Advances in Social Science, Education and Humanities Research, volume 618
International Joint Conference on Arts and Humanities 2021 (IJCAH 2021)

Predictors of Overweight and Obesity Among Children and Adolescents in Developing Countries: A Literature Review

Anindya Mar'atus Sholikhah[1,*] Nik Anni Afiqah Hj Mohd Tuah[2]

[1] *Department of Health Education and Recreation, Universitas Negeri Surabaya, Surabaya, Indonesia*
[2] *Institute of Health Sciences, Universiti Brunei Darussalam, Bandar Seri Begawan, Brunei Darussalam*
[*]Corresponding author. Email: anindyasholikhah@unesa.ac.id

ABSTRACT
Overweight and obesity have been a global pandemic over the years, with their prevalence increasing at an alarming rate. It has become a severe health problem that severely affects health and quality of life. The aim of this study is to elucidate the factors linked to overweight and obesity among school-aged children and adolescents in developing countries. Electronic databases such as Google Scholar and PubMed were searched from 2007 to 2017. Only studies on children and adolescents under 19 years from developing countries were included. The results were screened, and we had full-text papers on topics available in English and passed the critical appraisal process using the Quality Assessment Tool developed by the Effective Public Health Project. A total of nine cross sectional studies met the criteria, thus they were included in the final review. All of the studies were conducted in rural/urban settings in Asia and Africa, with population and sample consisted of children and adolescents under 19 years old. The potential risk factors with a solid relationship with overweight and obesity included genetics, demographics, socioeconomic status, physical inactivity, and dietary habit. This literature review provides evidence of predictors or critical contributors to the increasing number of childhood obesity and overweight in developing countries. The involvement of a range of actors and stakeholders is needed to tackle the problem of obesity in children.

Keywords: *Adolescent, Children, Obesity, Overweight, Risk factor.*

1. INTRODUCTION

Obesity is a global epidemic in the 21st century, and the number is on the rise, especially among children and adolescents [1], [2]. The worldwide prevalence of childhood obesity has increased rapidly over the years, both in developed and developing countries [3], [4]. Globally, the prevalence varies from more than 30% in the US to less than 2% in Sub-Saharan Africa. In 2016, more than 41 million overweight/obese children-under-five in the world [5]. Recent data shows that the prevalence of childhood obesity in some developed countries such as Europe and the US has reached a plateau. While in some developing countries, the number has doubled since 1990 [6]. In most Asian countries, the prevalence of overweight and obesity in children has increased many folds in the past decades. It is expected to reach 6,9% by 2020, with the increase seemingly continuing. In absolute number, Asia has the highest prevalence of overweight and obese children because more than half of the affected children live in this region [7].

Obesity is defined as the accumulation of excess body fat or adipose tissue, while overweight is described as extra weight about height [8]. Weight gain is mainly caused by the imbalance of energy intake, which often characterized by significant amount of calorie-dense food—that increases the release of insulin and fat storage—and low physical activity [9]. The increase in bodyweight is also stimulated by biological, behavioural, and environmental factors, whose interactions have driven the current levels of worldwide obesity that the world is facing today as one of the global public health problems [10].

Due to the odd risks, childhood obesity becomes a primary concern as it also affects children's physical health, social and emotional well-being in the next stage of life [11]. Both overweight and obese children are exposed to a greater risk of becoming obese adults than

their normal-weight peers [12]. Previous cohort research conducted in the UK showed that 38% of boys and 44% of girls above the 95th BMI centile at age 7 were obese at age 33. Researches showed that obesity during childhood could adversely affect many organ systems that often lead to severe problems, ranging from non-communicable diseases such as hypertension, hyperlipidemia, cardiovascular disease, diabetes mellitus, fatty liver disease [13] to psychological issues such as depression, anxiety, as well as a social problem [14]. Peer problems and social isolation are more common in obese children [15], [16] as they might be subjected to teasing and bullying by their peers [17], [18]. In the long term, the consequences of obesity or being overweight during childhood can lead to disability as well as premature mortality [10].

In many developing countries, especially Asia and Africa, childhood and adolescent obesity prevalence remains high. Thus, it is essential to understand the predictors or factors related to obesity among children population in developing countries. Previous studies that have been conducted were mainly focused on childhood obesity only, with few reports documenting the results from various countries. A comprehensive understanding of the determinants of predictors of obesity and overweight will provide better policy and decision-making to lower its prevalence, especially among children and adolescents.

2. METHODS

2.1. Inclusion and Exclusion Criteria

The inclusion criteria of this review were: (1) quantitative studies with cohort or cross-sectional designs; (2) participants were children and adolescents age under 19 years according to World Health Organization [19]; (3) studies done in developing countries based on the classification from Development Policy and Analysis Division (DPAD) of the Department of Economic and Social Affairs of the United Nations Secretariat (UN/DESA) [20]; (5) overweight or obesity in children and adolescents were measured using Body Mass Index (BMI) as defined by WHO [21], [22]; and (6) studies published in a peer-reviewed journal between 2007 and 2017.

The exclusion criteria of this review were: (1) articles that were not written in the English language; (2) studies that include only a specific group of children (e.g., children born preterm or children with special needs); (3) studies focusing on the clinical treatment of obesity or obesity-related disease.

Table 1. Search Strategy

Search Term	Keywords
[1] Children	child* OR adolescent* OR school-age OR preschool* OR teen*
[2] Obesity	obese* OR overweight OR early life obesity OR pediatric obesity OR childhood obesity OR abdominal obesity OR central obesity OR visceral obesity OR body mass index
[3] Predictor	predict* OR risk factor OR cause OR etiology OR determinants OR factor associated
[4] Developing country	developing country OR LMIC OR Asia OR Africa
Final search	[1] AND [2] AND [3] AND [4]
	(((((((child*) OR adolescent*) OR school age) OR preschool) OR teen*)) AND (((((((((obese*) OR overweight) OR early life obesity) OR pediatric obesity) OR childhood obesity) OR abdominal obesity) OR central obesity) OR visceral obesity) OR body mass index)) AND ((((((predict*) OR risk factor) OR cause) OR etiology) OR determinants) OR factor associated)) AND ((((developing country) OR LMIC) OR Asia) OR Africa)

2.2. Search Strategy

We conducted a comprehensive search of literature published no later than ten years before 2017 using search engines such as Google Scholar and PubMed. The electronic search used Medical Subject Headings (MeSH) and keywords related to the predictor of childhood obesity, including appropriate synonyms (**Table 1**). All keywords were combined with Boolean operators "AND" to unite and filter the search results.

2.3. Selection Process

We excluded reviews, editorial reports, letters, commentaries, conference papers, qualitative and experimental studies from this review and then screened the titles and abstracts of potential articles that might meet the inclusion criteria. A total of 31 articles met the selection criteria. The articles were then selected to be critically appraised using a modified Quality Assessment Tool developed by the Effective Public

Health Project (EPHPP) [23]. The quality of the articles was assessed against six out of eight criteria: (1) Selection Bias; (2) Study Design; (3) Confounders; (4) Data Collection Method; 5) Withdrawals and Drop-outs; and 6) Analyses, with a global rating stated for each article. Two criteria (‘Blinding’ and 'Intervention and Integrity') were excluded because experimental studies were not included in this review. The flow diagram of the search and selection process is shown in Fig 1.

3. RESULTS

3.1. Geographical Location and Study Design

The inclusion criteria of this review were: (1) quantitative studies with cohort or cross-sectional designs; (2) participants were children and adolescents ages under 19 years according to World Health Organization [19]; (3) studies done in developing countries based on the classification from Development Policy and Analysis Division (DPAD) of the Department of Economic and Social Affairs of the United Nations Secretariat (UN/DESA) [20]; (5) overweight or obesity in children and adolescents were measured using Body Mass Index (BMI) as defined by WHO [21], [22]; and (6) studies published in peer-reviewed journals between 2007 and 2017.

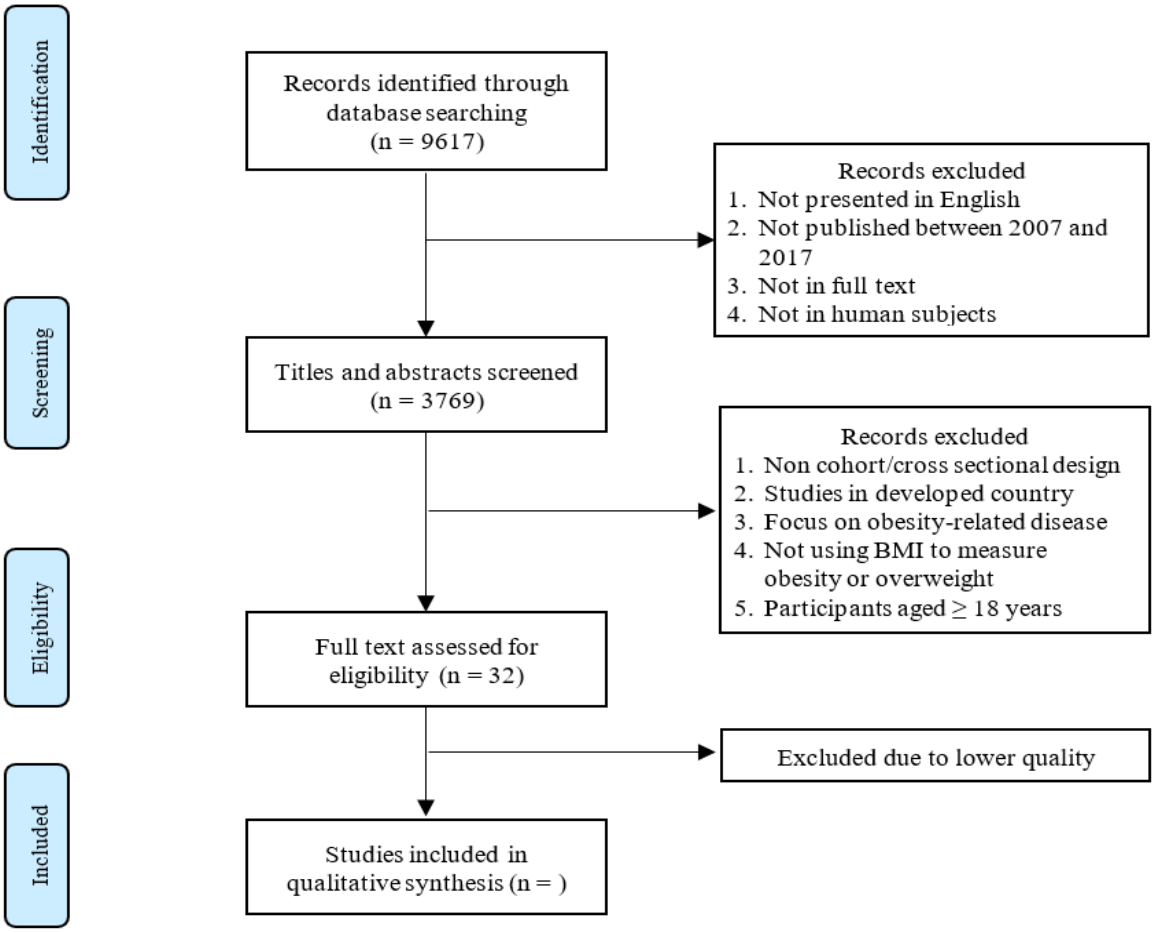

Figure 1. Flow diagram on the process of literature searching

3.2. Predictor and Factors Associated with Overweight and/or Obesity

All articles applied cross-sectional study design, and most of them were school-based. Population and sample consisted of school children and adolescents aged 2-19 years living in urban and rural parts of Asia and Africa.

3.2.1. Demographic

Five studies found that gender was related to overweight/obesity in children [24]–[28]. Male sex has been determined as a risk factor of overweight/obesity [29], while the remaining study reported that females were likely to be obese [30]. The association between an urban area and household size with overweight/obesity was evaluated in three studies, of which all reported a significant association [29], [31]. Living in an urban area had a greater chance of being overweight [30].

A study found that children who went to private schools had three times greater chance to develop overweight/obesity, than those who went to the government or public schools (AOR=3.4, 95% CI:1.4, 8.5) [25]. Other factors related to overweight/obesity in children were household size [29], [31].

3.2.2. Genetic

Six studies examined the family history of obesity as a risk factor and found a positive correlation [24], [26]–[28], [31]. Multiple logistic regression showed that children with at least one overweight/obese parent were more likely to be overweight/obese than those who had average parent (OR=2.32, 95% CI: 1.17-4.59) [31]. The further report showed that overweight/obese children are closely related to mothers' or fathers' high BMI [30].

Table 2. Summary of Included Studies (Order by Year of Publication)

Author &Year	Year of Publication	Location and Setting	Study Design	Population and Sample	Criteria Used for Overweight / Obese	Quality of Studies
Desalew, et al., 2017 [25]	2017	Five public schools and three private schools in Dire Dawa, Ethiopia	Cross sectional	456 students in classes 5 to 8, response rate 98.2%	CDC 2000	Moderate
Zhang, et al., 2016 [28]	2016	Seven schools in Guangzhou, China	Cross sectional	3766 students aged 7-12 years. 100% response rates for schools and 78.4% for students	Working Group of Obesity in China (WGOC) 2004	Moderate
Hassanzadeh-Rostami, et al., 2016 [29]	2016	Fars Province of Iran	Cross sectional	8911 children aged 2-6 years	WHO-NCHS 1995 and CDC 2000	Weak
Do, et al., 2015 [31]	2015	Rural Ba Vi and Urban Dong Da districts, Hanoi, Vietnam	Cross sectional	2667 children (1364 living in urban and 1313 in rural)	WHO 2004	Moderate
Hatami, et al., 2014 [26]	2014	15 girls' school	Cross section	1157 students	WHO 2007	Moderate

Author &Year	Year of Publication	Location and Setting	Study Design	Population and Sample	Criteria Used for Overweight / Obese	Quality of Studies
		and 15 boys' school	al	aged 10-18 years. Response rate 94.1%		
Musaiger, et al., 2014 [32]	2014	Five secondary schools in Bahrain	Cross sectional	735 students aged 1-18 years old	THANKS-1	Moderate
Andegiorgish, et al., 2012 [24]	2012	Five primary and middle schools in Tianjin City, Northeast China	Cross sectional	3140 students aged 7-18 years	Group of China Obesity Task Force 2004	Weak
Hong, et al., 2011 [27]	2010	31 junior high schools (17 schools from the wealthy urban areas and 14 schools from less affluent urban areas) in Ho Chi Minh	Cross sectional	2678 students in grades 6-9 (11-16 years)	IOTF 2000	Moderate
Khader, et al., 2009 [30]	2009	Two private schools, two public	Cross sectional	2131 students aged 6-12 years	International cut off points of BMI for	Weak

Author &Year	Year of Publication	Location and Setting	Study Design	Population and Sample	Criteria Used for Overweight / Obese	Quality of Studies
		schools for boys and two public schools for girl			boys and girls aged 2-18 years	

Table 3. Association between Risk Factors and Overweight/Obesity in Children and Adolescents

Author	Family History of Obesity	Sedentary Behaviour	Physical Activity	Dietary Habit	SES
Desalew, et al., 2017 [25]	-	• Spent free time on resting (p=0.049) (AOR=2.6, 95% CI: 1.0, 6.7); • Watching TV and video (p=0.002) (AOR=3.57, 95% CI: 1.6, 7.9); • Playing computer (p=0.013) (AOR=4.6, 95% CI: 1.4, 15.4)	Spent only few minutes for physical activity or no vigorous sports (p=0.005) (AOR=3.8, 95% CI:1.5, 9.8)	Sweet food preference (p=0.039) (AOR=2.3, 95% CI: 1.1, 5.1)	Monthly income above the mean (p=0.000) (AOR=16.9, 95% CI: 6.5, 23.9)
Zhang, et al., 2016 [28]	• Having obese mother (p<0.001) • Having obese father (p<0.001)	• Spent more time on doing homeworks (p=0.007) (OR= 1.24; 95 % CI: 1.08–1.43) • Using computer often (p<0.001) (OR=1.04, 95% CI: 0.84, 1.30)	-	• Eating faster than peers (p<0.001) (OR=3.18, 95% CI: 2.28, 4.44) • Eating more meat products (p=0.037) (OR=0.96, 95% CI: 0.855, 1.08) • Frequent intake of sweetened beverages (p<0.001) (OR= 1.39, 95%CI: 1.05–1.85)	-

Author	Family History of Obesity	Sedentary Behaviour	Physical Activity	Dietary Habit	SES
				• Frequent consumption of fried food (p=0.019) (OR=1.07, 95% CI: 0.93, 1.24)	
Hassanzadeh-Rostami, et al., 2016 [29]	-	-	-	-	• Mother's higher education (p=0.014) • Father s' occupation (p=0.013) • More access to household facilities (p=0.012)
Do, et al., 2015 [31]	Having at least one obese parents (p=0.03) (OR=2.32, 95% CI: 1.17-4.59)	-	• Spent < 2h on outdoor activity in rural (p=0.01) (OR=1.87, 95% CI: 1.18-2.94) • Spent < 2h on indoor activity in rural (p<0.001) (OR=2.06, 95% CI: 1.36-3.12)	• Large consumption of food in urban (p<0.001) (OR=2.89, 95% CI: 1.8- 4.66) • Frequent consumption of fatty food (p<0.001) (OR=7.64, 95% CI: 4.29- 13.63) and fried food (p=0.01, 95% CI: 1.14-2.6) in rural area • Often consumption of irregular snacks in rural (p<0.001) (OR=3.81, 95% CI: 1.62-8.97) • Fast eating in urban (p<0.001) (OR=2.22, 95% CI: 1.56-3.16)	Household size > 6 people in rural (p=0.02) (OR=0.54, 95% CI: 0.31-0.95)

Author	Family History of Obesity	Sedentary Behaviour	Physical Activity	Dietary Habit	SES
				• Snack availability in home (p=0.01) (OR=1.75, 95% CI: 1.16-2.64)	
Hatami, et al., 2014 [26]	Having obese parents (p=0.020) (OR=2.05, 95% CI: 1.30-3.22)	Spent more time on watching TV (p<0.001) (OR=2.63, 95% CI: 1.79-3.86)	Spent less time on physical activity (p<0.001) (OR=2.57, 95% CI: 1.73-3.81)	• Higher energy intake (p<0.001) (OR=3.35, 95% CI: 2.28-4.93) • Having breakfast ≤ 3 times/week (p<0.001) (OR=2.43, 95% CI: 1.80-3.29)	Maternal occupation (p=0.001) (OR=1.82, 95% CI: 1.29-2.57)
Musaiger, et al., 2014 [32]	-	Watching TV > 3 h/d in boys (p=0.004) (OR=1.28, 95% CI: 0.75-2.17)	-	• Having breakfast irregularly (in girls) (p=0.052) (OR=0.65, 95% CI: 0.41- 1.03) • Bring food from (in girls) (p=0.004) (OR=0.54, 95% CI: 0.35-0.81) • Eating during school breaks (in girls) (p=0.049) (OR=0.52, 95% CI: 0.25- 1.06) • Eating between lunch and dinner in boys (p=0.015) (OR=1.36, 95% CI: 0.66- 2.82) • Eating fast food < 4 times/week (in boys) (p=0.054) (OR=1.09, 95% CI: 0.59-2.02) • Having breakfast at school (in boys) (p=0.039) (OR=1.64, 95% CI: 0.99- 2.99) • Double size of burger (in boys) (p=0.002) (OR=5.2,	Higher mothers' education in male adolescents (p=0.0167) (OR=2.24, 95% CI: 1.09-4.63) and in female (p=0.007) (OR=1.69, 95% CI: 0.95-3.03)

Author	Family History of Obesity	Sedentary Behaviour	Physical Activity	Dietary Habit	SES
				95% CI: 1.36-23.36) • More fruit intake (in boys) (p=0.042) (OR=1.62, 95% CI: 0.99-2.66) • Sweet intake (in boys) (p=0.55, 95% CI: 0.33-0.94)	
Andegiorgish, et al., 2012 [24]	• Having family history of obesity (p<0.001) • Mother's history of gestational diabetes (p=0.003) (OR=2.76, 95% CI: 1.11-6.87)	-	• < 2 h/d on physical activity (p=0.033) (OR=1.24, 95% CI: 1.00-1.55) • Taking part in outdoor activity (p<0.001) (OR=0.63, 95% CI: • 0.51-0.78)	Eating food not prepared at home (p<0.001) like at cafetaria (OR=1.92, 95% CI:	• Higher mothers' education (p<0.001)
Hong, et al., 2011 [27]	Having both obese parents (AOR=3.5, 95% CI:1.7, 7.0)	• Spent more times on watching TV (> 4 h/d) (AOR=3.9, 95% CI: 1.5, 9.9) • Playing video games/computer > 2 h/d (COR=1.2, 95% CI:0.8, 1.6)	• Being physically inactive/never doing sport (COR=1.9, 95% CI: 1.1, 3.3) • Taken to school by parents (COR=1.7, 95% CI: 1.2, 2.2)	Frequent consumption of soft drinks (AOR=3.0, 95% CI: 1.6-5.3)	• Higher family income status (COR=3.7, 95% CI: 2.0, 6.8) • Both parents got high education (COR=2.7, 95% CI: 1.9, 3.5)
Khader, et al., 2009 [30]	• Having obese mother (p=0.002) (OR=1.8,	Watching TV > 2 h/d (p=0.04) (OR=1.29, 95% CI: 1.01-1.66)	-	-	• Monthly family income > 300 JD (p=0.02)

Author	Family History of Obesity	Sedentary Behaviour	Physical Activity	Dietary Habit	SES
	95% CI: 1.24, 2.61) • Having obese father (p<0.001) (OR=2.36, 95% CI: 1.67, 95% CI: 1.67, 3.34)				(OR=2.34, 95% CI: 1.13, 4.81) • Daily pocket money > 0,2 JD (p<0.001) (OR=1.29, 95% CI: 1.26, 2.07)

3.2.3. Physical Inactivity

Five studies analyzed the association between physical inactivity (resting, watching TV, playing games) and overweight/obesity in children, of which all reported a significant correlation [25], [31], [32]. The duration of these activities ranged from 2 to 4 hours/day. Children who spent more than 4 hours/day watching TV were four times more likely to be overweight/obese (OR=3.9; 95% CI: 1.5– 9.9) [27]. A study also found that overweight/obesity was significantly higher in children being taken to school by parents than walking (COR=1.9, 95% CI: 1.1, 3.3) [27] and spending less time on physical activity (OR=1.24, 95% CI: 1.00-1.55) [24].

3.2.4. Socio-economic Status

The tendency to have a higher risk of being overweight/obesity in a family with high SES has been observed in seven studies. Most studies found that overweight/obesity in school-age children and adolescents was positively correlated with parents' education. Two studies found that overweight/obese children are related to parental average monthly income [25], [27], [30]. Different SES measures were used, such as average monthly income, mother's education, father's occupation, and access to a household.

3.2.5. Dietary Habit

Five cross-sectional studies found that the prevalence of obesity was higher in children who consumed calorie-dense food, high-carbo, and high-sugar food. Children who preferred sugary food were more likely to develop overweight/obese than those peers who did not (p=0.55, 95% CI: 0.33-0.94) [32]. Dietary habits such as fast eating and consuming large amounts of food were found in those who were overweight/obese [31].

4. DISCUSSION

This review aims to identify the predictors of overweight and obesity among children in developing countries. It was done by synthesizing the evidence and findings on factors associated with overweight/obesity from several studies. The result showed that children's characteristics (gender, setting, dietary intake, physical activity) and family characteristics (household size, socioeconomic status, parents' education, overweight/obese parents) were strongly correlated with overweight/obesity among children.

Most studies found that the prevalence of overweight/obesity was higher among boys than girls. It was consistent with findings reported from other studies conducted in developing countries as well. In Pakistani, boys are likely to have more access to various types of food while girls suffer from restrictions [33]. It also might be related to cultural issues as some families, especially in Asian countries, still favor boys over girls [31].

Family history also played a significant role as the risk of obesity among children rises in proportion to parental obesity. Some studies found that Body Mass Index is 25-40% heritable [34]—least when neither parent is obese, higher when one of the parents is obese, and highest when both parents are obese [33]. However, Anderson & Butcher revealed that genetic factor accounts for less than 5% of all cases of obesity in children; thus it did not cause a dramatic increase on its prevalence [34]. Furthermore, genetic susceptibility usually needs to be paired with other factors such as behavioral and environmental to impact weight gain [35].

Most studies reported that a lack of physical activity was a key factor in obesity among children [32]. Children who spent more time to engage in sedentary or screen-based activities like watching television or playing games were more at risk of being

overweight/obese. Further studies reported that watching TV lowered the amount of time spent in playing outdoor activities that could promote weight gain as its consequence [32]. In addition, research indicated that the duration children spent on watching TV or playing games were positively correlated with their consumption of the most advertised goods, including sweets, cereals, sugary beverages, salty snacks, and other high-calorie foods [6]. Watching TV for long hours tends to promote children towards unhealthy snacking through food advertisements. A study in Vietnam found that watching food advertisement by both parents and children was more strongly correlated with the development of overweight/obesity in children [31]. Therefore, these sedentary lifestyle habits should be considered in any program concerned with lowering the prevalence of overweight or obesity, especially in schoolchildren [32]. Physical activity in children could be different due to demographic setting. Children in urban areas were more physically inactive than those in rural areas [29], [31]. It might be caused by many factors, such as urban areas often lack open spaces where children can play outdoor [31]. Safety was also a significant concern due to the high volume of vehicles which made parents reluctant to walk or cycle to school [33].

In many developing countries such as Chile, Egypt, Brazil, and Haiti, overweight/obesity-related to high socioeconomic status (SES) [36]. It was contrary to the situation in developed countries where low socioeconomic status groups are tend to become overweight or obese [37]. The high prevalence of childhood overweight/obesity in developing countries is also associated with belief, overweight or obese children tend to be perceived as a sign of wealth [38]. Studies reported that children of parents with higher SES had a greater chance to be overweight/obese [27], [28]. Similar findings were also reported in other studies conducted in low- and middle-income countries (LMIC). LMIC have experienced an improvement in socioeconomic status, which shifted the lifestyle towards more sedentary. They were more able to afford different kinds of foods included calorie-dense ones [33]. A recent study also revealed that the relationship between SES and obesity was more pronounced in children that went to private schools.

Food consumption and dietary habits are an essential factors influencing weight gain [26], and it has been extensively studied since the last decade. A diet containing food that is high in calories (e.g., fried food or junk food) and low nutritional values will result in excessive energy intake, which later is stored as fat, and lead to overweight or obesity. These diets have been linked to risk for atherosclerosis, central adiposity, and cardiovascular disease that can develop later in adulthood [28], [32]. Sugary or sweetened beverages are other factors that have been reviewed by the previous study as potential factors that contribute to obesity [39]. Sweetened beverages are often thought of as being limited to soda or soft drinks. Still, actually juice, vitamin-style water, coffee, and other sweet beverages fall into this category [39], [40] as they all contain added sugar that is strongly associated with the increase of BMI in children and adolescents [41].

5. CONCLUSION

This review provides evidence about the potential contributors or predictors of childhood overweight and obesity in some developing countries. The cause of obesity is multifactorial, ranging from the most basic as genetic and biological factors to socioeconomic factors. The findings from this review have important implications for actors such as government, policymakers, planners, and other parties at all levels to develop policies to combat obesity, especially in childhood. The government needs to promote preventive interventions in various groups such as schools and the wider community. Some preventive policies that can be applied include promoting physical activity, healthy eating, building more open space for the public, and guiding advertisements for unhealthy foods on TV. Interventions at household levels and beyond are also required to reduce the prevalence of obesity in children and adolescents.

REFERENCES

[1] P. Gonzales-Muniesa, M. A. Martinez-Gonzales, F. B. Hu, J. P. Despres, Y. Matsuzawa, and E. Al., “Obesity,” *Nat. Rev. Dis. Prim.*, vol. 3, no. 17034, 2017, DOI: 10.1038/nrdp.2017.34.

[2] P. M. Pego-Fernandez, B. J. Bibas, and M. Debono, "Obesity: The greatest epidemic of the 21st century?" *Sao Paulo Med. J.*, vol. 129, no. 5, 2011, DOI: 10.1590/S1516-31802011000500001.

[3] M. Ng, T. Fleming, M. Robinson, B. Thomson, and E. Al, "Global, the regional and national prevalence of overweight and obesity in children and adults 1980-2013: A systematic analysis," *Lancet*, vol. 384, no. 9945, pp. 766–781, 2014, DOI: 10.1016/S0140-6736(14)61316-7.

[4] Y. Wang and H. Lim, "The global childhood obesity epidemic and the association between socioeconomic status and childhood obesity," *Int. Rev. Psychiatry*, vol. 24, no. 3, pp. 176–188, 2012, DOI: 10.3109/09540261.2012.688195.The.

[5] WHO, “Obesity and Overweight,” 2017. http://www.who.int/mediacentre/factsheets/fs311/en/.

[6] I. Romieu *et al.*, "Energy balance and obesity: what are the main drivers?" *Cancer Causes Control*, vol. 28, no. 3, pp. 247–258, 2017, DOI: 10.1007/s10552-017-0869-z.

[7] M. de Onis, M. Blosser, and E. Borghi, "Global prevalence and trends of overweight and obesity among preschool children," *Am. J. Clin. Nutr.*,

vol. 92, no. 5, pp. 1257–1264, 2010, DOI: 10.3945/ajcn.2010.29786.

[8] H. N. Sweeting, “Measurement and definitions of obesity in childhood and adolescence: A field guide for the uninitiated,” *Nutr. J.*, vol. 6, no. February 2007, 2007, DOI: 10.1186/1475-2891-6-32.

[9] The Australian Institute of Health and Welfare, “Risk Factors to Health,” 2017. https://www.aihw.gov.au/reports/risk-factors/risk-factors-to-health/contents/overweight-and-obesity/causes-of-overweight-and-obesity.

[10] M. Di Cesare *et al.*, “The epidemiological burden of obesity in childhood: A worldwide epidemic requiring urgent action,” *BMC Med.*, vol. 17, no. 1, pp. 1–20, 2019, DOI: 10.1186/s12916-019-1449-8.

[11] S. Karnik and A. Kanekar, “Childhood obesity: a global public health crisis,” *Int. J. Prev. Med.*, vol. 3, no. 1, pp. 1–7, 2012.

[12] WHO, *Consideration of The Evidence on Childhood Obesity for The Commission on Ending Childhood Obesity*. Geneva: WHO, 2016.

[13] N. K. Güngör, “Overweight and obesity in children and adolescents,” *J. Clin. Res. Pediatr. Endocrinol.*, vol. 6, no. 3, pp. 129–143, 2014, DOI: 10.4274/jcrpe.1471.

[14] CDC, “Childhood Obesity Causes and Consequences,” 2020. https://www.cdc.gov/obesity/childhood/causes.html.

[15] J. C. Han, D. A. Lawlor, and S. Y. Kimm, “Childhood obesity,” *Lancet*, vol. 375, no. 9727, pp. 1737–1748, 2010, DOI: 10.1016/S0140-6736(10)60171-7.

[16] T. J. Parsons, C. Power, S. Logan, and C. D. Summerbell, “Childhood predictors of adult obesity: A systematic review,” *Int. J. Obes.*, vol. 23, no. SUPPL. 8, 1999, DOI: 10.1038/SJ.ijo.0801139.

[17] D. Bacchini *et al.*, “Bullying and victimization in overweight and obese outpatient children and adolescents: An Italian multicentric study,” *PLoS One*, vol. 10, no. 11, pp. 1–13, 2015, DOI: 10.1371/journal.pone.0142715.

[18] The Australian Institute of Health and Welfare, *Overweight and obesity among Australian children and adolescents*. Canberra: AIHW, 2020.

[19] WHO, “Who Growth Reference 5-19 Years,” 2007. http://www.who.int/growthref/who2007_bmi_for_age/en/.

[20] WESP, “Country Classifications,” 2014. doi: 10.1017/cbo9780511615702.009.

[21] WHO, "WHO Child Growth Standards: Methods and development length/height-for-age, weight-for-age, weight-for-length, weight-for-height, and body mass index-for-age," 2006.

[22] WHO, “BMI-for-age (5-19 Years),” 2007. https://www.who.int/tools/growth-reference-data-for-5to19-years/indicators/bmi-for-age (accessed Mar. 05, 2021).

[23] PHP, "Quality assessment tool for quantitative studies," *Eff. Public Heal. Pract. Proj. McMaster Univ. Toronto.*, no. 1998, pp. 1–4, 2010, [Online]. Available: https://merst.ca/wp-content/uploads/2018/02/quality-assessment-tool_2010.pdf.

[24] A. K. Andegiorgish, J. Wang, X. Zhang, X. Liu, and H. Zhu, “Prevalence of overweight, obesity, and associated risk factors among school children and adolescents in Tianjin, China,” *Eur. J. Pediatr.*, vol. 171, no. 4, pp. 697–703, 2012, DOI: 10.1007/s00431-011-1636-x.

[25] A. Desalew, A. Mandesh, and A. Semahegn, "Childhood overweight, obesity and associated factors among primary school children in dire Dawa, eastern Ethiopia; a cross-sectional study," *BMC Obes.*, vol. 4, no. 1, pp. 1–10, 2017, DOI: 10.1186/s40608-017-0156-2.

[26] M. Hatami *et al.*, "Dietary factors as the major determinants of overweight and obesity among Iranian adolescents. A cross-sectional study," *Appetite*, vol. 82, pp. 194–201, 2014, DOI: 10.1016/j.appet.2014.07.026.

[27] T. K. Hong, N. H. H. D. Trang, M. J. Dibley, and D. W. Sibbritt, “Factors associated with adolescent overweight/obesity in Ho Chi Minh city,” *Pediatr. Obes.*, vol. 5, no. 5, pp. 396–403, 2011, DOI: 10.3109/17477160903540735.

[28] T. Zhang, L. Cai, L. Ma, J. Jing, Y. Chen, and J. Ma, “The prevalence of obesity and influence of early life and behavioral factors on obesity in Chinese children in Guangzhou,” *BMC Public Health*, vol. 16, no. 1, pp. 1–13, 2016, DOI: 10.1186/s12889-016-3599-3.

[29] Z. Hassanzadeh-Rostami, E. Kavosi, and A. Nasihatkon, “Overweight and obesity among preschool children from Fars Province of Iran: Prevalence and associated factors,” *J. Res. Health Sci.*, vol. 16, no. 1, pp. 26–30, 2016, DOI: 10.34172/jrhs162422.Y. Khader, O. Irshaidat, M. Khasawneh, Z. Amarin, M. Alomari, and A. Batieha, "O

[30] Y. Khader, O. Irshaidat, M. Khasawneh, Z. Amarin, M. Alomari, and A. Batieha, “Overweight and obesity among school children in Jordan: Prevalence and associated factors,”

Matern. Child Health J., vol. 13, no. 3, pp. 424–431, 2009, DOI: 10.1007/s10995-008-0362-0.

[31] L. M. Do, T. K. Tran, B. Eriksson, M. Petzold, C. T. K. Nguyen, and H. Ascher, "Preschool overweight and obesity in urban and rural Vietnam: Differences in prevalence and associated factors," *Glob. Health Action*, vol. 8, no. 1, pp. 1–10, 2015, DOI: 10.3402/gha.v8.28615.

[32] A. O. Musaiger, K. Al-Roomi, and Z. Bader, "Social, dietary and lifestyle factors associated with obesity among Bahraini adolescents," *Appetite*, vol. 73, pp. 197–204, 2014, DOI: 10.1016/j.appet.2013.11.002.

[33] S. K. Mistry and S. Puthussery, "Risk factors of overweight and obesity in childhood and adolescence in South Asian countries: A systematic review of the evidence," *Public Health*, vol. 129, no. 3, pp. 200–209, 2015, DOI: 10.1016/j.puhe.2014.12.004.

[34] P. M. Anderson and K. E. Butcher, "Childhood obesity: Trends and potential causes," *Futur. Child*, vol. 16, pp. 19–45, 2006.

[35] CDC, "Contributing factors," 2010.

[36] A. Sjoberg, L. Lissner, K. Albertsson-Wikland, and S. Marild, "Recent anthropometric trends among Swedish school children: Evidence for decreasing prevalence of overweight in girls," *Acta Pediatr.*, vol. 97, no. 1, pp. 118–123, 2008.

[37] K. Deren, S. Nyankovskyy, O. Nyankovska, E. Luszczki, et al., "The prevalence of underweight, overweight and obesity in children and adolescents from Ukraine," *Sci. Rep.*, vol. 8, p. 3625, 2018, DOI: 10.1038/s41598-018-21773-4.

[38] C. Knai, M. Suhrcke, and T. Lobstein, "Obesity in Eastern Europe: An overview of its health and economic implications," *Econ. Hum. Biol.*, vol. 5, pp. 392–408, 2007.

[39] K. Sahoo, B. Sahoo, A. K. Choudhury, N. Y. Sofi, R. Kumar, and A. S. Bhadoria, "Childhood obesity: causes and consequences," *J. Fam. Med. Prim. Care*, vol. 4, no. 2, 2015, DOI: 10.4103/2249-4863.154628.

[40] Australian Government, "The Australian Dietary Guideline," *National Health and Medical Research Council*. https://www.eatforhealth.gov.au/guidelines (accessed Jan. 12, 2019).

[41] S. Gibson, "Sugar-sweetened soft drinks and obesity: a systematic review of the evidence from observational studies and interventions," *Nutr. Res. Rev.*, vol. 21, pp. 134–147, 2008.