.

Threat to Children Given the evidence of DBM and high proportion of young population in SAR (minimum 20% for Maldives and 42% for Afghanistan), it is clear that childhood obesity is a serious threat. Kindly refer to population pyramids in Appendix Figure 4.1 and 4.2 to see the proportion of young children in SAR. Moreover, children in the SAR born to malnourished mothers suffer from intra-uterine malnutrition and are more likely to become obese in later life (Hales and Barker, 2001).

Given the rising burden of overweight/obesity in the SAR, the consequences of overweight/obesity and high proportion of youth population, it is extremely vital to invest resources in primary prevention of childhood overweight/obesity in the region. School food environment is often seen as an opportunistic setting in this regard. Systematic review by Kelishadi and Azizi-Soleiman (2014) found that school-based programs may have long-term effects on reducing childhood overweight/obesity. Another systematic review and meta-analysis by Pineda et al. (2019) found that behavioural modification among students was possible with the reduction in the availability of sugary drinks and increase in the availability of fruits/vegetables in the school food environment. Welker and Lott M (2016) suggested monitoring food retail establishments around schools to prevent childhood obesity.

School food environment mainly consists of two parts: the within-school food environment and the food environment around schools. In the case of within-school food environment,

banning of sodas, regulating the food items in canteens and tuck shops and free school meals and lunches form the main interventions (Story et al., 2009; Brown and Summerbell, 2009; Sabinsky et al., 2019; Miyawaki et al., 2019). In the case of food environment around schools (FEAS), food retail outlets, especially those selling foods high in fat, sugar and salt (HFSS) form the focal points for intervention. Obesogenic FEAS is an independent risk factor for childhood overweight/obesity (Davis and Carpenter, 2009; Currie et al., 2010; Tang et al., 2014) and could thwart within-school healthy food reforms.

One of the South Asian countries, India has recognised the importance of a healthy school food environment, both within and around schools, to reduce overweight/obesity among children and promote healthy eating. It passed the Food Safety and Standards (Safe food and healthy diets for School Children) Regulations in 2019 (FSSAI, 2019). A section of these regulations restricts the sale/exposure and bans advertisement of unhealthy and HFSS food at a distance of 50m around schools. In the draft regulations these are presented as:

1. School Authority shall ensure that no person shall offer or expose for sale of pre-packaged foods which are referred to as foods high in fat, salt and sugar as per the Food Safety and Standards (Labeling and display) Regulations, 2019 to school children in school canteens/ mess premises/ hostel kitchens or within 50 meters of the school campus.

2. Food Business Operators manufacturing HFSS food products shall not advertise or offer for free sale of such foods to children in school premises or within 50 meters of the School campus.

However, no scientific evidence behind this distance has been specified. Moreover, no plan to test its efficacy was found. Since, the distance protocol directly relates to the food environment around schools, it is crucial to review this distance in light of existing evidence related to school food environment and its impact on student overweight/obesity.

Table II: Descriptive statistics of malnutrition: undernutrition and overnutrition for countries in the South Asian Region.

Country	Stunting prevalence (% of children below 5 years of age) (Year)[1]	Wasting prevalence (% of children below 5 years of age) (Year)[1]	Overweight prevalence (% of children under 5 years of age) (Year)[1]	Overweight prevalence (% adults) (2016)[1]	Obesity prevalence adolescents aged 10-19 (%) (2016)[2]	Obesity prevalence adults aged 18+ (%) (2016)[2]	Diabetes Prevalence (% of population 20-79 years) (2019)[1]
Afghanistan	38.2 (2018)	19.1(2018)	4.1 (2018)	23	2	5	9.2
Bangladesh	30.8 (2018)	21.9(2018)	2.2 (2018)	20	2	3	9.2
Bhutan	–	–	–	27.1	3	6	10.3
India	34.7 (2017)	33.4(2017)	1.6 (2017)	19.7	2	4	10.4
Maldives	–	–	–	30.6	6	8	9.2
Nepal	36 (2016)	27.2(2016)	1.2 (2016)	21	1	4	7.2
Pakistan	37.6(2018)	23.1(2018)	2.5 (2018)	28.4	3	8	19.9
Sri Lanka	17.3 (2016)	20.5(2016)	2 (2016)	23.3	4	5	10.7

[1]Data from World Bank.

[2]Data from Non-Communicable Diseases Country Profile 2018, World Health Organization

– Data not available.

Table III: Descriptive statistics on general population demography for countries in the South Asian region.

Country	Total population in million (2019)	Population aged 0-14 years (% of total population) 2019	Urban population (% of total population) 2018	Current Health Expenditure (% of GDP) 2017
Afghanistan	38.04	42.47	25.8	11.8
Bangladesh	163.05	27.21	37.4	2.3
Bhutan	0.76	25.34	41.6	3.2
India	1,366.42	26.62	34.5	3.5
Maldives	0.53	19.91	40.2	9
Nepal	28.61	29.57	20.2	5.6
Pakistan	216.57	35.05	36.9	2.9
Sri Lanka	21.80	23.96	18.6	3.8

Data from World Bank.

Existing gaps Systematic reviews could help in this review of evidence. da Costa Peres et al. (2020) found that out of the 31 papers used for systematic review, 14 showed direct association between proximity of food outlets to schools and overweight/obesity among children, 13 showed inverse association and 4 showed no association. Williams et al. (2014) found that food outlets near schools affected student body weight. Only these two systematic reviews exist in the field and given the inconclusive evidence from these it is very difficult to comment upon or critically analyse the 50m distance specified in the Indian Draft Regulations. For a more informed analysis, a broader and wider exploratory review of the evidence is required. Such a review will be more useful to theoretically asses the efficacy of the 50m distance restriction.

Research Objective In order to accomplish this theoretical assessment, the dissertation follows a step-wise approach. The first step aims to review the policy and programs in South Asia which target overweight/obesity. This would help in providing a background against which Indian draft regulations could be analysed and critiqued. In the second step, a scoping review is conducted to explore the relationship between proximity of food outlets to schools and overweight/obesity in children. The results of this would facilitate the theoretical assessment of the 50m distance. Finally, based on the results of the scoping and policy review in South Asia, a critique for the 50m distance will be presented.

1.1 Objectives

The objectives are as following:

1. To review the past and current nutrition-related policies aimed at reducing overweight/obesity directly or indirectly in South Asia.
2. To examine how proximity of food outlets to schools affects the overweight/obesity risk among school students.
3. To review the 50m buffer distance between food outlets and schools specified in the Indian food regulations 2019.

Chapter 2 presents the methods used for policy review and scoping review. Chapter 3 presents and discusses the results of policy and scoping review. Chapter 4 presents a critique of the draft regulation based on findings presented in Chapter 3.

Chapter 2

Methods

This chapter discusses methods followed for the South Asian overweight/obesity policy review and scoping review.

2.1 Policy Review

Countries forming the South Asian region were chosen as per World Bank: Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, Pakistan and Sri Lanka (World Bank, 2020).

Search Strategy and Inclusion Criteria For each country in South Asia, nutrition and child-health related policy documents were searched on the websites of Ministry of Health, Education and World Health Organization. On the Ministry websites where search functionality was available, keywords (nutrition, health, child health, overweight/obesity,food) were used to search the relevant documents. In case of India, further search was performed on the website of Food Safety and Standards Authority of India, the apex national body for formulating food related policies in India and Ministry of Women and Child Development. Additional Google Search was also performed to obtain relevant documents. In case the obtained document was in regional language, Google Translate was used to translate it into English.

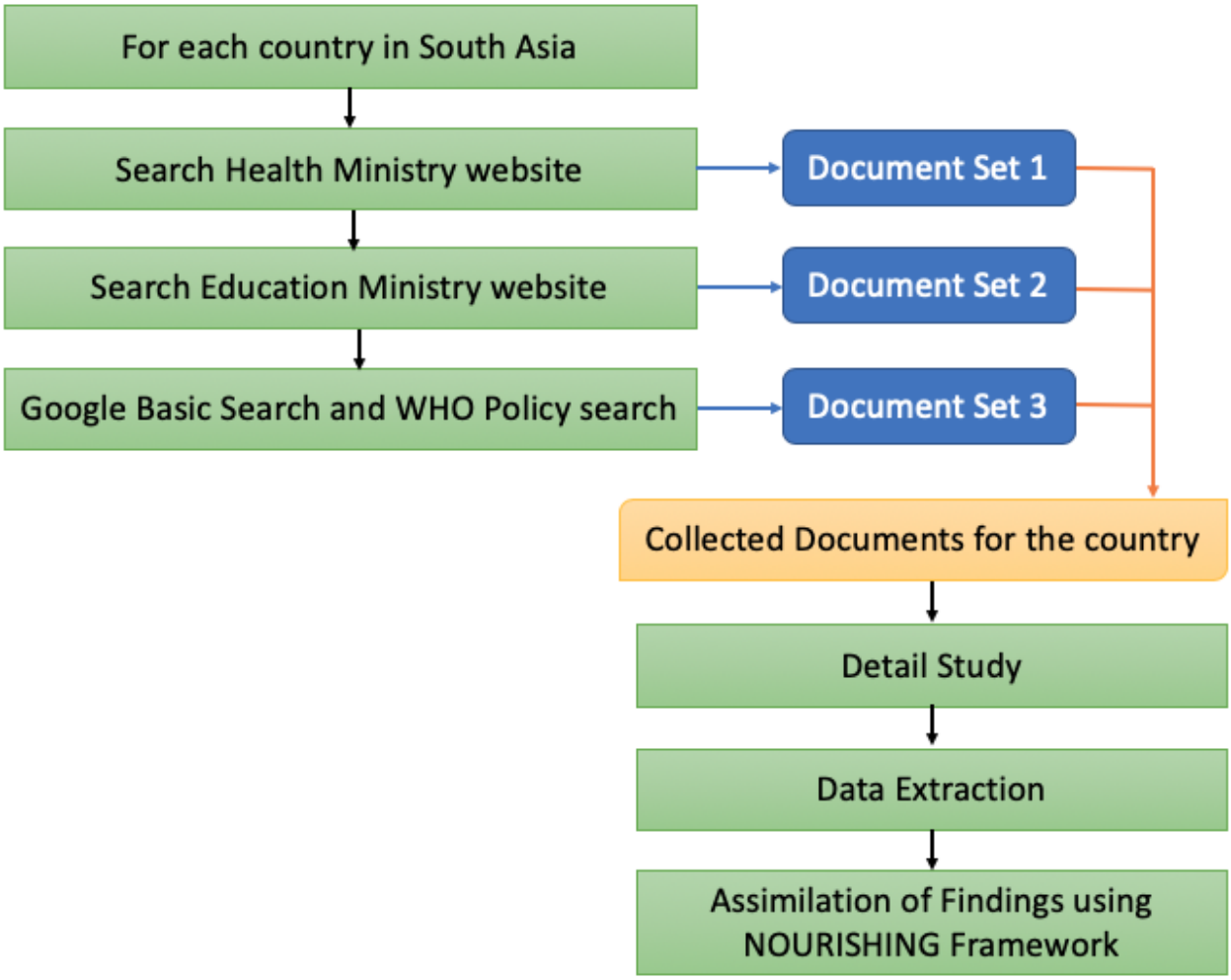


Figure 2.1: Flow chart showing the procedure followed for nutrition related health policy review for South Asia.

Exclusion Criteria Documents which did not relate to overweight/obesity/overnutrition, non-communicable diseases, school children health, healthy lifestyle promotion were excluded after detailed reading.

The next section describes the framework used to systematically organize the information obtained from the policies.

2.1.1 NOURISHING framework

NOURISHING framework was chosen because it provides a way to categorize and organize policies related to reduction of obesity, non-communicable diseases (NCDs) and promotion of healthy nutrition (NOURISHING, 2018*b*). NOURISHING organizes these policies into three

domains: Food Environment, Food System, and Behaviour Change and Communication, each consisting of evidence-informed policy areas (NOURISHING, 2018*a*). Refer figure: 2.2 for these policy areas. The domains were relevant to the overall theme of the dissertation, further guiding the choice of the framework. Strategies/actions/interventions relating to the policy areas in each domain were identified for each country from the retrieved policy documents. The next section explains the methods followed for the scoping review.

Figure 2.2: Figure showing the description of the ten policy areas of the NOURISHING framework. Source: (NOURISHING, 2018*b*)

2.2 Scoping Review

Joanna Briggs Institute's guidelines on scoping review were followed (Joanna Briggs, 2020). The target population was school-going children aged 4-18 years. The concept explored was the relationship between obesogenic food environment around schools and childhood overweight/obesity. The context was global. Two outcome measure were chosen: overweight/obesity and dietary intake/behaviour among school going children . Dietary intake/behaviour was included as an outcome measure because poor eating habits are a risk

factor for overweight/obesity (Mu et al., 2002).

Search Strategy The search was performed in CINAHL, MEDLINE, EMBASE, Web of Science, and PubMed from earliest available date of databases to 27 June 2020 using a combination of controlled language and free-text word for fast food outlets, healthy food, around school, overweight and dietary behaviour. Table I and Figure 4.3 in Appendix describe in detail the search strategy used for the scoping review.

Inclusion and Exclusion Criteria Studies were included if they assessed children between 4 and 18 years old. If their age was not mentioned, the school type or class/ grade was used as proxy for their age. The studies had to measure directly or indirectly distance to fast food outlets and its relationship with overweight/obesity in children or dietary intake. Studies with no description of FEAS and those not relating to the relationship between proximity of retail food outlets to schools and the outcome measure(s) were excluded. Qualitative studies, and those written in a different language to English were excluded.

EndNote Web was used for managing the retrieved research papers. The list of rejected papers along with reasons is presented in the Appendix Table XI. Following information was extracted from each paper:

1. Title/ Reference of the paper.
2. Year of publication.
3. Country of study.
4. Students' age/grade/class/type of school.
5. Food outlets used to characterise FEAS.
6. Distance specified to measure proximity of food outlets to schools.
7. Health outcome(s) used in the study.
8. Research question.
9. Result.

A summary based on the data extracted was done to complete the scoping review. The main discussion points in summary relate to the outcome measures characterisation and food environment around school description. The final results and discussion relate to proximity of food outlets to schools and overweight/obesity and dietary intake/behaviour among students.

The next chapter presents and discusses the results of the policy review and the scoping review.

Chapter 3

Results and Discussion

The chapter is divided into two sections. The first section presents and discusses the results of overweight/obesity policy review in South Asia and the second section relates to the scoping review. Discussion is done simultaneously with results to preserve the context and facilitate understanding of the results under consideration.

3.1 South Asian Childhood Overweight/Obesity Policy Analysis

The policy review set out to identify and critically analyse the current and past South Asian policies focused on overweight/obesity. A total of 32 documents were used for the final policy analysis. Appendix table II lists the final set of policy documents used for the study. Google Translate was not found much useful to convert regional language documents into English. For example, documents in Dhivehi language (Maldives) and Bangla language (Bangladesh) could not be properly translated into English using Google Translate.

The policy results and discussion is divided into three broad sections as per the NOURISHING policy framework: Food Environment, Food Systems, and Behaviour Change and Communication. For each policy area, results are presented and discussed together to maintain the context.

Food Environment

N = Nutrition label standards and regulations on the use of claims and implied claims on food. From Table I it is clear that only the Sri Lankan government had regulations relating to

accurate labelling and nutritional profiling of food items.

While for packaged food this type of regulation may be effective, for unpacked food items sold by vendors and hawkers or at food stalls in South Asia, nutrition standards monitoring can be very challenging (Food and Agriculture Organization, 2003). Secondly, nutrition labelling may not be sufficient if the consumers do not read or understand the nutrition information. Language used for nutrition labelling and illiteracy of consumers can further act as barriers to understanding nutrition information. Mhurchu et al. (2018) found that 60% of Asia-Pacific consumers partly understood the nutrition labels. This emphasizes the need to sensitize consumers about nutritional label information and educate them about using that information to purchase healthy food.

O = Offer healthy food and set standards in public institutions and other specific settings.

Almost all countries in South Asia have policies that mandate maintaining proper food quality and safety standards for commercial foods available to public on large scale. However, most of these policies have been devised keeping in mind the problem of undernutrition which is highly prevalent among mothers and children in this region (Sadana et al., 2004; Ahmad and Yuasa, 2018; Akhtar, 2016). India, Maldives and Pakistan have established food standards, safety norms and benchmarks for healthy food served in canteens and tuck shops in schools.

Bhutan's policy on healthy food in schools mandates monitoring the food sellers and ensuring that the food provided by them is cooked properly, is covered and is prepared in a hygienic manner. The nutrition content of the food sold by such sellers is not addressed in the discussion. Afghanistan, Bangladesh and Sri Lanka have programs to ensure the availability of nutritious and culturally-accepted foods within the country, especially during the times of violence, conflict and environmental disasters. SAR also had policies and guidelines related to food standards and food safety to prevent diseases caused by food poisoning or contamination of food. Specific standards in public settings focused on preventing overweight/obesity were not found.

U = Use economic tools to address food affordability and purchase incentives. None of the countries in the SAR had policy structures related to the use of economic tools to address the food behaviour of consumers. This is the policy area which the countries in South Asia must focus on because the international food and beverage companies have increasingly begun to establish their food chains across in the region (Pan et al., 2012). In the light of globalization

and rapid urbanization in South Asia, the eating habits of people in the region are increasingly shifting towards unhealthy and highly processed foods (Bishwajit, 2015). In this respect, policies relating to taxation of unhealthy foods and beverages and incentives for healthy food purchase could be helpful to reduce the risk of overweight/obesity.

R = Restrict food advertising and other forms of commercial promotion. Out of all the countries in South Asia only India had regulations relating to restricting the advertisement/sale/marketing/exposure of HFSS foods within and around schools. The regulation mandates food business operators (FBOs) to promote only healthy food in sponsoring events inside schools and to avoid the use of large portion sizes for free food promotion. Other countries in South Asia can also learn from these draft regulations introduced by India. Overweight and diabetes prevalence is quite high in countries like Maldives (30.6% overweight, 9.2% diabetic), Pakistan (28.4% overweight, 19.9% diabetic), Sri Lanka (23.3% overweight, 10.7% diabetic) and call for serious regulations related to unhealthy food advertising and marketing.

Table I: Nutrition/Food policy for eight countries in South Asia as organized in NOURISHING Framework.

Country	N = Nutrition label standards and regulations on the use of claims and implied claims on food	O = Offer healthy food and set standards in public institutions and other specific settings.	U = Use economic tools to address food affordability and purchase incentives.	R = Restrict food advertising and other forms of commercial promotion.
Afghanistan	Not addressed	National food safety and food quality standard mandatory to uphold.	Not addressed	Not addressed
Bangladesh	Not addressed	Assess food health quality and safety. Emergency nutrition. Adequate nutrition to children, mothers and chronically sick.	Not addressed	Not addressed
Bhutan	Not addressed	Food seller food monitoring.	Not addressed	Not addressed
India	Not addressed	Food business operators (FBOs) within schools required to adhere to food selection and safety guidelines.	Not addressed	Prevent exposure, advertisement, sale, free-giveaway of food high in fat, salt, sugar within school premises and 50m around schools. FBOs allowed to sponsor events through nutrition-criteria verified foods. Reasonable portion size usage in marketing products by FBOs.
Maldives	Not addressed	School canteen standards under the School Health Program. Healthy school canteen promotion based on standards and guidelines.	Not addressed	Not addressed
Pakistan	Not addressed	Ensure healthy food provided in school canteens and tuck shops. Offer good supplements for malnourished children. School feeding/lunch program.	Not addressed	Not addressed
Sri Lanka	Accurate labelling of food, relay accurate information to consumers, claims to be scientifically proven. Improved food labelling through nutrition profiling.	Sell affordably nutritious and culturally-acceptable foods. Emergency nutrition preparedness, ensure affordability of nutritious food to mothers and children.	Not addressed	Not addressed

Table II: Nutrition/Food policy for eight countries in South Asia as organized in NOURISHING Framework.

Country	I = Improve nutritional quality of the whole food supply	S = Set incentives and rules to create a healthy retail and food service environment	H = Harness food supply chain and actions across sectors to ensure coherence with health
Afghanistan	Flour fortification, ghee and cooking oil fortification, salt iodization, micro-nutrient supplementation	Creating Supportive Environment to encourage healthy behaviour adoption	Not addressed
Bangladesh	Food fortification, salt iodization.	Not addressed	Not addressed
Bhutan	Not addressed	Ensure good nutrition in schools.	Not addressed
India	Micronutrient supplementation, food fortification. FBOs to develop nutrient and energy dense foods, reformulate foods high in fat, sugar, salt.	Prevent physical, biological, chemical food contamination. Prevent exposure to food high in fat, salt, sugar within school premises and 50m around schools. Sale of nutrition-criteria verified food by FBOs.	Mandatory license and registration of food business operators within schools.
Sri Lanka	Food fortification for micronutrient supplementation.	Establish healthy canteens and eating places in work places, schools and public places. Create food nutrition enabling school environment.	Not addressed.

I = Improve nutritional quality of the whole food supply. In South Asia, improvement in the nutrition quality of the whole food supply mainly related to food fortification, micro-nutrient supplementation, salt iodization and oil fortification because of traditional undernutrition health problems, such as wasting, stunting and nutrition deficiency among mothers and children (Ahmad and Yuasa, 2018; Harding et al., 2018). In the case of India, food business operators have been encouraged to reformulate their food in order to reduce the amount of fat, salt and sugar in the diet. Food reformulation is a positive step to ensure that healthy food is available to consumers. In fact Muth et al. (2019) have demonstrated reduction in sugar and fat consumption and increase in fibre consumption after food reformulation. For Nepal, Pakistan

and Maldives no such policy structures were found in this policy review.

Efforts to improve the nutritional quality of food supply chain do not match the threat of DBM in South Asia. For South Asian countries which invest a very small amount of GDP in health (range 2.3% in Bangladesh to 11.8% in Afghanistan. Refer Table III) improving dietary habits in the population through food chain supply could be a cost-effective strategy against the rising burden of overweight/obesity.

S=Set incentives and rules to create a healthy retail and food service environment. Bhutan, Sri Lanka and India have set rules to monitor food in schools. While Bhutan and Sri Lanka promote healthy food in schools, India has recognised the importance of restricting the sale of unhealthy, specifically HFSS, foods. South Asian countries' policies on a healthy supportive environment in schools mainly focus on maintenance of a clean and hygienic environment with proper drinking water and sanitation facilities. In the case of Afghanistan and Pakistan, a healthy school environment relates to prohibition of violent activities in its vicinity. In the case of India, prevention of food contamination by chemical, biological and physical agents forms a crucial component of a healthy food environment. Overall however, the nutrition policies in SAR do not directly focus on the school food environment and appear largely unaware of its role in overweight/obesity prevention.

In the context of this policy area, it must be noted that while promotion of healthy foods is essential, sale of unhealthy food especially highly processed, calorie dense HFSS foods must be strictly monitored if healthy dietary habits are to be inculcated among students. Restricting the sale of HFSS foods and promotion of healthy food collectively make a healthy food environment, inclusion of either and exclusion of the other may not be of much help. The current nutrition-related health policies in the SAR seem to be missing this crucial point as most of them promote healthy eating without giving adequate attention to unhealthy eating.

Food System

H = Harness food supply chain and actions across sectors to ensure coherence with health. None of the SAR countries had any rules in place that integrated healthy dietary habits with food supply chains but almost all of them mentioned the importance of inter-agency and inter-ministry collaboration to ensure good public health.

With respect to the multi-sectorial actions, Indian government has instructed food business operators to get registered and procure a license before operating within schools. Even though registration lends credibility to such food establishments, it may not ensure the health quality of food sold by those FBOs. The health quality of food sold may need extra supervision, if not considered apriori during licensing.

Table III: Nutrition/Food policy for eight countries in South Asia as organized in NOURISHING Framework.

Country	I = Inform people about food and nutrition through public awareness	N = Nutrition advice and counselling in health care settings
Afghanistan	Sensitize care givers and communities about malnutrition. Breastfeeding, micronutrient-rich foods, micro-nutrient supplements and safe, nutritious and diverse foods consumption promotion.	Integrated mother and child initiatives for healthy nutrition.
Bangladesh	Promote breastfeeding, healthy diet, micronutrient-rich foods. Community nutrition program. Fats, carbohydrates and micronutrients consumption guidance. Pregnant women diet promotion. Limit excess consumption of salt, sugar and oil.	Nutrition promotion by community-based health care workers.
Bhutan	Community nutrition promotion. Rice fortification.	Not addressed
India	Nutrition counselling for pregnant mothers, adolescent children.	Not addressed
Maldives	Nutrition problem solving workshops in community.	Nutritional advice to adolescents.
Nepal	Adequate nutrition awareness for parents and community people.	Nutrition education and counselling practice to pregnant women.
Pakistan	Create awareness in community on nutrient sufficient food, micronutrient supplements and dietary diversification.	Not addressed
Sri Lanka	Nutrition awareness for parents. Promote behavioural change to make right food choices, dietary diversification.	Not addressed

Behaviour Change and Communication

I = Inform people about food and nutrition through public awareness. In South Asia, public awareness on nutrition has mainly focused on traditional nutrition-related problems like undernutrition, micronutrient deficiencies and protein-energy malnutrition through programs such as micronutrient-supplementation, food fortification and promotion of food diversification and breastfeeding. In the case of Bangladesh, nutrition related public awareness involved spreading information about the consumption of macronutrients and salt, sugar and oil. For India, the Integrated Child Development Services (ICDS, 1975), National Nutrition Strategy (NITI Aayog, 2017) and the POSHAN Abhiyaan (POSHAN Abhiyaan, 2017) recognised the importance of promotion of nutrition and health information for general well-being of pregnant women and new born children.

Although awareness creation is extremely important, its efficacy in improving the unhealthy dietary behaviour in the public is not yet fully established. Barry et al. (2014) showed that messages from video media campaign did not affect the public attitude about seriousness of obesity, its consequences or support for policies preventing obesity. On the other hand, GreenMills et al. (2013) observed increase in awareness among parents on nutrition and obesity post an obesity awareness campaign. Whether or not the knowledge from campaigns translates to behavioural change is unclear. In this regard, Kite et al. (2018) using mediation analysis established that public awareness triggers a sequence of actions leading to desirable behavioural changes. The authors pointed out that self-efficacy was a huge determinant of behaviour change. Thus, it is appears that public awareness and self-efficacy collectively determine dietary behavioural change and South Asian governments must be mindful of this while planning public awareness programs against overweight/obesity.

N = Nutrition advice and counselling in health care settings. In the South Asian settings, nutritional counselling is mainly related to promotion of healthy diet to prevent malnutrition or vitamin/protein deficiencies in either pregnant mother or child. However, no specific policy relating to nutrition counselling in health care settings for overweight/obesity was found for the region.

Given the rising burden of overweight/obesity in SAR, nutrition counselling in health care settings could be used as an effective approach to promote healthy dietary intake/behaviour.

In fact, direct message to patients could be more impactful than the media campaigns. For example, Kim et al. (2017) showed that a 10-week long nutritional counselling program helped university students in reducing body weight, fat and BMI. Vasiloglou et al. (2019) discuss the challenges and perspectives in nutrition counselling and emphasize the need of training the healthcare personnel for nutrition counselling.

Nutritional counselling raises similar questions of behavioural change as noticed for nutritional public awareness. The ability of people to translate counselling information to action is determined by several factors such as socio-economic position, locality and attitude to change (Short and Mollborn, 2015; Lee et al., 2019). Therefore, for nutritional counselling to be most effective, the South Asian governments must consider these aspects and plan accordingly.

G = Give nutrition education and skills. In the South Asian region, nutrition education and skills training has been chiefly linked to health problems caused by poor nutrition - underweight, nutrition deficiency and low energy intake. Therefore, majority of the national level policies in these regions, as seen in Table IV, relate to breastfeeding, infant feeding, micro-nutrient supplementation and increasing energy intake. Within schools, through Health Promoting Schools, Nutrition Programs and School Health Program, nutrition education is imparted to pupils. This is a very significant way to train youth to adopt lifelong healthy dietary habits.

However, for nutrition education to be truly impactful, discussion on various diseases caused by excess consumption of unhealthy food must also form a part of the discussions. Just like the discussion on undernutrition is linked to diseases such as wasting, stunting and protein deficiency, discussion on unhealthy foods must be linked to overweight/obesity. Such an approach to nutrition education could potentially send a stronger message to the public and encourage them to adopt necessary actions to improve their dietary choices.

Table IV: Nutrition/Food policy for eight countries in South Asia as organized in NOURISHING Framework.

Country	G = Give nutrition education and skills
Afghanistan	Nutrition promotion in schools, health care settings and media. Emergency time nutrition counselling and local food recipe promotion. Breastfeeding counselling, complementary feeding demonstrations, participatory food preparation sessions. Training of nutrition partners.
Bangladesh	Breastfeeding, weaning foods, complementary feeding, dietary malnutrition control information dissemination. Nutrition message dissemination program and nutrition education promotion in schools and colleges. Sensitization on micronutrient deficiencies, fruits and vegetables preservation and food diversification. Healthy diet with fruits and vegetables promotion.
Bhutan	Health promoting schools, Parental and teacher nutrition education, Food guide pyramid for Bhutanese Children. Nutrition education in schools.
India	Train counsellors, medical health officers, community health workers, program managers and ASHA workers in healthy dietary behaviour. Nutrition education at primary, middle and high school levels. Promote nutrition education in schools.
Maldives	Health food choice education to young people. Nutrition information dissemination in health care facilities. School, pre-school nutrition program. Nutrition education to young women and adolescent girls. Nutrition education to community based organizations and women's group. Nutrition training to community health workers. Train teachers in nutrition education. Educate Maldivians about nutrition to prevent chronic diseases. Nutrition awareness in schools
Nepal	Nutrition education to adolescent girls. Life-skill approach based nutrition education to school children. Nutrition education in schools, for mothers, community level. School nutrition program. School Health and Nutrition services to promote healthy nutritional behavioural habits among students.
Pakistan	School Nutrition Program.
Sri Lanka	Nutrition awareness among students and parents through Health Promoting Schools. Improve nutrition education in school children. School nutrition program development. Nutrition friendly schools.

3.2 Scoping Review

This section presents the results of scoping review conducted to explore the evidence relating proximity of food outlets to schools and overweight/obesity among school children. The total

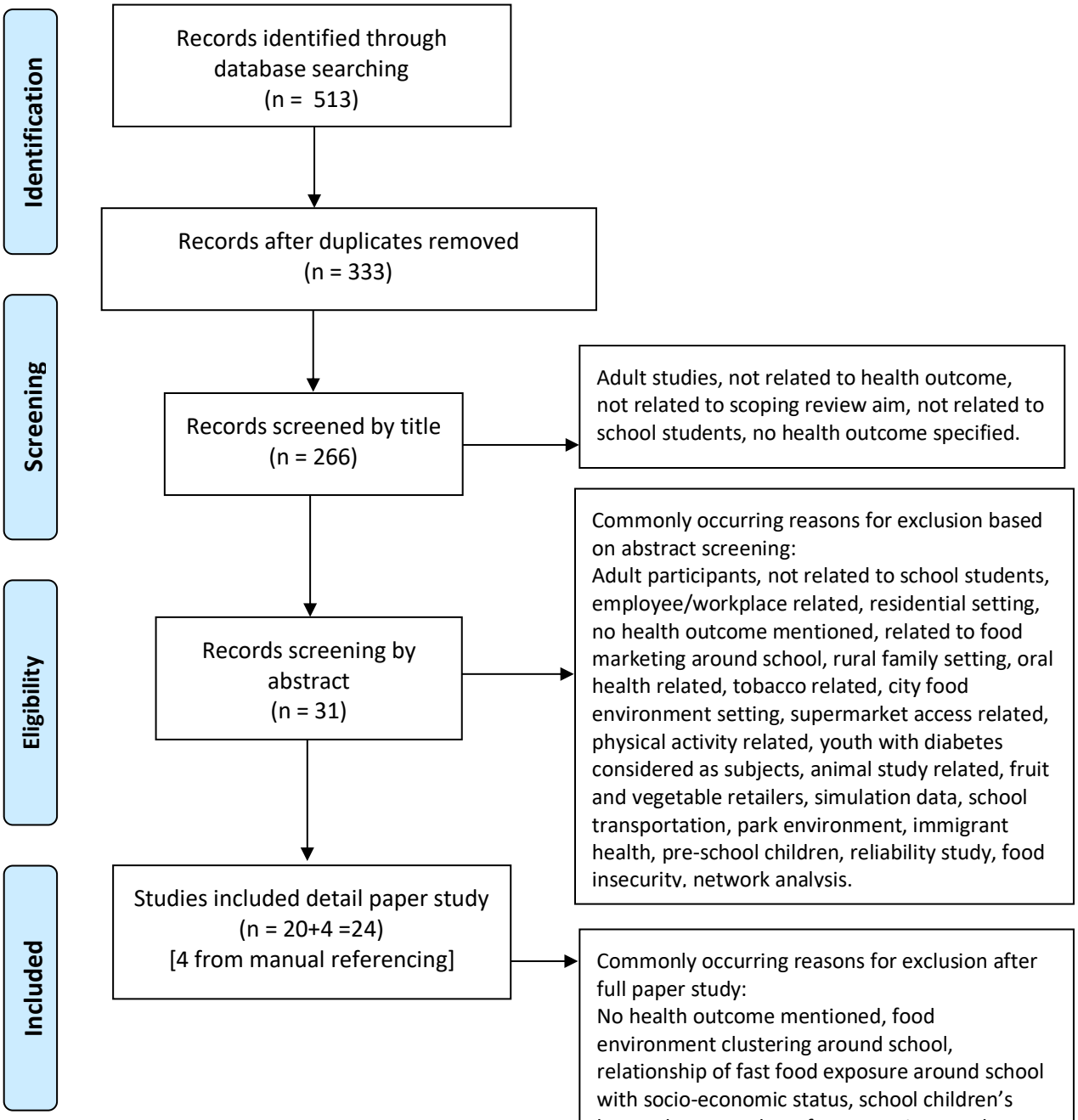
number of research papers gathered in preliminary search is shown in Table V.

Table V: Table showing results of retrieved documents from five databases.

Database	Number of retrieved records
Web of Science	78
CINAHL	42
MEDLINE	73
EMBASE	96
PubMed	224
Total	513

The PRISMA Diagram for scoping review is shown in the next page.

PRISMA DIAGRAM FOR THE SCOPING REVIEW



3.2.1 Study details

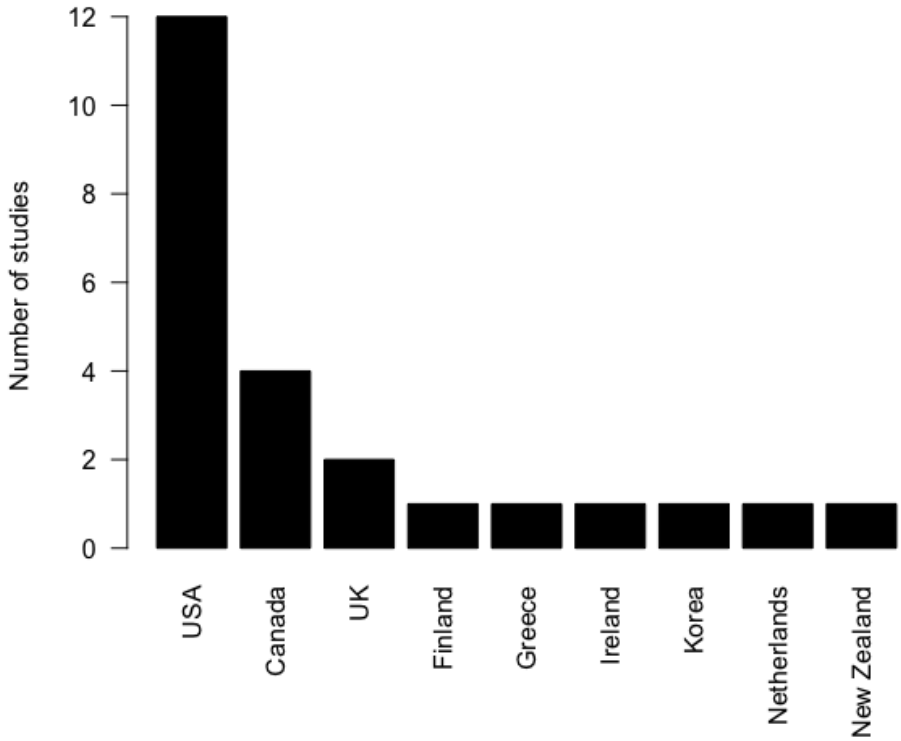


Figure 3.1: Distribution of studies as per countries.

180 duplicates were found out of the total 513 retrieved papers. Remaining 266 papers were screened by reading their abstract. Post this, 31 papers were selected and after reading these, a total of 20 papers were selected and 4 were identified manually from references. Thus, a total 24 studies were included in the scoping review. Maximum number of studies (12) were conducted in the USA, followed by Canada (4) and the UK (2) (Figure 3.1). This fact must be kept in mind while interpreting the results of the scoping review. Cross-sectional studies were the most common (20, 83.3%) and two each for ecological and longitudinal. Figure 3.2 shows the distribution of studies with years. Note the increasing number of studies with time.

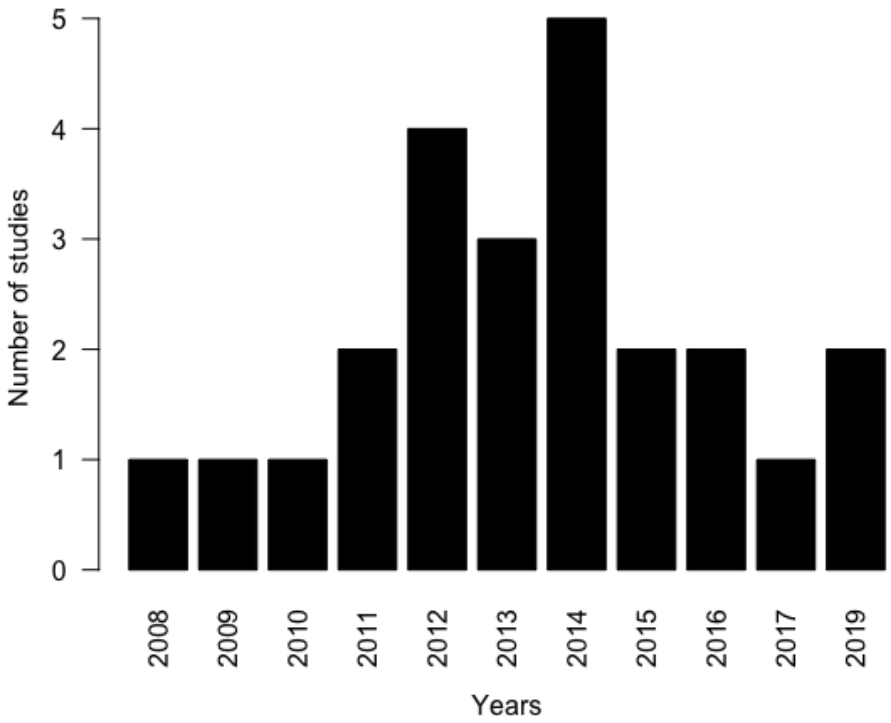


Figure 3.2: Distribution of studies across years.

Tables VI present the findings from each research study included in the scoping review.

Table VI: Table showing the results of scoping review.

Author,Year and Sample Size	Age Group or Class/Grade /School type	Health Outcome	Country	Nature of food establishment	Distance Indicator	Finding
(Currie et al., 2010) N=3million	9th Grade	Overweight rate	USA	Fast food restaurant	160m	5.2% increase in obesity rates observed in schools having fast food restaurants within 0.1 miles(160m)
(Virtanen et al., 2015) N=23, 182	8, 9 Grade	Overweight status	Finland	Fast food outlet, grocery store.	$\leq$100m, 101m-500m, $>$ 500m	Among adolescents with a low socio-economic status, proximity of fast food outlet associated with higher risk of overweight.
(Virtanen et al., 2015) N=23, 182	8, 9 Grade	Eating habits	Finland	Fast food outlet, grocery store.	$\leq$100m, 101m-500m, $>$ 500m	Frequent skipping of breakfast associated with short distance ($\leq$100m) of fast food outlet or grocery store to schools.
(Tang et al., 2014) N=12, 954	Middle and high-school students	BMI z-score	USA	Supermarkets, convenience stores, small grocery stores, limited service restaurants	0.25 miles distance from school(400m)	Lower BMI-z score associated with grocery stores selling healthy options and supermarkets within 0.25 miles of schools, whereas opposite found for convenience stores and limited service restaurants.
(Smith et al., 2013) N=524	11-12 year old	Healthy and unhealthy diet score	UK	Takeaway (fast food), grocer's, supermarket, convenience store	400m and 800m road network buffer from school	Both mean healthy and unhealthy score decreases overtime. Small significant relationship between proximity to takeaway and unhealthy diets observed.
(Davis and Carpenter, 2009) N=529,367	Age $\leq$ 12, 13, 14, 15, 16, $\geq$ 17, grade $\leq$7 , 8, 9, 10, 11, 12	BMI	USA	Fast food restaurant	1/4 miles (400m), between 1/4-1/2 mile (400m-800m), 1/2-3/4 mile (800m-1200m)	Students were heavier and more likely to be overweight or obese if their school was located within 1/2 mile of a fast food restaurant. Direct relationship between the proximity of a fast food restaurant to a school and students' BMI.

(Davis and Carpenter, 2009) N=529,367	Age $\leq$ 12, 13, 14, 15, 16, $\geq$ 17, grade $\leq$7 , 8, 9, 10, 11, 12	Food consumption	USA	Fast food restaurant	1/4 miles (400m), between 1/4-1/2 mile (400m-800m), 1/2-3/4 mile (800m-1200m)	Students were heavier and more likely to be overweight or obese if their school was located within 1/2 mile of a fast food restaurant. School proximity to fast food restaurant associated with higher odds of soda consumption, lower odds of vegetable or juice consumption.
(Barbouni et al., 2017) N=940	7, 10 Grade. Age 13, 16 years.	BMI	Greece	Newsagents, cafes, internet cafes, fast food, kiosks, bakers, pastry shops, grocers.	500m	Higher BMI associated with students of schools located close to newsagents (p=0.025). More shops of same kind and different kinds of shops close to school associated with higher BMI of students (p=0.022).
(van der Horst et al., 2008) N=1293	12-15 years	Soft drink and snack consumption	Netherlands	(1) fast-food outlets; (2) large supermarkets; (3) small food stores (small supermarkets, ethnic-food stores, news agencies, stores at petrol stations); (4) bakeries; and (5) fruit/vegetable stores.	500m buffer	Inverse association between soft drink consumption and intermediate distance to the nearest store(200m-300m). No association found for snack intake and distance to the food stores.
(Gilliland et al., 2012) N=891	6,7, 8 Grade. 10-14 years	BMI z-score	Canada	Fast food restaurant and Convenience store.	Circular, network buffer of 500m and 1000m, school walkshed (walkable territory around schools for students residing close to schools)	Presence of fast-food outlets within the school walkshed associated with BMI-z score (0.073, p$<$0.05) adjusted for home environment covariates.
(Grier and Davis, 2013) N=100,000	7, 9, 11 Grade	BMI	USA	Fast food	Distance from school to fast food outlet 0.33 miles (531m).	Negative association between fast food distance from school and BMI of student.
(Grier and Davis, 2013) N=100,000	7, 9, 11 Grade	Soda consumption	USA	Fast food	Distance from school to fast food outlet 0.33 miles (531m).	Fast-food distance from school not associated with soda consumption, but found true for Black sample at lower income, urban schools.

(Asirvatham et al., 2019) N=1,352,696	Less than 18 years, Grade 1-9	BMI-z score	USA	Fast food restaurants = hamburger fast food restaurants, sandwich places, and pizzerias	Proximity: distance of the school to the nearest US highway used as an instrumental variable for fast food restaurant. Shortest Distance: 536m.	Restaurant distance from school is inversely proportional to BMI. 2.1% increase in BMI z-score at one-third mile radial distance from school, at two-thirds mile radius it decreased by a third and at a mile, it decreased by a fifth.
(Van Hulst et al., 2012) N=512	8-10 years, Grade 2-5, Primary	Children's dietary intake (vegetable and fruit consumption, sugar sweetened beverages) and dietary behaviour (snacking/eating out and consuming delivered/takeout food)	Canada	Supermarkets, fast food restaurants, convenience stores, speciality food stores (bakeries, vegetables, fruits, gourmet, meat, fish markets).	Proximity: nearest distance to each food establishment around school. Shortest Distance: 545m	Marginal association between dietary outcome (intermediate vs shortest) distance increased the likelihood of consuming recommended vegetable and fruits (p=0.08)
(Howard et al., 2011) 879 public schools	9th Grade	School overweight rate.	USA	Fast food restaurants, convenience stores and supermarket.	800m network buffer around school.	Higher rates of overweight found in schools surrounded by convenience stores within 800m. No association found for fast food or supermarkets.
(Wasserman et al., 2014) N=12118	4-12 years old	BMI percentile	USA	Fast food restaurants and grocery stores.	800m radius around each school.	Bivariate analysis shows negative association between BMI percentile and number of convenience stores. Direct association of number of grocery stores with higher BMI percentile values.
(Langellier, 2012) N=1694 schools	5, 7, 9 Grade	Overweight prevalence	USA	Fast food and corner stores	1/2 mile (804m)	Majority-Latino schools having atleast 1 corner store within half a mile associated with higher overweight prevalence. No association found for fast-food restaurant and schools.
(Clark et al., 2014) N=664	11-13 classes, 15-18 years old	Diet Quality Index (DQI)	New Zealand	Convenience store, Cafes and restaurants, supermarkets, takeaways.	Buffer size 800m, 1500m around school.	High number of cafes, restaurants, supermarkets and takeaways around schools associated with higher Diet Quality Index in boys. No such result found for girls.
(Tucker et al., 2012) N=810	7, 8 Grade. 11-14 years old.	Dietary intake	Canada	Fast food restaurants, convenience stores, supermarkets.	1km straight line buffer from school.	Low healthy diet score associated with close proximity to convenience stores and fast food outlets.

(Kelly et al., 2019) N=5344	≤14, 14, 15 ≥16	Dietary habit (healthful and unhealthful foods)	Ireland	Fast food.	1km radius around schools.	Decreased odds of vegetable and fruit consumption associated with schools having more than 10% of food premises around schools as fast food outlets.
(Seliske et al., 2013) N=6971	9, 10 Grade	Lunch time eating behaviour	Canada	Fast food, convenience stores, coffee/donut shops.	1km distance around school.	Higher likelihood of eating outside associated with higher number of food retailers around schools.
(Baek, Sanchez-Vaznaugh and Sánchez, 2016) N=3, 193, 184	7th Grade	School level mean child BMI z-score	USA	Convenience stores	100 ring shaped areas defined by concentric circles upto 1 mile (1.6km).	Association between each additional convenience stores within 1/2 miles (804m) and BMIz is 0.004 ($p<0.05$)
(Baek et al., 2014) N=926,018	5th, 7th, 9th Grade	BMI z-score	USA	Fast food restaurant and convenient stores	buffer size upto 1 mile (1.6km)	BMIz increases 0.022 per one convenience store within 1/4miles (402m) from a schools. No significant associations between the number of fast food restaurants within 1/4, 1/2 and 3/4 mile from schools and child's BMIz. Stronger association between convenience store and BMIz than fast food restaurant and BMIz.
(Baek, Sánchez, Berrocal and Sanchez-Vaznaugh, 2016) N=601,847	5th and 7th Grade	BMI z-score	USA	Convenience stores	1 mile (1.6km) around school.	Higher effect of convenience stores on BMI-z score seen within shorter distance from schools, became negligible with longer distances. BMIz was 0.009 higher for each additional convenience store within 1/4 miles (402m).
(Griffiths et al., 2014) N=13291	Secondary school	BMI s-score	UK	supermarkets, takeaway and retail (including petrol stations).	circular buffers with a 2 km Euclidean (straight line) radius, centred on school location.	Farther retail outlet is associated with lower odds of obesity.

(Harris et al., 2011) 552	9-12 class	BMI	USA	Restaurant, small stores selling pre-packaged foods, grocery stores, supermarkets.	2km distance from schools	No significant relationship between the proximity of food stores around schools and obesity risk.

3.2.2 Health Outcomes Summary

This section presents and discusses different ways in which the outcome measures: overweight/obesity and dietary intake/behaviour were characterised and estimated in the different papers included for the scoping review. Table VII maps outcomes measures: overweight/obesity and dietary intake/behaviour to studies included in the scoping review.

Table VII: Table mapping the outcome measures to the studies included for the scoping review.

Outcome measure	Number of Papers	References
Overweight/obesity	13	Overweight/obesity rate/prevalence(Currie et al., 2010; Howard et al., 2011) BMI z-score (Tang et al., 2014; Gilliland et al., 2012; Asirvatham et al., 2019; Baek et al., 2014; Baek, Sánchez, Berrocal and Sanchez-Vaznaugh, 2016; Griffiths et al., 2014; Baek, Sanchez-Vaznaugh and Sánchez, 2016) BMI (Grier and Davis, 2013; Virtanen et al., 2015; Barbouni et al., 2017; Langellier, 2012) BMI percentile (Wasserman et al., 2014; Harris et al., 2011; Davis and Carpenter, 2009)
Dietary Intake/Behaviour	8	Eating habits (Virtanen et al., 2015; Joo et al., 2015*a*; Smith et al., 2013; Davis and Carpenter, 2009; Van Hulst et al., 2012; Clark et al., 2014; Tucker et al., 2012; Kelly et al., 2019; Seliske et al., 2013) Soft drink and/or snack consumption (van der Horst et al., 2008; Grier and Davis, 2013)
Both	3	(Virtanen et al., 2015; Davis and Carpenter, 2009; Grier and Davis, 2013)

Overweight/Obesity

Group-level overweight/obesity rate Currie et al. (2010) used the abdominal fat percentage among boys and girls to compute class-level obesity rates. Boys and girls with abdominal fat exceeding 25% and 32% respectively were considered obese. Howard et al. (2011) use the gender- and age- cut-offs (for a 14 years old male, BMI $<$24.5 and for 15 year old female skinfold $<$32 to be categorized as overweight) to compute school-level overweight rate.

BMI z-score BMI z-score shows the deviation of a child's BMI from the reference category BMI identified by age-gender (Centers for Disease Control and Prevention, 2005). BMI-z scores are

used for studies related to children because in contrast to adults they are still growing (Must and Anderson, 2006). Tang et al. (2014); Asirvatham et al. (2019) used Center for Disease and Control (CDC), USA growth charts to compute BMI z-score for children, (Gilliland et al., 2012) used World Health Organization (WHO) growth charts to compute age-sex-specific BMI z-score values and Griffiths et al. (2014) used the British 1990 growth reference charts (UK90) to compute BMI z-score. No information about choice of growth curves was found for (Baek, Sánchez, Berrocal and Sanchez-Vaznaugh, 2016; Baek et al., 2014; Baek, Sanchez-Vaznaugh and Sánchez, 2016).

BMI percentile/ BMIp Wasserman et al. (2014) used BMI percentile to measure overweight/obesity but no reason was mentioned behind the choice. BMIp $\geq$ 85 was used to categorize an individual as overweight, while BMIp $\geq$95 indicated obesity. BMI-for-age percentile was used by (Harris et al., 2011; Davis and Carpenter, 2009) to classify weight for individual students: top 5% were considered obese and 85th-95th were considered overweight as per (Centers for Disease Control and Prevention, 2000). For better understanding the concept of BMI percentile please refer to Appendix Figure 4.4.

BMI Four research papers used standard BMI to measure overweight/obesity. Virtanen et al. (2015) used BMI $\geq$ 25 to indicate overweight (including obesity). Harris et al. (2011) limited BMI in the range of 10-37 as per the Centres for Disease Control (CDC), USA. Barbouni et al. (2017) used WHO Growth Reference Data for 5-19 year old children to classify students as normal, weight overweight or obese (World health Organization, 2007). Langellier (2012) used age and sex- cut-off defined BMI to classify students as overweight. These cut-offs were apriori defined (California Department of Education, 2009).

Conclusion - BMI Various methods to measure overweight/obesity among children were used by researchers. The diversity of methods may make the comparison of results difficult but since overweight/obesity reflect higher end of BMI irrespective of the growth curves, gross difficulties seem unlikely.

Furthermore, some authors measured overweight/obesity at the school-level while others at the individual level. Both these values convey different information and using one to inform another could lead to either atomistic fallacy or ecological fallacy (Diez Roux, 2002). For instance, association of higher overweight/obesity rates at school-level with close proximity to

food outlets may or may not indicate high risk of overweight/obesity at the individual level in the same setting; concluding thus would be an ecological fallacy. Similarly, assuming that overweight/obesity association with proximity of schools to food outlets at individual level is linked to population level overweight/obesity rates, could lead to atomistic fallacy. But none of the research papers discussed these fallacies which are quite significant when doing such kind of multi-level research relating to population subgroups.

Dietary Intake/Behaviour

Table VIII describes briefly the different ways in which dietary intake/behaviour was conceptualized and measured in the included research papers. Only five studies examined the consumption of both healthy and unhealthy foods to characterise the dietary intake/behaviour of students (Davis and Carpenter, 2009; Tucker et al., 2012; Kelly et al., 2019; Smith et al., 2013; Van Hulst et al., 2012). Among these, only (Davis and Carpenter, 2009; Kelly et al., 2019; Smith et al., 2013; Van Hulst et al., 2012) assessed them separately.

Separate assessment of healthy and unhealthy dietary behaviour is vital because both impact the risk of overweight/obesity (Rush and Yan, 2017; Smethers and Rolls, 2018; Mohammadbeigi et al., 2018). In absence of such separate assessment establishing unambiguously the link between proximity to retail food outlets around schools and children's dietary intake/behaviour is difficult. This issue was seen in the work by Tucker et al. (2012) wherein the authors used an index that combines both healthy and unhealthy food habits into a single index.

Dietary behaviour was also assessed by examining specific food choices: unhealthy food (Grier and Davis, 2013; van der Horst et al., 2008) or balanced food containing vegetables, fruits, milk or milk products, cereals and meat Clark et al. (2014). Balanced food intake in students was assessed using a national level index, New Zealand Diet Quality Index for Adolescents (NZDQI-A) (Clark et al., 2014). It is argued that to understand the impact of retail food outlets' proximity to school on students' dietary intake/behaviour use of national level indices may not be appropriate. This is because such indices measure the diet quality of people in a general and broad manner, hence may not capture the specific dietary behaviour attributable to unhealthy food consumption. Smith et al. (2013) provide a solution by using separate healthy and unhealthy diet scores.

Table VIII: Table showing different definitions used for dietary intake/behaviour in the studies included for scoping review.

Reference	Definition/Description for Dietary Index/Behaviour
Davis and Carpenter (2009)	Indicator variables for soda, vegetables, fruits, juice and fried potato chips consumption.
Tucker et al. (2012)	A modified Healthy Eating Index (HEI), measuring 9 components (vegetable, fruit, grain, whole grain, milk and beans, saturated fat, sodium, solid fat and added sugar)
Kelly et al. (2019)	Daily consumption of healthful foods: fruits, vegetables and unhealthful foods: sweets (candy or chocolate), coke or sugar-sweetened beverages (SSB), and chips (French fries).
Seliske et al. (2013)	Lunch-time eating behaviour measured. Eating at snack bar, fast-food restaurant, cafe considered to indicate eating behaviour dependent on food retailers around schools.
Virtanen et al. (2015)	Eating behaviour assessed through binary indicators relating to skipping breakfast, eating school lunch, free snack consumption at school, obtaining snack from outside of school (gas stations, grocery store) and eating with family.
Smith et al. (2013)	Computes score of healthy diet and unhealthy diet based on a set of questions. Fruits, vegetable consumption and eating breakfast constitute healthy diet while consumption frequency of selected unhealthy food items is used to compute the unhealthy diet score.
Clark et al. (2014)	Diet Quality Index (DQI) computed based on New Zealand Diet Quality Index for Adolescents (NZDQI-A). Intake of fruits, vegetables, bread and cereals, milk and milk products, meat and alternatives as per the national recommendations is used to compute the score.
Van Hulst et al. (2012)	Four measures used to assess diet. Binary variable for daily consumption of fruits and vegetables as per the recommended servings, consumption of soft drinks and sugar-sweetened beverages, eating meal or snack outside of school and consuming take-away or delivered food.
van der Horst et al. (2008)	Daily consumption of soft drink and snacks (sweet : candy, candy bars, chocolate, cake, biscuits and savoury : fast-food, pizza, fries, chips, nuts) used to measure the dietary quality.
(Grier and Davis, 2013)	Soda consumption used to measure the fast-food consumption.

Seliske et al. (2013) assessed the lunchtime eating behaviour of students but no information about the kind of foods purchased/available in the snack bars, fast-food restaurant and cafe

was provided. Authors assumed eating at home/school or not eating in the lunch time as a healthy dietary behaviour, whereas eating at snack bars, fast-food restaurants (FFRs) and cafe was considered unhealthy. While this could be true, unhealthy food could also be consumed at home/schools and healthy in the snack bars, FFRs and cafes. Absence of clarity on this aspect made it difficult to interpret the findings of this work.

Conclusion Measuring dietary intake/behaviour is not an uncomplicated task. With wide diversity in the FEAS globally, it is imperative that minimal set of foods to assess healthy/unhealthy quality of diet are identified. This could help in obtaining clearer evidence to inform policies related to food outlets proximity around schools.

3.2.3 Food Environment Around Schools

In this section, main characteristics of FEAS observed in the included studies are presented and discussed. These include the type of buffer and the buffer size/distance used to map the food environment around schools. Confounding factors which could potentially affect the association between food outlet proximity to schools and outcome measures are also presented and discussed. Figure 3.3 shows the different types of food outlet identified in the 24 studies. It is seen that fast foods outlets were the most common food outlet types found near schools, followed by convenience stores and supermarkets.

Proximity to these outlets around schools is described in different ways (Table IX across the studies.

Buffer Types

Different techniques were used to map the proximity of retail food establishments around schools. The most common were:

1. Euclidean/Straight line Distance.
2. Network Buffer or Road-Network Buffer.
3. Circular Buffer.

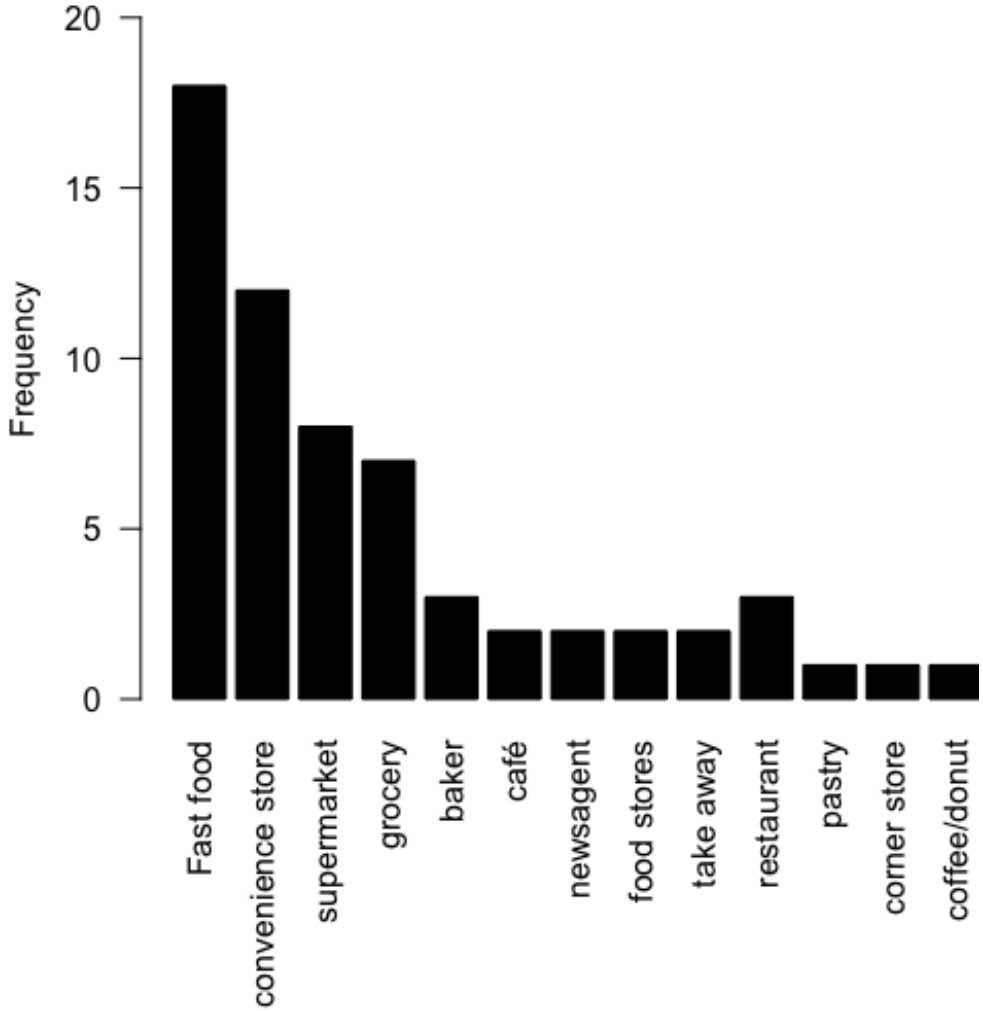


Figure 3.3: Different types of food outlets in the food environment around schools identified in the studies included for scoping review. The various terms are extracted as-it-is from the included papers.

Choice of technique and the buffer size considerably influenced the presence/absence and the magnitude of the association of food outlet proximity to schools and BMI/dietary intake. James et al. (2014) demonstrated that the statistical significance and effect size differed with the choice of buffer. According to Oliver et al. (2007), line-based road network buffers showed more accurate association than the circular buffers. This was also demonstrated by Seliske et al. (2013) who noted a stronger relationship between dietary behaviour and retail food environment when road network was used than when circular buffer was used. The differences in the choice of mapping technique and buffer size may explain the widely-prevalent discrepancy and inconsistency in the conclusions regarding the association of retail food establishment around schools and overweight/obesity and dietary intake/behaviour

among school students.

Table IX: Table listing different specifications of distance used to describe the proximity of food outlets to schools in the studies included in the scoping review.

Reference	Proximity Description used in the study
(Van Hulst et al., 2012)	Exact address of school is geocoded. Road-network distance between the nearest fast food establishment to school is measured.
(Asirvatham et al., 2019)	Distance of the nearest interstate or US highway from the school used as an instrument of fast food proximity.
(Baek, Sánchez, Berrocal and Sanchez-Vaznaugh, 2016)	Geocodes of schools and convenience stores used to compute the distance of schools from stores. Maximum distance upto which proximity is measured is 7 miles, starting from 1/4 mile (400m).
(Baek et al., 2014)	Geocodes of schools and food stores (fast food and convenience stores) used to compute the distance of schools from stores. Proximity relates to food establishments around 1/4, 1/2, 3/4 mile of a school.
(Baek, Sanchez-Vaznaugh and Sánchez, 2016)	Geocodes of schools and food stores (fast food and convenience stores) used to compute the distance of schools from stores.
(Barbouni et al., 2017)	Zones of 500m around schools based on Geographic Information System (GIS) are used to describe the food environment around schools.
(Clark et al., 2014)	Buffer zones of 800m and 1500m around schools. Shortest straight line distance from school to the nearest food outlet ranged from 289m to 419m.
(Davis and Carpenter, 2009)	Proximity categorised into three mutually-exclusive groups: (400m), (400m-800m) and (800-1200m).
(Gilliland et al., 2012)	Circular and network buffers of 500m and 1000m from school address. Additional proximity indicator is the school walkshed which refers to the school's catchment area encompassing students who live close to school within 1600m.
(Grier and Davis, 2013)	Nearest straight-line distance (Euclidean distance) of fast food establishment from school obtained using the longitude-latitude of schools and restaurants.
(Griffiths et al., 2014)	Circular buffer of 2km around school measured using straight-line distance (Euclidean distance).
(Harris et al., 2011)	Distance to the closest food store from school. Range of distance observed was 90m to 2.9km.
(Tucker et al., 2012)	A 1km straight line buffer is used to describe the food environment around a school.
(Howard et al., 2011)	800m network buffer is used around schools which are identified using geocoded locations.
(Kelly et al., 2019)	1km buffer used around schools. Dichotomous variable created to indicate whether or not fast foods comprise more than 10% of total food outlets within 1km of school.
(Langellier, 2012)	800m road-network buffer around school and presence of fast-food outlet/corner store determined.
(Seliske et al., 2013)	1km circular and road-network buffers used.
(Smith et al., 2013)	Road network distance of 400m and 800m around each school used to create the food environment around schools. Minimum distance to food outlet was 0m.
(Tang et al., 2014)	Within 400m distance from school. Both road-network radius and Euclidean radius of 400m used to determine presence/absence of food outlets around schools.
(van der Horst et al., 2008)	500m crow-fly buffer used for every school.
(Virtanen et al., 2015)	Shortest distance from school to fast-food outlet or grocery store. This distribution is classified as $\leq$100m, 101m-500m and $>$ 500m.
(Wasserman et al., 2014)	800m radius area around schools.
(Currie et al., 2010)	Area around school at 160m, 400m and 800m.

To understand the difference between radial/circular buffer and line-based buffer, please refer to Figure 3.4 and Figure 3.5.

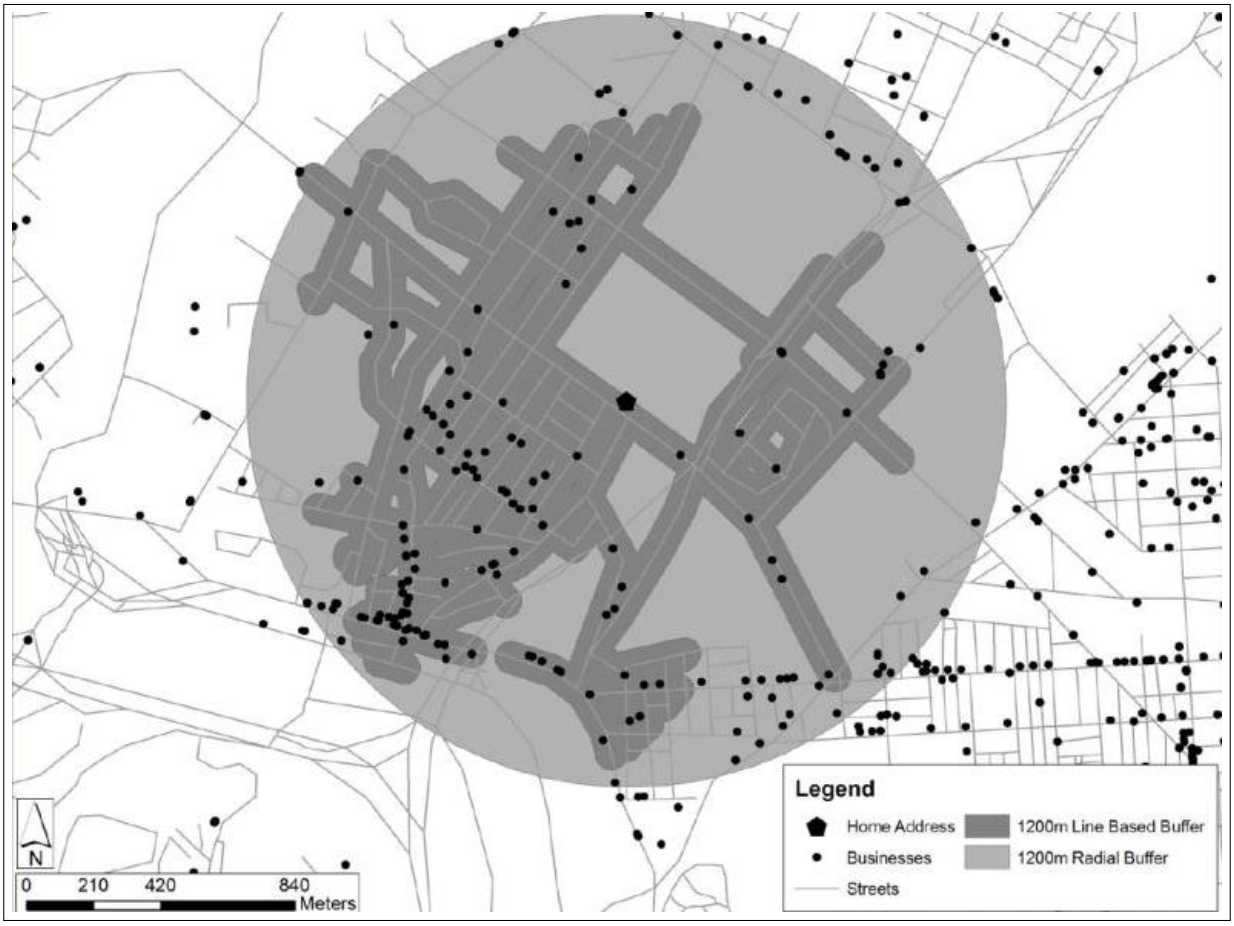


Figure 3.4: Example of a Radial Buffer and Line-based Buffer with Business Addresses. Source of image: (James et al., 2014)

Figure 3.5: 1km food retail environment around school shown using circular and network buffers. The white area represents the road network buffer, the gray area and white area both encompass the circular buffer. Black dots represent food retailers and small flag represents the school. Source of image: (Seliske et al., 2013)

Buffer size/Distance choice

The reason behind the distance used to specify the proximity of food outlets to schools varied across the studies but not all authors provided the reasons (9 out of 24 studies justified choice of distance). Most common reasons are listed in Table X.

Table X: Table listing the reasons behind distance specifications for proximity between food outlets and schools identified in the studies included for the scoping review.

Reference	Reason authors cite for choosing distance/proximity from school
(Seliske et al., 2013)	Chose 1km for it is walkable in 10 to 15 minutes (Pikora et al., 2002).
(Virtanen et al., 2015)	Chose shortest distance from school to fast food restaurant, further classifying as less than 100m, 101m-500m and more than 500m. Choice guided by closed campus policy of Finnish lower secondary schools.
(van der Horst et al., 2008)	500m distance around schools is selected because it is accessible within the 30 minute lunch break at school.
(Tang et al., 2014)	400m distance is selected because food outlets around schools at this distance can be easily accessed by walking.
(Smith et al., 2013)	400m and 800m distance selected because this distance is commonly used in food-access research (An and Sturm, 2012; Day and Pearce, 2011*a*; Simon et al., 2008)and takes five-ten minutes of walking.
(Kelly et al., 2019)	1km distance chosen based on previous literature which assert that such distance as walkable in 10-15 minutes (Seliske et al., 2009) or in less than 10 minutes (Héroux et al., 2012)
(Howard et al., 2011)	800m distance is chosen based on previous research (Austin et al., 2005; Zenk and Powell, 2008) and is walkable in ten-minutes.
(Tucker et al., 2012)	Choice of 1km distance from school based on commonality of this distance used in accessibility studies (Larsen and Gilliland, 2008) and is walkable within10-15 minutes.
(Harris et al., 2011)	Choice of 2km chosen for a plausible distance to be travelled to-and-fro during the high-school lunch break.

Walkability to and accessibility of food outlets around school during meal time was used as a criteria to choose the proximity distance. However, the authors seemed to be missing a crucial point. Going out to eat lunch during school break involves time spent in walking upto the location, placing the order, obtaining it, eating the food and getting back to school. Most researchers did not consider the time spent in this process and based proximity distance solely on the approximate time taken to walk till food outlets.

For example, Seliske et al. (2013) chose 1km as it is walkable in 10 to 15 minutes, but walking upto this distance, ordering, obtaining and eating food and walking back to school may take more than 40 minutes and it cannot be assumed that school breaks are that long. Moreover, Seliske et al. (2013) based 1km distance on the work by Pikora et al. (2002) which is related to

assessment of neighbouring environment for physical activity and not FEAS. And generally for physical activity, people are willing to walk longer distance (walking or cycling), hence 1km may not be appropriate in the context of FEAS. However, for after-school access to food outlets, this may not be the case but generally students visit nearby food outlets during the school hours (Caraher et al., 2016).

It is noteworthy that 9 studies reportedly used distance of atleast 1km or more but only 2 reported the reasons behind the choice of distance. In fact, research by Harris et al. (2011), which did not specify reason behind its choice of 2km proximity distance, is often cited in FEAS research to reinforce the absence of relationship between obesity risk among students and proximity to food outlets from school (Williams et al., 2014; Tang et al., 2014; Lytle and Sokol, 2017). On the other hand, Davis and Carpenter (2009); Currie et al. (2010) showed that the effect of food outlets on dietary outcomes and overweight/obesity diminishes as the distance of food outlets from school increases. These findings indicate that the choice of proximity distance considerably impact the presence/absence and magnitude of the association under consideration.

Distance specifications for food outlets around schools vary widely and since FEAS vary with cultures, countries and contexts, it is very difficult to arrive at a universally-valid buffer size. However, existing policies in this field may guide this choice. As per the Special Act on Safety Control of Children's Dietary Life, Korea, fast food outlets are prohibited within 200m from schools (Green Food Zone, 2008) and in the UK at a distance of 400m (Barking and Dagenham, 2010) and 152m in Detroit, USA (Detroit Municipality, 2008). On the whole however, it is clear that the inconclusive evidence in the domain of FEAS and childhood overweight/obesity could be attributed to varying buffer sizes chosen in an arbitrary and ad-hoc manner.

Confounding Factors

The included papers reported confounding factors for which the analysis was adjusted as to provide more reliable estimate of association. These factors could be categorised into two groups: individual-level and school-level.

Table XI: Table listing the most common confounding variables mentioned by researchers in the studies included for the scoping review.

Level	Variables
Individual Level	Age, Sex, Physical Activity/ Exercise Regimen, Ethnicity/Race, Socio-economic position, Parents education, Annual Household Income.
School Level	Urban/Non-Urban/Sub-Urban/Rural location, Socio-economic deprivation, Free/Reduced price school meal prevalence, close/open campus, cafeterias, vending machines, school snack/tuck shops, Ethnicity/Race.

Socio-economic factors affect the risk of overweight/obesity both at the individual level and school level (Davis and Carpenter, 2009). At the school level, socio-economic status is often measured through the proportion of students who qualify for the free/reduced-price school meals (Grier and Davis, 2013). Schools with lower socio-economic status and higher deprivation are found to have stronger association between proximity to retail food outlets and the school-level overweight rate (Howard et al., 2011).

Other confounding factors are the food vending machines, cafeterias and tuck shops in schools. One may assume that these reduce the likelihood of snacking outside schools but reduced prices for meals outside school often prompt students to eat outside (Seliske et al., 2013). At school-level, open-campus or closed-campus policies also affect the relationship between proximity of the retail food outlets to schools and students' overweight/obesity status and dietary intake/behaviour (Neumark-Sztainer et al., 2005). But these policies may not be effective before- and after-school hours.

At the individual level, apart from physical activity, ethnicity is considered as a significant confounding variable. Black students in USA show stronger and consistent association between food outlet proximity to schools and overweight/obesity as compared to other ethnic populations (Davis and Carpenter, 2009; Langellier, 2012; Grier and Davis, 2013). Home neighbourhood environment and parental eating habits also affect the eating habits of students at school.

Taking account of confounding factors is essential for thorough investigation of the role of FEAS on childhood overweight/obesity. However, it must be remembered that establishing the

impact of FEAS on weight status or dietary behaviour of students is not a simplistic problem of modelling. Such a simplistic reduction of this complex problem would continue to raise questions about causality and perhaps risk silencing the issue of obesogenic FEAS when statistically significant associations are not discovered. A simpler and more useful approach could be to prevent the clustering of unhealthy fast food outlets in school vicinity based on the evidence related to the harmful effect of such foods on overweight/obesity (Mu et al., 2002; Kelishadi and Azizi-Soleiman, 2014; Liu et al., 2019).

3.2.4 Food Outlet Proximity and Dietary Intake and Overweight/Obesity

In this section, main results relating to the relationship between proximity of food outlets around schools and overweight/obesity and dietary intake/behaviour among students are presented and discussed. Discussion is simultaneously carried out with results to preserve the context.

Dietary Intake

Van Hulst et al. (2012) using 24-hour dietary recall among 8-10 year old students with family history of obesity found that higher consumption of vegetables and fruits was associated with greater distance of fast-food restaurants from school (p=0.08). The per-day consumption of sugar sweetened beverages declined as the distance of fast-food restaurants, supermarkets and convenience stores from school increased. The subjective reporting of diet could be inaccurate and bias the results. Shim et al. (2014) describe multiple methods to assess dietary intake, such as 24-hour dietary recalls and records, dietary history or food-frequency questionnaires which may be applied in the current context.

One method used by Clark et al. (2014) was the national dietary-quality questionnaire.The authors found that girl students aged 15-18 years whose schools were at a higher distance from the food outlets had lower diet quality. The authors concluded that food environment has a minor role in dietary quality of students due to small effect sizes. However, this small effect could be attributed to the choice of distance (800m) in the study because it has been shown in several research studies related to food environment around schools that the effect size wanes as the distance of food establishments from a school increases (Baek, Sánchez, Berrocal and Sanchez-Vaznaugh, 2016; Davis and Carpenter, 2009; Joo et al., 2015*a*). In fact, (Virtanen et al., 2015) showed that grocery stores and fast food restaurants at smaller distance

($\leq$100m) from lower-secondary schools in Finland were associated with irregular eating habits like skipping breakfast and free school lunch as compared to the longer distance ($>$500m).

In contrast to the results of Clark et al. (2014), Davis and Carpenter (2009) showed that among middle and high school students in USA, poor quality of food environment around schools (within 800m) was associated with lower consumption of fruits and vegetables, higher consumption of soda and increased likelihood of being overweight/obesity. Context can explain the observed discrepancy in results. Clark et al. (2014) used the National Dietary Quality Index of New Zealand to assess the dietary quality whereas Davis and Carpenter (2009) used information on soda, vegetables, fruits, juice and fried potato chips consumption to assess dietary quality of students. This raises concerns about methods to measure the dietary intake/behaviour among students in the context of FEAS. Since, the goal is to assess the overweight/obesity risk, the dietary assessment must examine presence of those foods which are more likely to contribute to the risk. A specific measurement of dietary quality with respect to overweight/obesity could be much more informative than the general diet quality measures in the current context, and much more relevant from the policy evidence point of view.

A modified Healthy Eating Index (HEI) was used by Tucker et al. (2012) to assess the nutritional intake among students in 7th and 8th grade. The authors found that schools which had convenience stores and fast-food restaurants within 1km of radius had lower HEI scores as compared to those farther than 1km ($p<0.05$ for each). For the same distance Kelly et al. (2019) found that students aged 14-16 years belonging to schools having more than 10% of retail food outlets within 1km as fast-food had reduced odds of daily vegetable and fruit intake. However, it would be more insightful to know about the distance from school of these food outlets because that will help in understanding the role of proximity in reduced odds of vegetable consumption. Another study relating to food outlet proximity of 1km around schools found strong relationship between the presence of food retailers and poor lunch time-eating behaviour of students aged 13-16 years (Seliske et al., 2013). This association was stronger when road-network buffer was used than when the circular buffer was used. Road network considers all walkable distance around schools whereas circular buffer includes only the circular area around school, the former simulating real life scenario in a much more accurate manner.

Furthering the research on food environment around schools and dietary intake, Smith et al. (2013) conducted a longitudinal study and found that takeaways located within 800m of schools were associated with unhealthy diet scores among 11-12 year old students. Both healthy and unhealthy diet scores decreased for students overtime but the decrease in healthy score (-1.10) was more than that in unhealthy score (-0.48). In fact the mean score for vegetables and fruits decreased by 0.55, fizzy drinks by 0.21 and very small change in mean score of fried food (0.06), sweet (-0.06) and biscuit (-0.06) was found. This is despite increased grocers within 400m and decreased takeaways but increased number of convenience stores within 800m.

van der Horst et al. (2008) investigated the association between food outlet at 500m from schools and snack and soft drink consumption among 12-15 year students. The authors found that higher soda consumption was associated with smaller distance to the nearest food store (200m-300m). From the above findings, it is clear that proximity to fast food outlets from schools may be associated with unhealthy dietary intake/behaviour among school students. The nature of this relationship varies with the proximity specification and construct used to assess the dietary intake/behaviour.

Overweight/Obesity

Asirvatham et al. (2019) found that proximity of schools to fast food restaurants was associated with higher BMI among students and the effect size decreased as the distance increased. The effect size was small because the schools observed closed campus policy, but was highly significant ($p<0.001$). Similarly, Barbouni et al. (2017) found that for students in class 7 and 10, those belonging to schools with food shops around 500m had higher BMI than those whose schools were faraway ($p=0.022$). Furthermore, higher clustering of such food shops at a close distance from schools was significantly associated with higher BMI ($p=0.022$). Clustering of grocery stores and fast food restaurants at a distance of 2miles around schools was found to be associated with higher BMI among students by Wasserman et al. (2014). In such cases, it is more important to obtain information on proximity of each outlet in the cluster because higher proximity and higher density are more threatening to childhood overweight/obesity (Davis and Carpenter, 2009).

In contrast, Harris et al. (2011) report the absence of association between proximity of food stores to schools and the risk of obesity among students in 9-12 class. However, authors

point this lack of association to preponderance of unhealthy food selling establishments around high schools. It is noteworthy that out of 10 schools in the study 5 had food stores situated within 500m. Similarly, Tang et al. (2014) attributed lack of association between convenience stores and student weight status to their high presence around schools. The authors also found marginal significance for association of limited service restaurants and takeaways within 400m of school and BMI of middle and high school students. In contrast, grocery stores and supermarkets within the same distance were associated with lower BMI of students. This was a unique study for it showed that healthier food outlets around schools were associated with healthy weight status among students.

Adjusting for school-level variables, the presence of convenience stores within 800m from schools was associated with higher obesity rate among 9th grade students (1.2% [05% CI: 0.03-2.4]) than fast-food restaurants or supermarkets (Howard et al., 2011) . Baek, Sánchez, Berrocal and Sanchez-Vaznaugh (2016) using distributed lag modelling (DLM) over traditional regression modelling found that convenience store accessibility and availability around schools at a shorter distance was associated with higher BMI (0.004 [95% credible interval (CI): 0.003, 0.006] at 800m) among 5th and 7th grade students. This effect waned as the distance increased (0.000 (95% CI: -0.000,0.001) at 2.4km miles). Adjusting for covariates reduced the magnitude of the association but the estimates remained significant. DLM was used for it prevents the bias associated with arbitrary selection of spatial distance from the schools and thus, leads to more accurate and precise effect estimates. Similar to DLM, Baek et al. (2014) using the multiple informant model, which uses information from multiple food store types around schools, found for 5th, 7th and 9th grade students that convenience stores' association with BMI was significantly greater than that between BMI and fast food restaurants for all buffer size (distance from school). Moreover, the distance of 400m (1/4 miles) was the most relevant distance at which tangible association between convenience stores and BMI was observed. Baek, Sanchez-Vaznaugh and Sánchez (2016) reported that hierarchical distributed lag modelling (HDLM) resulted in significant and more precise estimates over the traditional multilevel regression: (0.004 [95%CI: -0.002-0.009]vs. 0.004 [95%CI : 0.001-0.007] BMIz increase per unit convenience store addition in 800m respectively). This association differed across districts indicating the need to consider localised environment to assess the influence of FEAS on overweight/obesity.

Gilliland et al. (2012) used three ways to map the FEAS (circular buffer, network buffer and school walksheds) and found a modest association between 10-14 year old students' BMI and food environment ($p<0.05$). Langellier (2012) demonstrated that after adjusting for other school-level covariates, presence of corner store within 800m of schools was associated with 1.6% point increase in overweight rate for students in 5-9 grade of majority-Latino schools. It indicates that the association between food environment and overweight/obesity in students differs by the majority ethnic composition of the schools. In fact, authors noted that the distribution of corner stores and fast food restaurants was less common around majority-white schools. This suggests that proximity to fast-food restaurants is a more important risk factor for socially-disadvantageous schools and must be dealt with seriously because students attending such schools are also at a higher risk of obesity and diabetes (Holub et al., 2013).

Griffiths et al. (2014) found no association between proximity of the nearest fast-food outlet to secondary school and obesity among students. However, for retail food outlets, the authors found lower likelihood of obesity with increased distance from the schools. Majority of the outlets in this study belonged to this group (71.3%), others were takeaways (25.4%) or supermarket (3.3%). Thus, it would be inappropriate to conclude that proximity of food outlets to schools does not influence the BMI of students, as retail food outlets which were in the majority showed some association. The authors seemed to be adopting a very objectionable and refutative stand with respect to the association of proximity of food outlets to schools and childhood obesity stating that mere exposure or geographical location of outlets with respect to schools was unimportant. But this is not entirely true as Chandon and Wansink (2012) in their nutrition review showed that exposure to unhealthy food is associated with overweight/obesity risk among public. Moreover, the evidence that Griffiths et al. (2014) use to negate the importance of geographical proximity of food outlets to schools related to adults (Drewnowski et al., 2014) and not to children who are relatively more impressionable to food promotion through availability, marketing or advertisement of foods as shown in a systematic critical review (Smith et al., 2019).

A longitudinal study by Currie et al. (2010) followed 3 million children for 30 weeks and found that the obesity rates increased by 5.2% among the 9th grade students whose schools had one fast food restaurant around 160m of distance. It did not find any effect at 400m and 800m distance and noted that non-fast food restaurants did not influence the obesity rates. More importantly, Currie et al. (2010) discovered that the change in the presence of fast-food outlets

around schools was not associated with the observable school-level characteristics. Thus, the likelihood of such establishments was equally likely at 160m, 400m and 800m. This proves that food business operators consider children as an important market segment and focus on clustering around schools (Austin et al., 2005).

This longitudinal study made clear that proximity of fast-food restaurants around schools is associated with overweight/obesity among school students. The distance of 160m was of particular significance because most of the studies generally considered distance ranging between 400m and 3.2km and on not finding any association they often concluded that obesogenic food environment around schools was unrelated to overweight/obesity among children (Griffiths et al., 2014; Harris et al., 2011). More importantly, in the Indian draft regulations 50m is the specified distance which is around one-third of 160m. This finding calls for urgent review of the 50m distance for its effectiveness prior to implementation. Overall, from the results it was clear that the association between proximity of food outlets to schools seemed to be differing with the choice of buffer sizes and buffer types.

3.3 Conclusion

3.3.1 Policy Review

South Asia presents a complex case with respect to malnutrition and its two forms: undernutrition and overnutrition. While all the countries in the region are struggling to eradicate undernutrition, emergence of overweight/obesity - a form of overnutrition, is slowly becoming a cause for concern. The prevalence of overweight/obesity differs across the regions owing to diverse socio-economic and cultural factors. The governments and ministries of Health and Education in the countries in this region have initiated several health and nutrition-related reforms to improve the health and well-being of its citizens, children and mothers, however, prevention of obesity is not yet recognised as a stand-alone policy agenda. Maintaining the status-quo with regard to this could prove very costly to the countries in this region, hence it is urgent that policies targetting overweight/obesity based on robust research evidence are formulated.

3.3.2 Scoping Review

The scoping review found evidence related to the proximity of different kinds of food outlets to schools and higher risk of overweight/obesity and poor dietary intake/behaviour among students. The results were not consistent and substantial heterogeneity in results existed but overall the case for monitoring obesogenic food environment around schools appears strong. The main areas identified for deeper investigation are specification of proximity distance keeping into account the lunch-time break, time spent in travelling to food outlets from school and back, and in ordering and eating food. Secondly, measurement of dietary intake/behaviour in the context of overweight/obesity needs to be precise such that it directly captures the diet-based risk of overweight/obesity rather than poor diet in general. Taking care of these two aspects could help in more robust research design and consequently, reliable and accurate evidence to inform policy.

For the scoping review no quality assessment criteria was applied so its possible that some low quality studies may have formed the part of discussion. Student was the only reviewer for the papers collected as this is a Master Dissertation. There may be a possibility of selection bias in study selection and information bias in extracting data from studies.

In the next section, findings from policy review and scoping review are used to critique the 50m distance in Indian Draft Regulations 2019.

Chapter 4

Indian Draft Regulations Critique

Indian Food Safety and Standards (Safe food and healthy diets for School Children) Regulations 2019 restricts sale/exposure and bans advertisement of unhealthy and HFSS foods at a distance of 50m around schools. Based on the results of the policy and scoping review conducted as part of this dissertation, this essay will comment on the distance threshold of 50m specified in the draft regulations.

Policy review related to overweight/obesity in the SAR showed that most programs in India focused on poor nutrition among pregnant women and children. This was quite similar to policies for other countries in South Asia. Most programs targetting healthy eating focused on general health and well-being. For example, health promoting schools and school meal programs for the health of school students. Only India had some rules related to restricting advertisement and sale of unhealthy food to children in schools. However, these exist in a very incipient stage and reflect generality of healthy food promotion rather than a rigorous focus required to prevent the rapid rise in overweight/obesity in the country. Nevertheless, the draft regulations are a step in positive direction.

In the context of the distance specified in the draft regulation, no study in the scoping review measured proximity of food outlets to schools at distance comparable to 50m. The minimum distance was 160m (Currie et al., 2010) whereas the maximum was 2km Harris et al. (2011). From the results of the scoping review it is clear that proximity of unhealthy retail food outlets to schools is associated with increasing overweight/obesity risk and poor dietary intake/behaviour of students. In fact, the strongest evidence was provided by Currie et al. (2010) who showed in their longitudinal study that the obesity rate among the 9th grade students whose schools had

one fast food restaurant around 160m of distance peaked by 5.2% in 30 weeks. Following the results of this study, it is argued that 50m distance, which is a little more than one-third of the 160m distance, demands an urgent review before the regulations are enforced.

One may argue that the Indian context is different from the countries wherein the studies used for the scoping review were conducted. This is a valid point but most unhealthy food selling vendors and hawkers are quite common in Indian streets and around schools (Kashyap, P., 1987), hence, it is even more vital to take into consideration the distance threshold seriously. A small distance of 50m from schools will allow proliferation of such unorganized unhealthy food sellers in the school vicinity further compromising the health of students. Thus, despite the contextual and demographic differences of the studies from the Indian settings, the findings make it clear that the review of 50m distance is an immediate requirement.

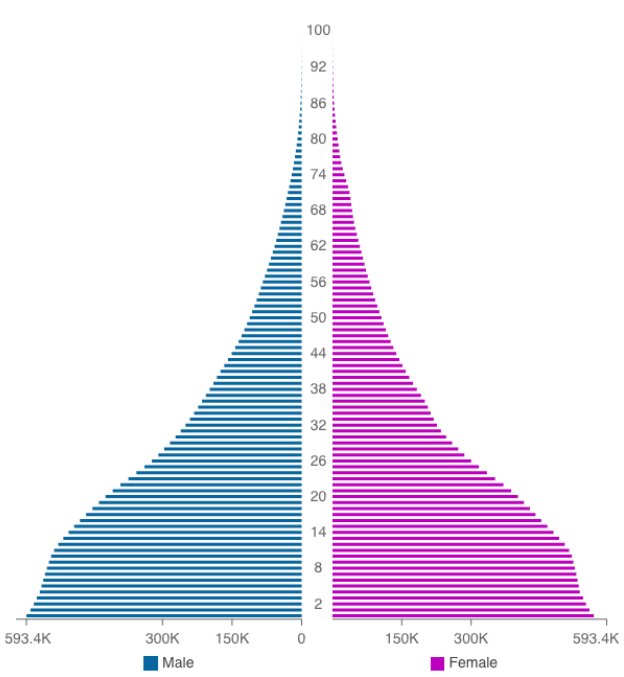
Conclusion Food Safety and Standards (Safe food and healthy diets for School Children) Regulations is an encouraging initiative in light of increasing prevalence of childhood overweight/obesity in India. However, the distance restriction of 50m for food business operators around schools is questionable regarding its efficacy to prevent the exposure of unhealthy foods to students and must be urgently reviewed.

Glossary

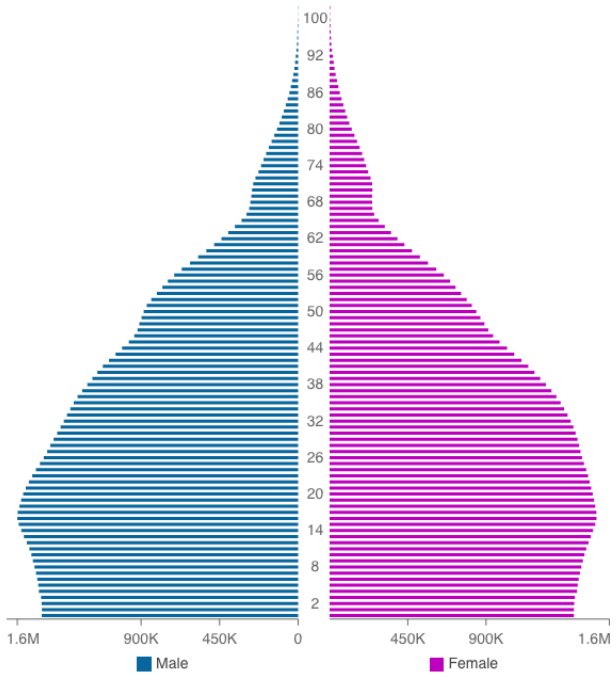
Stunting Stunting refers to low height-for-age and reflects a process of failure to reach linear growth potential as a result of suboptimal health and/or nutritional conditions (World Health Organization, 1997).

Wasting Wasting refers to low weight-for-height or thinness. In most cases it indicates a recent and severe process of weight loss, which is often associated with acute starvation and/or severe disease (World Health Organization, 1997).

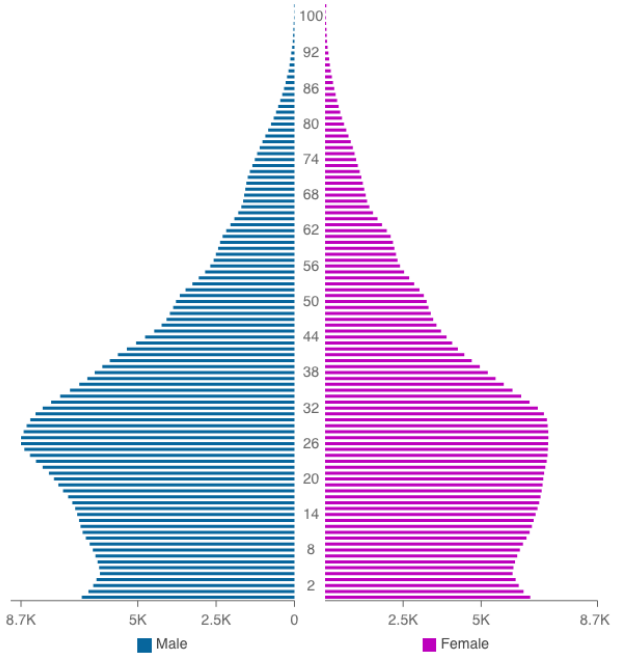
Appendices



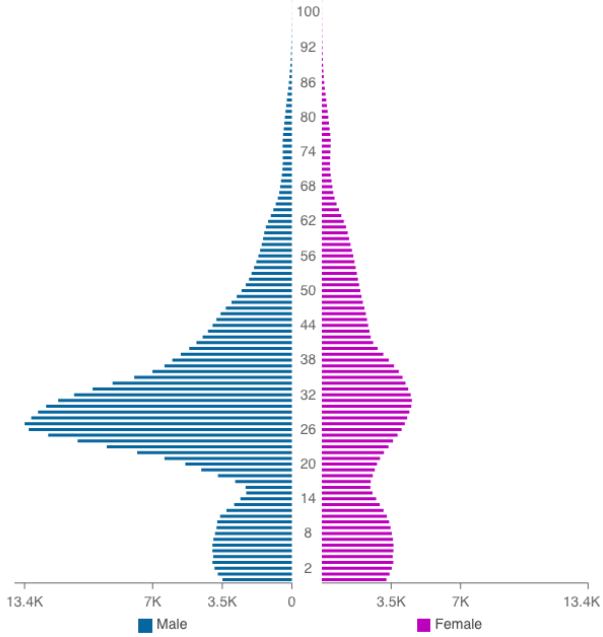
(a) Afghanistan



(b) Bangladesh

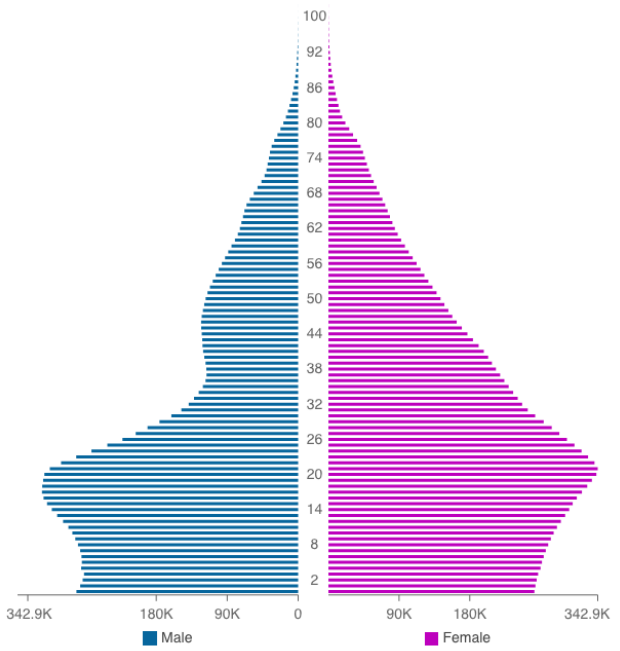


(c) Bhutan

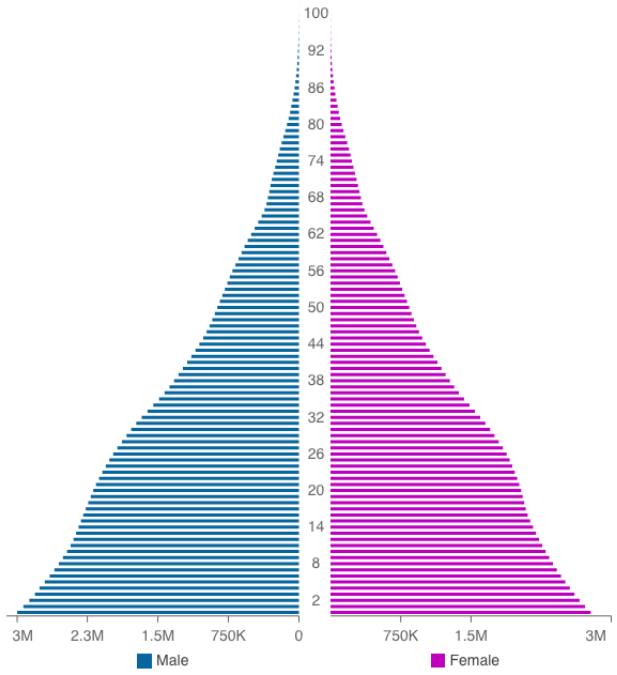


(d) Maldives

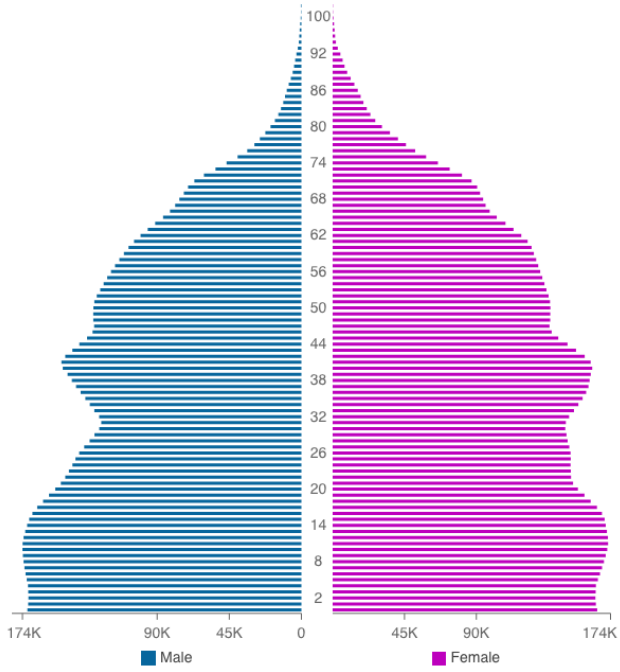
Figure 4.1: Population Pyramid of Afghanistan, Bangladesh, Bhutan and Maldives. (World Population Review, 2020)



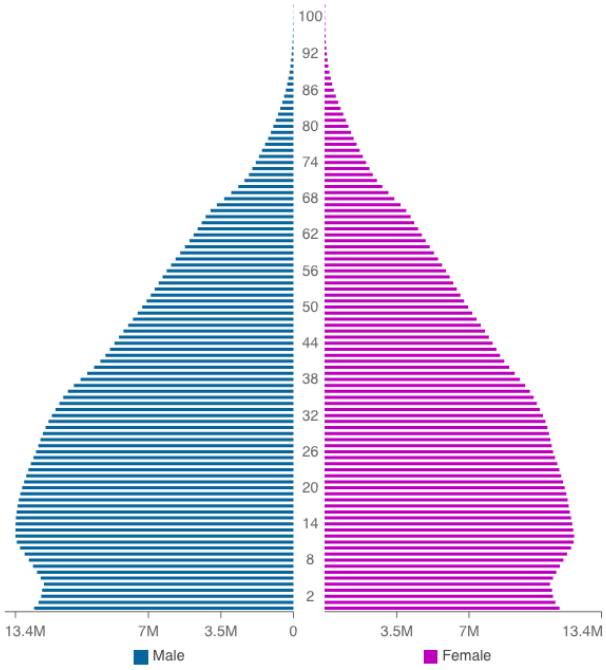
(a) Nepal



(b) Pakistan



(c) Sri Lanka



(d) India

Figure 4.2: Population Pyramid of Nepal, Pakistan, Sri Lanka and Bhutan. (World Population Review, 2020)

Table I: Table describing the search strategy used for the scoping review.

Entity	Name	Identifier	MeSH/Emtree terms
Query	Query 1	fast food OR food OR snack OR eatery OR burger OR pizza OR coke OR beverage OR salt OR sugar OR fat OR juice OR saturated fat OR transfat OR mcdonalds OR burger king OR kfc OR hfss OR HFSS OR chinese food OR fruit OR vegetable OR healthy OR unhealthy OR (high AND fat and salt and SUGAR)	fast foods, food, snacks, cokes, beverages, sodium chloride, sugars, fatty acids, asian continental ancestry group, fruit, vegetables.
Query	Query 2	food environment OR food retail OR food outlet OR food establishment OR food shop OR food vendor OR convenience store OR street food OR food corner OR food joint OR restaurant OR hotel OR grocery store OR food market	food, environment, commerce, restaurants, marketing, joints.
Query Result	Food Environment	Query 1 AND Query 2	
Query	Query 3	high school OR secondary school OR post-primary school OR post primary school OR post-elementary school OR post elementary school OR school	educational status, education, schools,
Query	Query 4	around OR vicinity OR nearby OR near OR closeby OR proximity OR surrounding OR adjacent OR neighbouring OR neighboring	
Query	Query 5	distance OR mile OR meter OR metre OR kilometer OR kilometre	
Query Result	Around School	Query 3 AND Query 4 AND Query 5	
Query	Query 6	pattern OR behaviour OR behavior OR choice OR preference OR habit OR practice	behavior, choice behavior, habits,
Query	Query 7	dietary OR diet OR food OR nutrition OR eating	diet, nutritional status, nutritional sciences, eating
Query Result	Dietary Pattern	(Query 6 AND Query 7) OR (energy intake OR nutritional status OR health behavior OR health behaviour)	energy intake, nutritional status, health behavior
Query	Query 8	obesity OR overweight OR over weight OR body mass index OR BMI OR zBMI OR body weight OR bodyweight OR adiposity OR fatness OR (fat AND(body or visceral or skin or abdominal)) OR skinfold thickness	obesity, overweight, body mass index, body weight, adiposity, human body, skinfold thickness, abdomen
Query Result	Health Related Outcome	(Query 6 and Query 7) OR (Query 8)	
Query Result	Food Environment Around Schools and Health Related Outcome	(Query 1 AND Query 2) AND (Query 3 AND Query 4 AND Query 5) AND ((Query 6 and Query 7) OR (Query 8))	

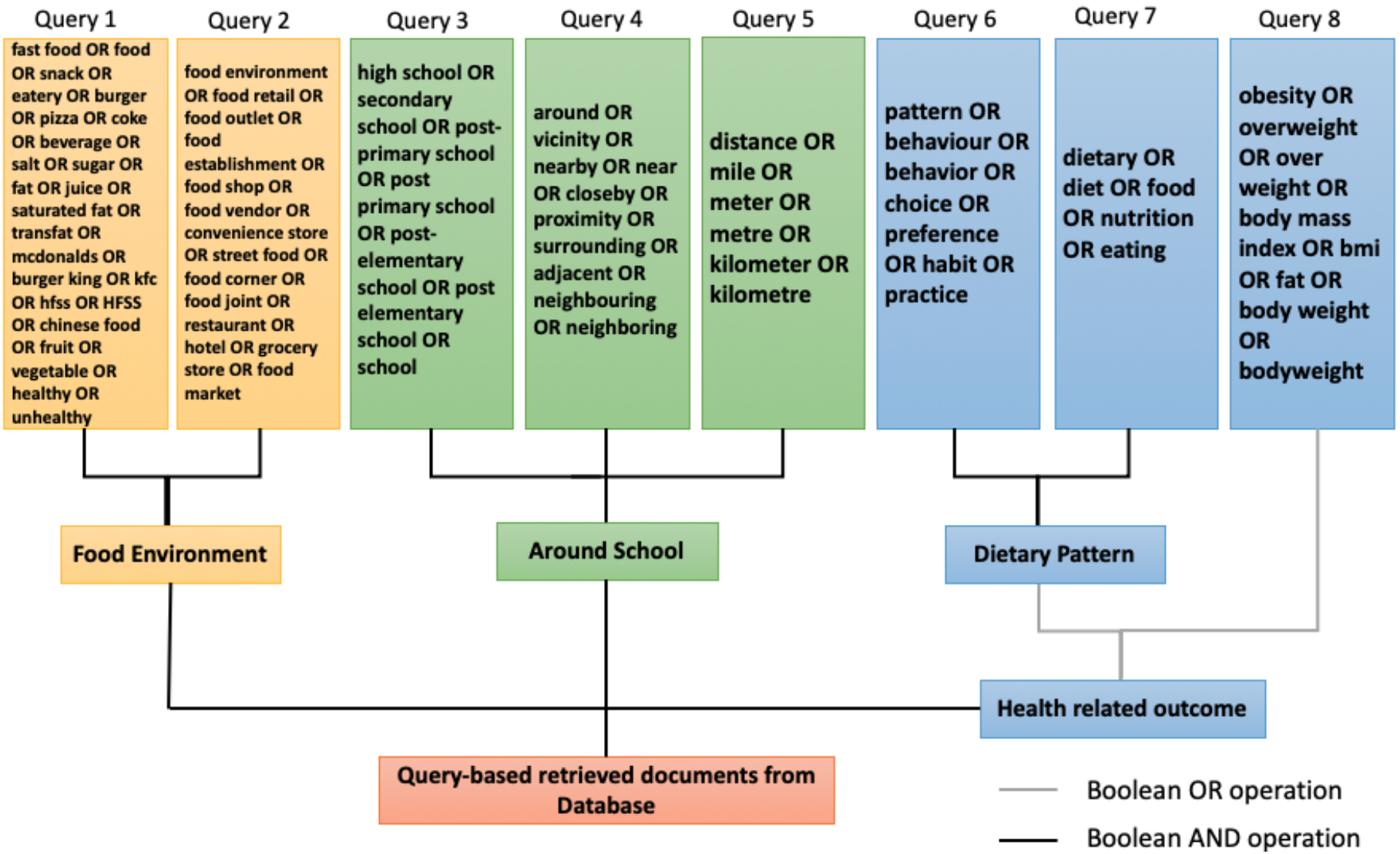


Figure 4.3: Schematic description of search strategy used for scoping review.

Table II: Table listing the nutrition related policies for all countries in South Asia Region included in the policy review.

Country	Policy name
Afghanistan	Public Nutrition Policy (Ministry of Public Health, 2010), National Health Promotion Strategy (Ministry of Public Health, Afghanistan, 2014)
Bangladesh	National Plan of Action for Nutrition (Bangladesh National Plan of Action for Nutrition, 1997), National Nutrition Policy (National Nutrition Policy, 2015)
Bhutan	Comprehensive School Health Program (Comprehensive School Health Promotion, 2007), Draft Bhutan country strategic plan , Food and Dietary Guidelines for School-Aged Children in Bhutan (Ministry of Health, 2011)
India	Food Safety and Standards (Safe food and healthy diets for School Children) Regulation (Food Safety and Standards Authority of India, 2019), National Health Policy (National Health Policy , 2016), Guidelines on Food Safety and Hygiene for School level kitchens under mid-day meal scheme (Mid-day meal scheme, 2015), National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular and Stroke (MoHFW , 2016*a*; 2017*c*; 2016*b*; 2017*b*;*a*), School Health Program under Ayushman Bharat (Ayushman Bharat, 2018), National Nutrition Strategy (NITI Aayog, 2017), POSHAN Abhiyaan (POSHAN Abhiyaan, 2017)
Maldives	Health Master Plan (Health Master Plan Maldives, 2016), Integrated National Nutrition Strategic Plan (Integrated National Nutritional Strategic Plan, 2016), National Food Based Dietary Guidelines for Maldives (Health Protection Agency, n.d.), School Health Policy in 2004 and 2011 (School Health Policy, 2011; 2014)
Nepal	National Nutrition Policy and Strategies (National Nutrition Policy and Strategy, 2004), School Sector Development Plan (Ministry of Education Nepal, 2016), School Health Nutrition Program (Ministry of Health Nepal, 2006), Nepal Health Sector Strategy (Nepal Health Sector Strategy, 2015), Joint Action Plan for School Health and Nutrition (Joint Action Plan School Health and Nutrition, 2011)
Pakistan	National Curriculum Framework of Pakistan (National Curriculum Framework Pakistan, 2019), Nutrition for National Development (Pakistan Integrated Nutrition Strategy, 2011), School Health Program (School Health Program, 2010)
Sri Lanka	National Policy and Strategic Frameworks for Prevention and Control of Chronic Non-Communicable Diseases (Ministry of Healthcare and Nutrition Sri Lanka, 2009), National Health Strategic Master Plan (National Health Strategic Master Plan , 2016), National Nutritional Policy (National Nutrition Policy, 2010), School Health Promotion Program (Medium Term Plan 2008-2012) (School Health Promotion Program, 2008), National Plan of Action for Children in Sri Lanka (National Plan of Action for Children in Sri Lanka, 2010)

Table III: Table describing Afghanistan's nutrition policies and their brief summary.

Framework area	Policy name	Framework specific policy information
N		
O	Public Nutrition Policy (2009-2013)	National food safety and food quality standard mandatory to uphold.
U		
R		
I	Public Nutrition Policy (2009-2013)	Flour fortification, ghee and cooking oil fortification, salt iodization, micro-nutrient supplementation
S	National Health Promotion Strategy (2014)	Creating Supportive Environment to encourage healthy behaviour adoption.
H	Public Nutrition Policy (2009-2013)	Nutrition and Food Security Surveillance Systems.
I	Public Nutrition Policy (2009-2013)	Sensitize care givers and communities about malnutrition. Breast-feeding, micronutrient-rich foods, micro-nutrient supplements and safe, nutritious and diverse foods consumption promotion.
N	Public Nutrition Policy (2009-2013)	Integrated mother and child initiatives for healthy nutrition.
G	Public Nutrition Policy (2009-2013)	Nutrition promotion in schools, health care settings and media. Emergency time nutrition counselling and local food recipe promotion. Breastfeeding counselling, complementary feeding demonstrations, participatory food preparation sessions. Training of nutrition partners.

Table IV: Table describing Bangladesh's nutrition policies and their brief summary

Framework area	Policy name	Framework specific policy information
N		
O	National Plan of Action for Nutrition (1997)	Assess food health quality and safety. Emergency nutrition.
	National Nutrition Policy (2015)	Adequate nutrition to children, mothers and chronically sick.
U		
R	National Nutrition Policy (2015)	Processed and commercial foods marketing regulation.
I	National Plan of Action for Nutrition (1997)	Food fortification, salt iodization,
S		
H	National Plan of Action for Nutrition (1997)	Collect nutrition situation data.
I	National Plan of Action for Nutrition (1997)	Promote breastfeeding, healthy diet, micronutrient-rich foods. Community nutrition program.
	National Nutrition Policy (2015)	Fats, carbohydrates and micronutrients consumption guidance. Pregnant women diet promotion
	Health, Nutrition and Population Strategic Investment Plan (HNPSIP) (2016)	Encourage limited excess salt, sugar, oil consumption.
N	Health, Nutrition and Population Strategic Investment Plan (HNPSIP) (2016)	Nutrition promotion by community-based health care workers.
G	National Plan of Action for Nutrition (1997)	Breastfeeding, weaning foods, complementary feeding, dietary malnutrition control information dissemination.
	National Nutrition Policy (2015)	Nutrition message dissemination program and nutrition education promotion in schools and colleges. Sensitization on micronutrient deficiencies, fruits and vegetables preservation and food diversification.
	Health, Nutrition and Population Strategic Investment Plan (HNPSIP) (2016)	Healthy diet with fruits and vegetables promotion.

Table V: Table describing Bhutan's nutrition policies and their brief summary.

Framework area	Policy name	Framework specific policy information
NO URISHING	Comprehensive School Health Program (2007)	Food seller food monitoring.
	Comprehensive School Health Program (2007)	Ensure good nutrition in schools.
HI	Comprehensive School Health Program (2007)	Community nutrition promotion.
	Draft Bhutan country strategic plan (2019–2023)	Rice fortification.
NG	Comprehensive School Health Program (2007)	Health promoting schools, Parental and teacher nutrition education,
	Food and Dietary Guidelines for School-Aged Children in Bhutan	Food guide pyramid for Bhutanese Children.
	Draft Bhutan country strategic plan (2019–2023)	Nutrition education in schools.

Table VI: Table describing India's nutrition policies and their brief summary

Framework area	Policy name	Framework specific policy information
N	Food Safety and Standards (Safe food and healthy diets for School Children) Regulation 2019	Reasonable portion size usage in marketing products by FBOs.
O	Food Safety and Standards (Safe food and healthy diets for School Children) Regulation 2019	Food business operators (FBOs) within schools required to adhere to food selection and safety guidelines.
R	Food Safety and Standards (Safe food and healthy diets for School Children) Regulation 2019	Prevent exposure/advertisement/sale/free-giveaway of food high in fat, salt, sugar within school premises and 50m around schools. FBOs allowed to sponsor events through nutrition-criteria verified foods.
I	National Health Policy (2017)	Micronutrient supplementation, food fortification.
	Food Safety and Standards (Safe food and healthy diets for School Children) Regulation 2019	FBOs to develop nutrient and energy dense foods, reformulate foods high in fat, sugar, salt.
U		
S	Guidelines on Food Safety and Hygiene for School level kitchens under mid-day meal scheme	Prevent physical, biological, chemical food contamination.
	Food Safety and Standards (Safe food and healthy diets for School Children) Regulation 2019	Prevent exposure to food high in fat, salt, sugar within school premises and 50m around schools. Sale of nutrition-criteria verified food by FBOs.
H	Food Safety and Standards (Safe food and healthy diets for School Children) Regulation 2019	Mandatory license and registration of food business operators within schools
I		
N		
G	National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular and Stroke	Train counsellors, medical health officers, community health workers, program managers and ASHA workers in healthy dietary behaviour.
	School Health Program under Ayushman Bharat (2018)	Nutrition education at primary, middle and high school levels.
	Food Safety and Standards (Safe food and healthy diets for School Children) Regulation 2019	Promote nutrition education in schools.

Table VII: Table describing Maldive's nutrition policies and their brief summary

Framework area	Policy name	Framework specific policy information
NO	Health Master Plan (2016-2025)	School canteen standards under the School Health Program.
	Integrated National Nutrition Strategic Plan (2013-2017)	Healthy school canteen promotion based on standards and guidelines.
URISHING	Integrated National Nutrition Strategic Plan (2013-2017)	Nutrition problem solving workshops in community.
	Health Master Plan (2016-2025)	Nutritional advice to adolescents.
	Health Master Plan (2016-2025)	Health food choice education to young people. Nutrition information dissemination in health care facilities.
	Integrated National Nutrition Strategic Plan (2013-2017)	School, pre-school nutrition program. Nutrition education to young women and adolescent girls. Nutrition education to community based organizations and women's group. Nutrition training to community health workers. Train teachers in nutrition education.
	National Food Based Dietary Guidelines for Maldives	Educate Maldivians about nutrition to prevent chronic diseases.
	School Health Policy in 2004 and 2011	Nutrition awareness in schools.

Table VIII: Table describing Nepal's nutrition policies and their brief summary

Framework area	Policy name	Framework specific policy information
N O U R I S H I N G		
	National Nutrition Policy and Strategies (2004)	Adequate nutrition awareness for parents and community people.
	National Nutrition Policy and Strategies (2004)	Nutrition education and counseling practice to pregnant women.
	School Sector Development Plan (2016)	Nutrition education to adolescent girls.
	School Health Nutrition Program (SHNP) (2006)	Life-skill approach based nutrition education to school children.
	National Nutrition Policy and Strategies (2004)	Nutrition education in schools, for mothers, community level.
	Nepal Health Sector Strategy (2015-2020)	School nutrition program.
	Joint Action Plan for School Health and Nutrition	School Health and Nutrition services to promote healthy nutritional behavioural habits among students.

Table IX: Table describing Pakistan's nutrition policies and their brief summary

Framework area	Policy name	Framework specific policy information
NO URISHING	National Curriculum Framework of Pakistan (2019)	Ensure healthy food provided in school canteens and tuck shops.
	School Health Program (2010)	Offer good supplements for malnourished children. School feeding/lunch program.
NUTRISHING	Nutrition for National Development	Create awareness in community on nutrient sufficient food, micronutrient supplements and dietary diversification.
	School Health Program (2010)	School Nutrition Program

Table X: Table describing Sri Lanka's nutrition policies and their brief summary.

Framework area	Policy name	Framework specific policy information
N	National Policy and Strategic Frameworks for Prevention and Control of Chronic Non-Communicable Diseases	Accurate labelling of food, relay accurate information to consumers, claims to be scientifically proven.
	National Health Strategic Master Plan (2016-2025)	Improved food labelling through nutrition profiling.
O	School Canteen Guidelines (2007)	Sell affordably nutritious and culturally-acceptable foods.
	National Nutritional Policy (2010)	Emergency nutrition preparedness, ensure affordability of nutritious food to mothers and children.
U		
R	National Policy and Strategic Frameworks for Prevention and Control of Chronic Non-Communicable Diseases	Ethical advertisement of food
I	National Nutritional Policy (2010)	Food fortification for micronutrient supplementation
S	National Health Strategic Master Plan (2016-2025)	Establish healthy canteens and eating places in work places, schools and public places.
	National Nutritional Policy (2010)	Create food nutrition enabling school environment.
H	National Nutritional Policy (2010)	Nutrition related behaviour surveillance system.
I	School Health Promotion Program (Medium Term Plan 2008-2012)	Nutrition awareness for parents.
	National Nutritional Policy (2010)	Promote behavioural change to make right food choices, dietary diversification.
G	School Health Promotion Program (Medium Term Plan 2008-2012)	Nutrition awareness among students and parents through Health Promoting Schools.
	National Plan of Action for Children in Sri Lanka (2016-2020)	Improve nutrition education in school children.
	National Health Strategic Master Plan (2016-2025)	School nutrition program development.
	National Nutritional Policy (2010)	Nutrition friendly schools.

Table XI: Table listing the research papers rejected after the final detailed reading screening and the reason for rejection.

Paper Title	Reason for exclusion
Obesity-Promoting Food Environments and the Spatial Clustering of Food Outlets Around Schools (Day and Pearce, 2011*b*)	The study was missing information on the health outcome.
The association between the geography of fast food outlets and childhood obesity rates in Leeds, UK (Fraser and Edwards, 2010)	The study used children's residential post-code to characterise the proximity to fast-food environments.
The commercial food landscape: outdoor food advertising around primary schools in Australia (Kelly et al., 2008)	The study was missing information on the health outcome.
School food environment: Quality and advertisement frequency of child-oriented packaged products within walking distance of public schools (Missbach et al., 2017)	The study was missing information on the health outcome.
Obesogenic Retail Food Environments Around New Zealand Schools: A National Study (Vandevijvere et al., 2016)	The study was missing information on the health outcome.
The Influence of Local Food Environments on Adolescents' Food Purchasing Behaviors (He et al., 2012)	Food purchasing behaviour measured.
The effect of fast-food restaurants on childhood obesity: A school level analysis (Alviola et al., 2014)	Not related to proximity.
School lunch and snacking patterns among high school students: Associations with school food environment and policies. (Neumark-Sztainer et al., 2005)	No distance metric mentioned to describe the school food environment.
Association between the food retail environment surrounding schools and overweight in Canadian youth (Seliske et al., 2009)	Not related to proximity of food outlets but density.
Obesity and the built environment among Massachusetts children (Oreskovic et al., 2009)	Related to food environment around residence.
Comparison of fast food consumption and dietary guideline practices for children and adolescents by clustering of fast food outlets around schools in the Gyeonggi area of Korea (Joo et al., 2015*b*)	Related to density of retail food outlets.

Table XII: Table showing the frequency of each food outlet type around school identified in the studies included in the scoping review.

Food outlet type	Frequency of occurrence in studies
Fast food	18
Convenience store	12
Supermarket	8
Grocery	7
Baker	3
Café	2
Newsagent	2
Food stores	2
Take away	2
Restaurant	2
Limited service restaurant	1
Pastry	1
Corner store	1
Cofee/donut	1

Table XIII: Table listing the countries of origin for the included studies in the scoping review.

Country	Frequency of studies
USA	12
Canada	4
UK	2
Finland	1
Greece	1
Ireland	1
Korea	1
Netherlands	1
New Zealand	1
	Total studies=24

Table XIV: Table listing the distribution of studies included in the scoping review across years in which they were conducted.

Year	Frequency of studies
2008	1
2009	1
2010	1
2011	2
2012	4
2013	3
2014	5
2015	2
2016	2
2017	1
2019	2
	Total studies=24

Table XV: Table showing the distribution of main study design types observed in the included studies for the scoping review.

Study Type	Frequency of studies
Cross-sectional	20
Longitudinal	2
Ecological	2
	Total studies=24

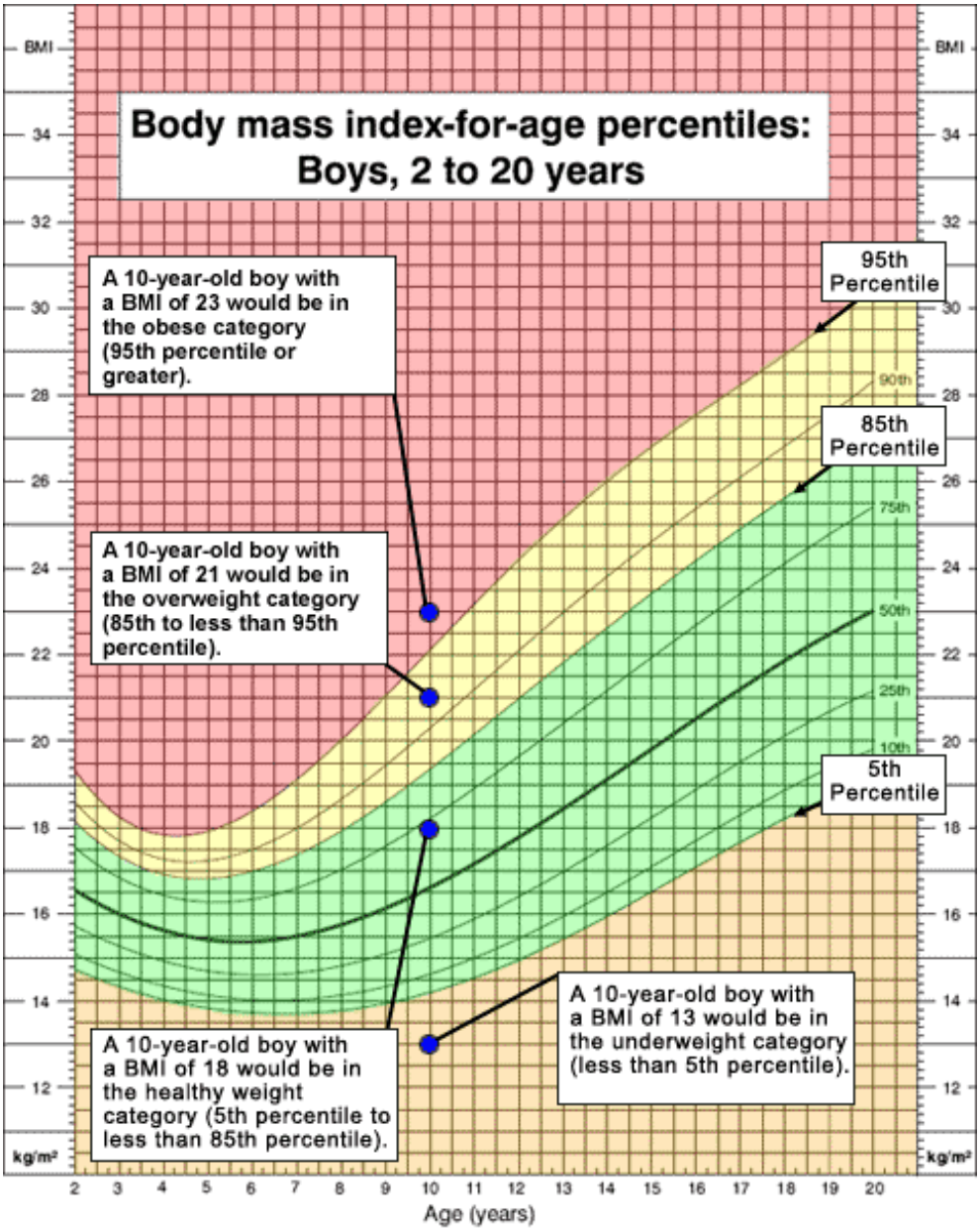


Figure 4.4: Body Mass Index percentile depiction. Using the example of a 10 year old boy, the diagram shows the demarcation of weight status categories as per the BMI values (Centers for Disease Control and Prevention, 2000).

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