Ultra-Processed Food Consumption and its Association with Nutritional Status and Diet-Related Non-Communicable Diseases among School-Aged Children in Lilongwe City, Malawi

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Abstract: In underdeveloped nations like Malawi, Non-Communicable Diseases (NCDs) have received less attention despite increasing NCDs morbidity and incidence rates. NCDs are responsible for 68% of all deaths worldwide each year. Dietary problems are the most common causes of these deaths. In underdeveloped countries, NCDs are responsible for two-thirds of all fatalities. In addition, developing countries account for two out of every three overweight and obese individuals worldwide. Lifestyle factors such as Ultra-Processed Foods (UPFs) consumption is among the causes.

Purpose of the Study: To investigate ultra-processed food consumption and its association with nutritional status and diet-related NCDs among school-aged children.

Methods: The research was conducted from March-April, 2021, using cross-sectional quantitative methods. A systematic random sample of 382 school-aged children was drawn to collect data. Data were analyzed using the R software package by frequency tables, means, and Chi-Square.

Study Findings: Findings suggest high consumption (95.6%) of UPFs, which included flitters, carbonated drinks, processed juice, French fries, and sweets. The study further attributed the high consumption of UPFs to age, residence, price, and availability. In addition, in children who consume high amounts of UPFs, dental problems and high mid-upper arm circumference were common.

Conclusion: Prevalence of UPFs is high among school-aged children in Lilongwe city. Although there are reported differences between these two locations, the locations are generally similar. However, age, residence, price, and availability seem to influence UPFs consumption behaviors. In later years, this may predispose children to be cardiovascular and metabolic conditions.

Keywords: Ultra-processed food, non-communicable diseases, Obesity, overweight, underweight, school-aged children, Malawi.

INTRODUCTION

The importance of a healthy diet in preventing numerous Non-Communicable Diseases (NCDs) cannot be overstated [1]. Those diseases that are not directly transmissible from one person to another are known as "non-communicable diseases" [2]. Cancer and cardiovascular diseases (CDVs), such as heart disease and stroke, are among the abovementioned diseases. Other disorders include congenital heart disease, peripheral arterial disease, and heart failure [2]. Different NCDs are claimed to be related to a poor diet [3], which is high in transitory fats, sugar, salt, and other harmful elements [3-5]. Ultra-processed Foods (UPFs) are made up of a combination of ingredients, the majority of which are intended for industrial use only [6,7]. These chemicals may cause certain chronic conditions in the long run. NCDs are responsible for 41 million fatalities each year, with the majority of these deaths occurring in poorer nations (85%) [8]. NCDs significantly influence children and young adults throughout their lives, with cancer being the top cause of mortality among children and adolescents worldwide [9]. World Health Organization (WHO) has found that these UPFs significantly impact an individual's nutritional health, particularly in young children and adolescents [5,10]. It has been demonstrated that the use of UPFs can result in overweight, obesity, underweight, and other chronic problems if they are used without prudence, that is, in high quantities and regularly. Undernutrition and being underweight have been identified as one of the most serious public health issues in various least developed countries in the world [5]. Obesity, on the other hand, continues to be a serious public health concern across the globe, particularly in developing countries. This dilemma was previously considered to be a major public health issue affecting primarily industrialized countries [11]. However, recent studies have revealed that obesity and overweight rates are also increasing in emerging

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countries [5]. As a result, low- and middle-income countries have a double burden of undernutrition, underweight, and Obesity, respectively. An obese person has a Body Mass Index (BMI) more than or equal to 30.0, whereas an overweight person has a BMI "greater than or equal to 25 and further evaluated in terms of fat distribution via waist-hip ratio" (WHR), respectively [12]. In children, BMI depends on the age and sex of the child. An obese child whose BMI falls at 95th percentile and above, while an overweight child falls within85th to 95th percentile, normal weight within 5th to 85th percentile, and underweight is below 5th percentile (refer to Charts **1** and **2**) [5]. Type 2 diabetes mellitus and cardiovascular disease are two of the health risks associated with obesity or overweight, respectively [13]. [Obesity is becoming one of the most significant public health challenges in underdeveloped countries, including Malawi [11,14,15]. In 2019, 38 million children under the age of five were overweight or obese, according to WHO [16]. Children aged 5-19 years were overweight or obese in 2016, with 340 million children falling into this category [5].

According to recent research, there has been an increasing trend of adiposity and overweight rate increases in Sub-Saharan African countries [17], with southern Africa being the most affected [12]. Similarly, the prevalence of obesity among preschool children has been rising for some time, and it is currently prevalent in the majority of sub-Saharan African countries [18]. Around 10.7 million children are overweight in Sub-Saharan Africa alone. In addition, being overweight is more widespread than being underweight [18]. Out of 26 countries, statistics show that some countries, such as Serra Leone, have 16.9 percent of children who are obese, Malawi has 14.5 percent, and Comoros has 15.9 percent of children who are obese [18].

In the case of Malawi, which is considered to be one of the world's least developed countries (LDC), with few health resources, both in terms of material and human resources [19,20], at the same time, the country is dealing with a double burden of communicable diseases and NCDs on the other hand [20-22]. As a result, preventive health interventions are extremely important to make efficient and effective use of a resource already in short supply. According to studies, undernutrition is responsible for approximately 23 percent of child mortality in Malawi, of which approximately 4 percent is acute malnutrition. While undernutrition is prevalent among adolescent girls in Malawi, the overall prevalence of undernutrition is 15.6 percent [23]. Additionally, approximately 64 percent of children under the age of five are anemic, and approximately 37 percent are stunted, which may result in poor school performance [24]. According to the Government of the Republic of Malawi, approximately 3.1 million Malawians do not consume the recommended amount of food and are therefore underfed, and close to 500,000 people have poor nutrition, relying heavily on *Nsima* (corn flour meal) and few vegetables as a result of seasonal food shortages [25].

Overweight and Obesity, as well as cancer, hypertension, and diabetes, have been increasingly common in both urban and rural Malawi in recent years. According to current statistics, metropolitan areas have a high incidence of NCDs paired with malnutrition [26]. For example, according to this study, Malawi's obesity rate grew from 4.1 percent in 1992 to 12.1 percent in 2014, representing a significant percentage increase over the previous decade [27]. Furthermore, two-fifths (about 40%) of those who depart on less than a dollar per day do so on a tight budget [20]. In most developing nations, including Malawi, a third of the illness burden is caused by non-infectious disorders, which are responsible for 800,000 deaths amongst young people under the age of 40 each year. Therefore, preventive measures through a healthy, nutritious diet are vital in the fight against malnutrition and NCDs.

MATERIALS AND METHODS

Study Design and Setting

The study quantitative cross-sectional study was conducted in Lilongwe. Lilongwe is the capital city of Malawi. Malawi is a landlocked country in Southeast Africa, neighboring Mozambique, Tanzania, and Zambia, with per capita gross domestic product GDP of US $ 371 in 2019 [28], with a population of 17,563,749 people [29]. Lilongwe city is the biggest and most highly populated city in Malawi. The city is divided into 58 administrative areas/sections called “area followed by a number", that is to say, area 1 to area 58 (see Figure **1**) [30]. The researcher recruited participants from two highly populated, fast-growing townships (Areas 25 & 36). Area 25 is in the southern part, while Area 36 is in the northern part of Lilongwe.

Inclusion and Exclusion Criteria

The study focused on school-aged children within the age bracket of 7 to 14 years in areas 36 and 25 for

not less than 6 months. These school-aged children were recruited into their households to get consent from their parents.

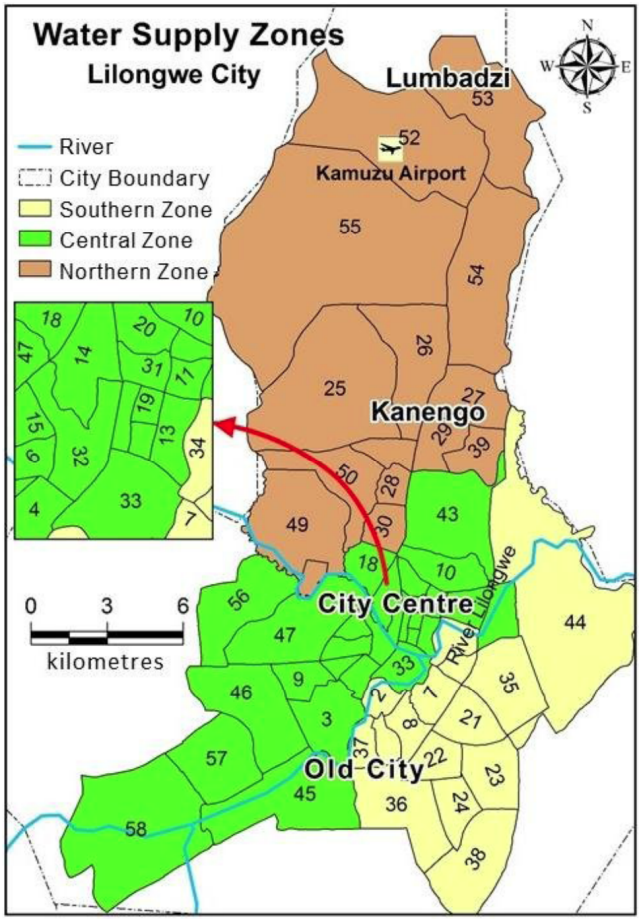

Figure 1: Map of administrative areas of Lilongwe city.

Source: Tiwale S, Rusca M, Zwarteveen M. www.water-alternatives.org.

Population and Sampling

The researcher used systematic sampling methods to recruit participants. Where each 5th household was picked, then from each household, one school-aged child was randomly recruited if there were more than one, a sample of 382 was drawn. The participants were between 7 and 14 years old. Excluding those children who have lived in the city less than 6 months; those below or above desired age bracket; and those with communicable/infectious diseases or illnesses.

Development of the Instrument and Data Collection Procedure

Data were cleaned, coded, and analyzed using R statistical package version 4.0, designed by Ross Ihaka and Robert Gentleman, developed by R Core Team [31]. The researcher used a structured questionnaire using google forms to collect data from the participants. Each questionnaire had a unique code for identification. The tool was pretested to ensure the completeness and validity of the data collection tool. The data collection tool was both in English and Chichewa. Data collection was in March-April 2021.

Ethical Consideration

The participants were given detailed information on the study's purpose, risks, benefits, and data collection procedures to get informed consent. The participants signed an informed consent form to participate in the study. Since the population under study is children, the consent was also with the parents or guardian and assent from the child. The national health sciences research committee of Malawi provided ethical approval for the research with approval reference of 21/01/2646.

RESULTS

In this study, the sample size was n=382 children. The children's ages ranged from 7 to 14 years old.

Social-Demographic Characteristics

Table **1** below shows the socio-demographics of the children and their parents or guardians.

Table 1: Socio-Demographic Characteristics Children/Guardians (N=382)

Parameter	Frequency (percentage)	
Age	7-10 years	53.4
	11-14 years	56.4
Gender of child	Male	47.1
	Female	52.9
Caregiver of the child	Father	13.0
	Mother	69.4
	Fellow child	2.4
	Other	15.2
Level of education for the caregiver	None	5
	Primary	48.9
	Secondary	42.4
	Tertiary	3.7
Occupation of the caregivers	Business	67.3
	Employed	8.9
	None	23.8
Residence	Area 25	51.3
	Area 36	48.7

Status of Presence of Chronic Conditions

Table **2** below shows the presence of chronic conditions in the Children based on self-reports from parents or guardians.

Table 2: Presence of Chronic Conditions Based on Self-Reports

Condition	Frequency (percentage)	
	Present	Not present
Diabetes	2.9	97.1
Asthma	8.4	91.6
Liver disease	0.3	99.7
Cancer	0.5	99.5
Sleep disorders	2.1	97.9
Dental caries	19.9	80.1

Consumption of UPF and UPF Frequency

Children were asked about the frequency at which they take the UPF and its quantity, the results of which are presented in Table **3**. According to the results in Table **3**, which shows the frequency of food consumption and amounts among children. The parents or guardians were asked about the food the child takes from the list on the food frequency questionnaire, including the amount of food and frequency of consumption. The amount of food consumption was categorized as small, medium, and large. The frequency was categorized as daily, three times a week, two times a week, once a week, once a month, and never. The results show that majority consume flitters, French fries, and sweets daily. In terms of quantity, the majority of the children reported that they consume the following foods in moderate quantities: cheese, French fries, jam, and sandwiches in medium quantities.

Nutritional Status

Four parameters of the nutrition status were assessed, and the results are presented in Table **4**. Weight in kgs, height in centimeters (cm), and mid-upper arm circumference (MUAC) in cm was checked for each child who participated in the study. The weight was checked using a body weighing scale, height using a height board, and MUAC using a MUAC tape for children. The BMI was calculated by dividing the weight in kilograms (kgs) by the square of the height (meters).

Table 3: Food Frequency and Quantity Distribution

Food item	Frequency (percentage)								
	Food Frequency						Food quantity		
	Never	Once a month	Once a week	Twice a week	At least 3 times a week	Daily	Small	Medium	Large
Fizzy drinks	19.9	44.2	16.8	7.1	10.5	1.6	51.3	47.4	1.3
Processed juice	12.8	17	23.3	13.4	14.7	18.8	60.1	38.7	1.2
Hot chocolate	89.5	3.1	3.4	1.8	1.3	0.8	67.5	32.5	0
Pizza	88.2	6	3.7	1	1	0	82.2	17.8	0
Burgers	81.2	8.1	6.3	3.1	1	0.3	81.9	18.1	0
sandwiches	38.2	10.7	18.3	13.6	16	3.1	38.6	58.5	3
Cake	76.7	14.9	3.7	3.1	0.5	1	71.9	27	1.1
Flitters	3.4	4.5	19.6	18.1	28.8	25.7	83.2	12.8	4.1
Sweets and chocolate	5	4.2	19.4	19.4	24.9	27.2	81.5	15.4	3
Jam	90.6	3.9	2.1	1.3	1.8	0.3	41.7	55.6	2.8
Tinned foods	85.3	8.6	2.1	2.4	0.8	0.8	76.8	21.4	1.8
French flies	7.1	8.9	16.2	17	24.9	25.9	34.7	59.4	6
Cheese	89	3.7	2.4	1.6	2.6	0.8	43.6	51.3	5.1
Yogurt	68.3	10.5	7.3	7.1	4.7	2.1	71.7	27.5	0.8
Sausages	68.1	15.4	7.9	4.7	2.9	0.8	58.2	40.2	1.6
Breakfast cereals	85.6	4.7	1.3	3.1	0.3	3.7	61.8	1.8	36.4

Table 4: Nutritional Status

Parameter	Statistical Measure		
	Mean	SD	95% CI
Weight	30.48 kgs	9.621	29.51 to 31.44
Height	129.32 cm	17.526	127.55 to 131.08
Body Mass Index	17.65	3.12	17.33 to 17.96
Mid-Upper Arm Circumference	19.65 cm	4.397	18.65 to 19.54

Weight Status Changes

The results from Table **5** show that the majority (83%) of the parents indicated that the weight of the child had increased over the past year.

Factors Associated with UPF Consumption/Nutritional Status

We used Chi-Square to analyze the associations as presented in Table **6**. The MUAC was categorized as “wasted” for values from 12.5 cm and below, "moderate malnutrition” for those between 12.5-13.5 cm, and "normal" for those above 13.5 cm. Then the BMI was categorized into “Underweight” BMI Below the 5th percentile; “Normal weight” BMI equal to or greater than 5th and less than 85th percentile and “Overweight” BMI above 85-below 95th percentile; “Obese” BMI above 95th percentile (Refer to Chart **1** and **2**) [5]. Table **6** shows that consumption of fizzy drinks, hot chocolate, and pizza (frequency); processed juice (frequency & quantity) was associated with the residence ($p<.05$). Moreover, the consumption of fizzy

Table 5: Weight Status Changes

Parameter	Category	%
Guardians’ views on the current weight of the child	Current weight of the child worries the guardian	3.1
	Current weight of the child does not worry the guardian	91.6
	Not sure	5.2
Child’s weight trend	Decreased	6
	Increased	77
	The same	12
	Not sure	5

Table 6: Associations between Variables

	Residence		Age		MUAC		BMI	
	p-value	Phi	p-value	Phi	p-value	Phi	p-value	Phi
Fizzy drinks (frequency)	0.000***	0.245						
Fizzy drinks (quantity)			0.000***	0.233	0.018**	0.162		
Processed juice (frequency)	0.000***	0.307	0.045*	0.172				
Processed juice (quantity)	0.005***	0.178	0.024**	0.149	0.019**	0.154		
Hot chocolate (frequency)	0.000***	0.318						
Pizza (frequency)	0.003***	0.206					0.001***	0.275

Note: * Statistic significance at 0.1, ** at 0.05 and *** at 0.001.

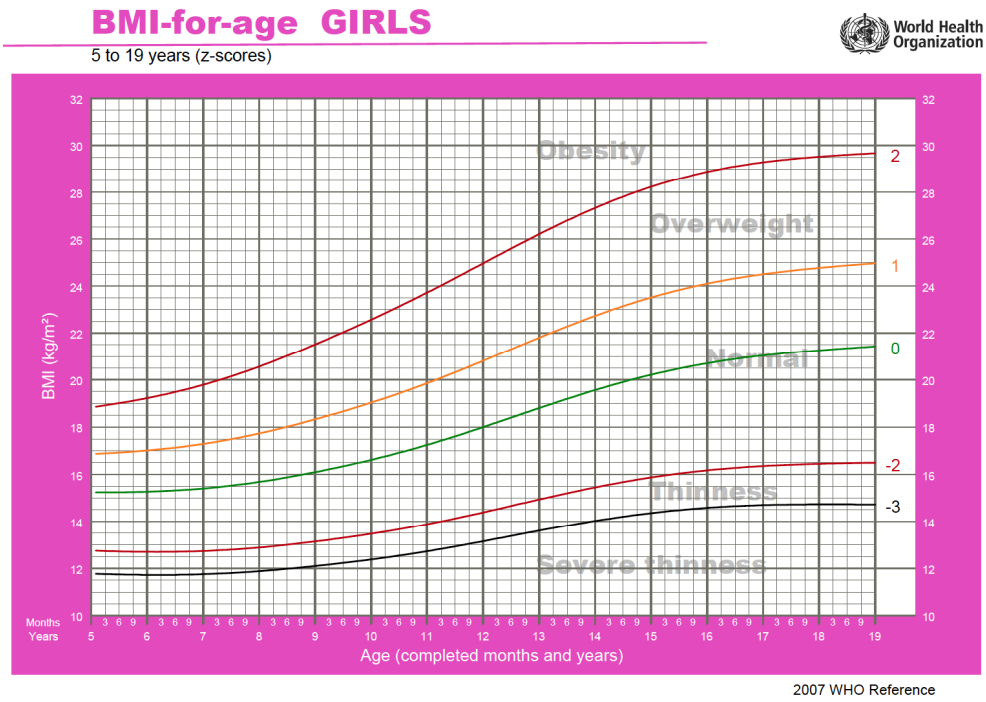

Chart 1:

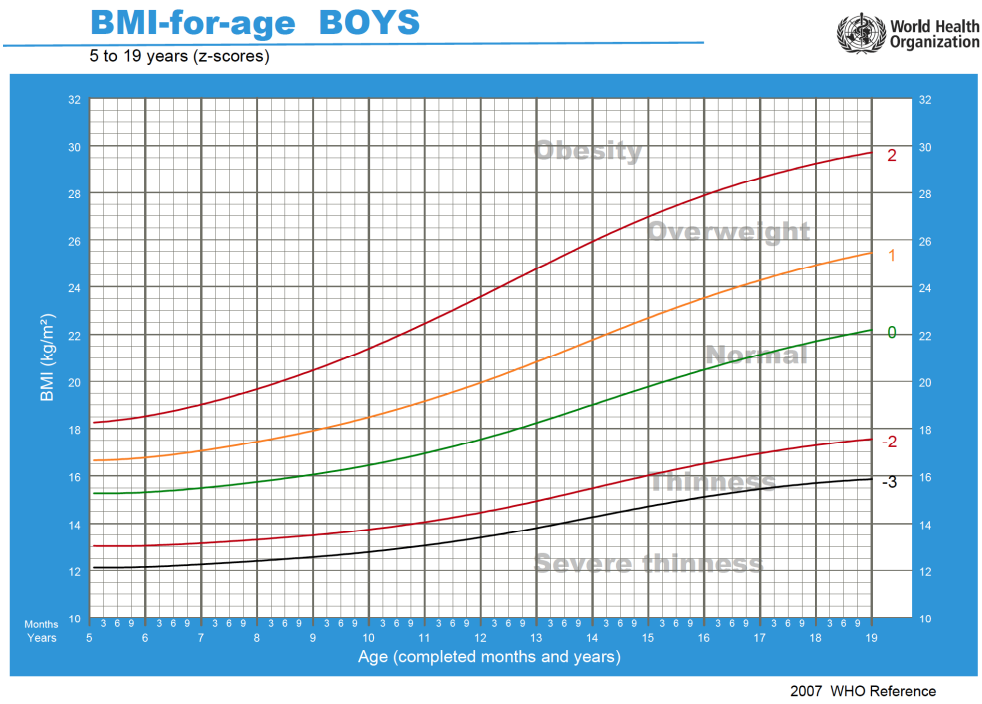

Chart 2:

drinks (quantity) and processed juice (frequency & quantity) was associated with the age of the children ($p<.05$). Results further show that MUAC was associated with the consumption of fizzy drinks ($p<.05$) while BMI was associated with the consumption of pizza (frequency) ($p<.05$).

DISCUSSION

The majority of enrolled children in the study were between 7 to 10 years as compared to those between 11 to 14 years. These findings are attributable to the level of involvement of these young children in school activities. Mostly, Malawi's children of this age bracket

belong to junior primary education [32-34]. This entails that they spend less time at school than their counterparts who attend classes beyond noon. Moreover, children of this age category are more controlled by guardians than their counterparts, hence their easy availability since they are usually constrained within their home surroundings. Age was associated with the consumption of behavior of a majority of food items. This study established that the older age group was associated with the consumption of fizzy drinks, processed juice, and sandwiches. Consuming fizzy drinks and sandwiches consistently can predict poor nutrition outcomes in the long run as these contain more sugars, fats, and caffeine [35]. On the other hand, those aged between 7-10 years consumed sandwiches significantly less frequently and less amount than the older group.

These results suggest that consumption of UPF was generally significantly higher in frequency and amount in the older age group than younger age group. This is related to the freedom of choice or selection of foods. The older groups usually are more mobile than the younger. Moreover, they spend more time at school, which predisposes them to consume the ready-made UPFs, besides considerably little parental control. These findings are partially consistent with findings reported from a study done in Argentina, where despite that UPF consumption was higher in 2-5 than in others, the study found out that consumption of UPFs increases with age and socioeconomic status [36]. Nutrition status in this study was associated with age. While children aged 11-14 years were overweight from BMI measurements, those between 7-10 years were associated with the first-class MUAC category. This finding is not surprising since UPF consumption is more prevalent in older children. Studies have revealed that UPF consumption contributes to overweight/obesity since most of these foods contain a lot of sugars and fats [37-40]. This reveals that there is a high likelihood for those children to develop Obesity and high blood pressure in the long run [38].

The study enrolled more girls than boys. This finding is consistent with Malawi culture, where girls are more encouraged to stay home than boys [41]. Studies done in India and Brazil, respectively, revealed that the gender of participants influenced UPF consumption and nutritional status [35, 42]. These studies show that gender affects UPF consumption behaviors, which later predict their nutritional status. However, this cannot be conclusive since males and females have different fat content despite their eating habits. The current study seems to uphold this sense; contrary to those studies done in Brazil and India, gender did not influence UPF consumption; neither was it associated with nutritional status in the current study. Nevertheless, the differences in UPF consumption between girls and boys can be suggestive of differences in food preferences in those sexes.

Among caregivers, the majority were mothers; the majority had attained education and were running businesses. More mother caregivers complement Malawi's cultural stratification, where mothers are generally responsible for providing care or looking after the children [41]. Additionally, mothers compose the majority of unemployed married persons in Malawi [43], which causes them to spend more time with their children than their male counterparts. Mothers and fathers differ in food selection and preparation for their children [41]. Evidence suggests that children taken care of by mothers are likely to have good consumption practices and hence less prone to consuming UPFs than their counterparts. This can contribute to their good nutrition status [41]. Although this study does not indicate or affirm this illustration, the study has reported a corollary finding where those children under parental care had poor nutritional status.

Moreover, although the majority of caregivers had formal education, the level of education is not satisfactory as the majority only attained primary education, which is insufficient to inform them on food selection and preparation. This can adversely affect the nutritional status of the children since they may be unnecessarily exposed to heavy UPF consumption [44]. Nevertheless, the educational status of the caregiver is attributed to the urban setting in which these people reside, where education is valued [43].

The occupation of the caregiver is multifactorial in both areas. As much as occupation status can predict the economic status of the strata, the economic status of these residences cannot be relied upon by basing judgments on the business type of occupation. Although they exist within urban settings, their structures and processes resemble the semi-urban setting [43]. In such settings in Malawi, most of the people earn a living through businesses, of which the majority are small-scale businesses [43]. In these settings, most of these businesses are in the form of home-based economic activities where people run those activities in their residences [43]. According to the Malawi population and housing census report, this is a form of the informal economy. Therefore, these

socio-economic statuses reported here cannot be compared to the findings in Argentina, where socioeconomic status influenced UPF consumption [36]. However, a study in Brazil did not find any significant influence of socioeconomic status on UPF consumption. The study in Brazil can be partially supported by the findings in the current study, where occupation did not influence UPF consumption [45]. However, socio-economic status in Brazil's study was multidimensional as compared to socioeconomic status in the current study, which was unilateral [45]. This study discusses that social variables and economic variables about the caregivers did not significantly influence UPF consumption. However, this finding relied on self-reports rather not on observations and dietary recalls, which is contrary to several other related studies [36, 39, 45-50].

Nevertheless, the residence of participants played a major role in UPF consumption. Those in area 36 were associated with high consumption of flitters, sweets, chocolates, tinned prepared foods, French flies, and breakfast cereals. On the other hand, those in area 25 were associated with high consumption of hot chocolate and processed juice. The findings illustrate the differences in the economic differences in these areas. Whereas area 36 is slightly underdeveloped. Area 25 is an increasingly growing area that is close to the industrial site [51, 52]. Most people staying in area 25 work in the institution at Kanengo industrial site [52]. This forces them to live more of a western lifestyle than their counterparts in area 36.

Although the study reports insignificant differences in socio-economic distinct for caregivers for children, the fact that area 25 is socioeconomically more advanced than area 36 is clear [51]. Our folks agree with us when they indicate that the commonly consumed UPF in area 36, except for burgers and tinned prepared foods, are all cheaper commodities than those reported from area 25. A good illustration is that French fries in Malawi are now prevalently known as "*zigege*" and flitters are "*mandasi*" which are all priced at K10 ($0.01) and K50 ($0.05), respectively. These findings are more suggested in the differences in nutritional status for the children whereby using BMI in area 36 is associated with undernutrition. According to the study done in India [39], the findings from this study agree with the Indian study, except that the current study did not categorically define urban and rural settings.

The study has revealed that consumption of UPFs is very prevalent among children as evidence shows that about 98% of the children consume at least one of the UPFs. The highly consumed UPFs included flitters, sweets and chocolate, French fries, processed juice, and fizzy drinks. It is not surprising to get these results since these commonly consumed UPFs are either mainly locally prepared in the form of Home-Based Economic Activities (HBEAs) or are sold at a lower price than other UPFs, including breakfast cereals, sausages, yogurt, tinned fish, jam, cake, sandwiches, burgers, pizza, and hot chocolate. Due to their easy availability and affordability, the majority of households can buy and give them to their children. Moreover, French fries and flitters are sold at a very low price, and children can buy them themselves.

Most of these commonly consumed UPFs are high in sugars, oils, and fats. Foods containing high amounts of sugars predispose children to dental caries [54, 55]. Moreover, consuming foods high in the content of oils and fats can lead to malnutrition and NCDs [26, 40, 46, 48, 55]. Frequent consumption of caffeine contains foods may lead to sleep disorders and later poor nutrition [35]. Different studies have also reported high consumption of UPFs in different settings [39, 44, 50, 55-57]. This supports the evidence that UPFs are new, highly consumed foods among the children and general population. Evidence attributes this to strategized advertisement forms, including TV advertisements [45, 49]. However, the easy availability and affordability seem to aggravate the situation in Malawi. Evidence has also revealed that this is becoming a widespread problem that while UPF consumption remains high in urban settings, there is a worrying growing tendency of UPF consumption in rural areas [54]. Fizzy drinks, processed juice, and sweets have also been reported to be highly consumed UPFs in several countries [38, 40, 42, 48, 50, 53, 55-60]. Contrary to the findings of this study, however, these studies have also reported high consumption of other UPFs not commonly consumed in this study, like burgers, pizza, tinned products, cake, and breakfast or fast foods [40, 47, 61]. This can be attributed to differences in economic structures. Most of these studies have been associated with poor nutritional status and their contribution to chronic diseases due to their nutritional and non-nutritional contents [35, 55, 62-64].

In terms of the prevalence of chronic conditions, the study reports that chronic conditions related to nutrition among children were less prevalent. However, this may not give a true reflection of the prevalence of such conditions in the study for two reasons: the study relied on self-reports which are non-diagnostic, and the age

of the children may not have caused them enough exposure since these conditions develop gradually [65]. Most of the studies done in Europe, North America, and Africa did not report these conditions [37, 47, 48, 60]. However, the current study reports the majority of the children considerably, about a fifth, had dental carries. Dental caries were associated with consuming sweets and chocolates, French fries, and *mandasi*, along with frequent yogurt consumption. These foods contain high levels of processed sugar, which lead to tooth decay [53,54].

Furthermore, it was associated with being cared for by the fathers and area of residence, where more children from area 36 reported to have dental caries than those from area 25. The association with fathers suggests that in Malawi's culture, where most of the fathers do not have enough time for their children, so they do not necessarily make follow-ups of the children [41] do tooth brushing, which can lead to the development of dental caries. More so, most children in area 36 are not strictly controlled as compared to area 25. This suggests the children are less controlled about their eating habits in area 36 than in area 25, which can lead to the consumption of sugary foods without proper control hence leading to the development of dental caries. These findings are consistent with findings from Nepalese studies, which reported that dental carry was prevalent among children and was associated with the consumption of sugary foods [53, 54, 56]. In contrast, dental carries were also associated with age [54].

CONCLUSION

This study was aimed at investigating the association of ultra-processed food consumption, nutrition status, and diet-related NCDs among school-aged children in Lilongwe. This study employed a cross-sectional survey design. The target population was only children that were within the age bracket of 7 and 14 years old were included in the survey. This study revealed that consumption of Ultra-Processed Foods among school-age children in areas 36 and 25 was prevalent. This was attributed to the low prices of most UPFs, availability, area of residence, parental guidance, and age of the child. Secondly, dental carries and nutrition status in school-age children are associated with consumption of UPF, especially those with high sugar content such as sweets, chocolate, and processed juice.

FUNDING

This research received no external funding.

LIST OF ABBREVIATIONS

BMI = Body Mass Index

LCD = Least Developed Countries

LMIC = Low and Middle-Income countries

MUAC = Mid Upper Arm Circumference

NCD = Non-Communicable Diseases

UPF = Ultra-Processed Food

WHO = World Health Organisation

WHR = Waist Hip ratio

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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DATA AVAILABILITY STATEMENT

Data is available from the corresponding author.

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