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Association between ultra-processed food consumption, sociodemographic characteristics, malnutrition and obesity among urban school-aged children in Lilongwe, Malawi: a cross-sectional study

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ABSTRACT

Introduction The escalating consumption of ultra-processed foods (UPFs) among school-aged children in developing countries poses a significant threat to public health, contributing to the dual burden of malnutrition. In Malawi, where undernutrition coexists with a burgeoning obesity epidemic, understanding the determinants of UPF consumption and its impact on children's nutritional status is imperative. This study, conducted in Lilongwe, Malawi, aimed to investigate the association between UPF consumption, sociodemographic factors and the nutritional status of school-aged children.

Materials and methods 511 children aged 7–14 were recruited from 2 densely populated townships using systematic random sampling. Data on sociodemographic factors, UPF consumption and nutritional status were collected through face-to-face interviews and anthropometric measurements. UPF consumption was assessed using a validated Food Frequency Questionnaire while multinomial logistic regression was employed to analyse associations.

Results Results revealed alarmingly high UPF consumption among children, particularly those high in sugar. Multinomial logistic regression identified significant predictors of malnutrition outcomes. Notably, children consuming UPFs more than three times a week were more likely to be malnourished. Overweight status was positively associated with sausage intake (β=0.226, adjusted OR 1.254, 95% CI 1.004 to 1.566, p=0.046) and age (β=0.020, adjusted OR=0.257, 95% CI 0.156 to 0.28, p=0.003). Conversely, underweight status was linked with residential location (β=4.507, adjusted OR 0.01, 95% CI 0.000 to 0.281, p=0.006) and fizzy drinks (β=1.071, adjusted OR 2.919, 95% CI 1.413 to 6.028, p=0.004).

Conclusion The high prevalence of UPF consumption among school-aged children is significantly associated with malnutrition. Moreover, sociodemographic factors influence UPF consumption, highlighting the need for targeted interventions to reduce malnutrition. These findings may inform public health policies to mitigate malnutrition among children in Malawi's urban communities.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The study addresses a relatively new research question by exploring the association between ultra-processed foods (UPFs) consumption and the nutritional status of school-aged children in Malawi. In this low-income country, UPFs are rapidly increasing with a double burden of malnutrition and obesity.
⇒ This study has revealed the differences between the global north and global south in the types of UPFs consumed.
⇒ The study was carried out when COVID-19 peaked in many countries. Malawi suffered its fair share of the devastating epidemic during the data collection from the participants. We obtained a letter from the Lilongwe City Council authorities before starting the survey. The council granted access rights to collect data.
⇒ The cross-sectional study involved a one-time survey that was said to have limitations of not showing a causation relationship between variables. On this limitation, it is the nature of the study. However, the researchers minimised the limitation through questions that collected information from dietary intake.

BACKGROUND

There is a growing concern about the impact of ultra-processed foods (UPFs) on the health of school-aged children, particularly in developing countries. UPFs are high in unhealthy fats, sugars and salt, and their consumption is linked to malnutrition in various forms.[1] While undernutrition remains a major issue, especially among young children, developing countries such as Malawi are also facing a rise in obesity.[1] This 'double burden'

of malnutrition presents a significant public health challenge.[1]

The global rise in childhood obesity is concerning. Studies show a significant increase in overweight and obese children in sub-Saharan Africa, with Malawi mirroring this trend.[2–4] This trend is particularly worrying because it coincides with a rise in undernutrition, creating a double burden for healthcare systems. In Malawi, the prevalence of obesity has jumped from less than 7% to 28% in just a decade.[5 6] This double burden of malnutrition has significant negative health consequences, both short term and long term.[5 7 8]

Disparities in dietary habits and nutritional status are evident between high-income and low-income countries.[6] Sociodemographic factors such as income, education and urbanisation play a role.[8–10] However, the lack of data on UPF consumption in Malawi hinders efforts to address this issue, especially in urban areas like Lilongwe. Here, poverty and limited knowledge about safe food processing methods increase the likelihood of children consuming unhealthy, highly processed foods.

Despite this, most studies in Malawi have focused on undernutrition in younger children. This research aims to fill that gap by investigating the link between UPF consumption, sociodemographic factors and the nutritional status of school-aged children in Lilongwe's two most populated areas.

MATERIALS AND METHODS

This study was conducted in Lilongwe, the capital city of Malawi, targeting school-aged children (7–14 years old). Systematic random sampling was employed to recruit participants from two high-density townships experiencing rapid growth. A sample size of 600 children was set, and 511 children were recruited (representing an 85% response rate) from a pool of 2000 households identified through random selection. Every fourth household was approached after a random selection to ensure representative participation. A single child per household was selected when multiple children met the age criteria. Guardians of participating children were excluded if their children resided outside the city limits or suffered from infectious illnesses during data collection.

Data collection involved face-to-face interviews with guardians using a standardised questionnaire to gather relevant sociodemographic information. Nutritional assessments were conducted on the children, including weight measured with a calibrated SECA scale (without shoes and heavy clothing), height measured with a stadiometer (without shoes) and mid-upper arm circumference (MUAC) measured using a WHO MUAC tape. Body mass index (BMI) was calculated using weight and height measurements.

Food consumption assessment

The consumption of UPFs was assessed using a validated Food Frequency Questionnaire (FFQ) designed for the study population, which produced a Cronbach's alpha of 0.874. This FFQ consisted of 20 food items commonly consumed in Malawi. The FFQ measured both the frequency and quantity of UPF consumption. Frequency was measured on a 6-point Likert scale ranging from 'never' (0) to 'daily' (5) consumption while quantity was categorised on a 3-point scale reflecting portion sizes (small: 250 mL/200 g, medium: 251–500 mL/401–600g, large: more than 500 mL/600 g). A cumulative UPF consumption score was calculated by multiplying the frequency, quantity and sum of all 20 food items. This score served as a continuous measure of UPF exposure. To facilitate analysis using a logistic regression model, the continuous score was then divided into three categories representing minimal (≤100), moderate (>100 to 200) and high (>200 to 300) exposure levels.

R software V.4.0. was used for all data analyses. Descriptive statistics were calculated to summarise participant characteristics and UPF consumption levels. χ^2 and Fisher's exact tests were employed to assess associations between UPF consumption and categorical variables like demographic characteristics and nutritional status. Multinomial logistic regression was performed to examine the relationships between UPF consumption, sociodemographic factors and BMI categories (underweight, normal weight and overweight) derived from WHO BMI-for-age percentiles. The significance level was set at $p<0.05$.

Patient and public involvement

The patient and public were not involved in the design, conduct, reporting or dissemination plans of our research.

RESULTS

A total of 511 children participated in this study, resulting in an 85% response rate. Table 1 summarises the sociodemographic characteristics of the children and their caregivers. Briefly, most children were aged 7–10 years and female. Mothers were the primary caregivers for most children. Caregivers typically had a primary level education and were engaged in business activities.

UPF consumption

Table 2 details the frequency and quantity of UPF consumption among school-aged children. The results indicate that children consumed UPFs daily, with a particular emphasis on those high in sugar.

Nutritional status

The children's mean weight, height, BMI and MUAC are presented in table 3, along with their corresponding SD and 95% CIs. The children's mean weight was 30.41 kg (SD 9.613, 95% CI 29.58 to 31.29). Their mean height was 130.47 cm (SD 14.446, 95% CI 129.22 to 131.73), with a mean BMI of 17.01 (SD 3.074, 95% CI 16.75 to 17.28). The mean MUAC was 19.72 cm (SD 8.821, 95% CI 18.86 to 20.06).

Table 1 Sociodemographic characteristics of children and their caregivers

Characteristic	Categories	Frequency	%
Age of the child (years)	7–10	271	53
	11–14	240	47
Gender	Female	271	53
	Male	240	47
Caregiver	Mother	355	69.5
	Father	61	11.9
	Fellow child	14	2.7
	Others	81	15.9
The education level of the caregiver	No education	32	6.3
	Primary	249	48.7
	Secondary	215	42.1
	Tertiary	15	2.9
Occupation of caregiver	Not employed	136	26.6
	Business	331	64.8
	Employed	44	8.6
Location	Area 25	248	48.5
	Area 36	263	51.5

Table 2 Showing frequency and quantity of ultra-processed food consumption

	Food frequency (%)						Food quantity (%)		
Food item	Never	Once a month	Once a week	Twice a week	Thrice or more a week	Daily	Small	Medium	Large
Fizzy drinks	18	**41.9**	18.4	6.7	12.3	2.7	47.7	**49.9**	2.4
Processed juice	12.3	18.6	**23.7**	13.1	13.7	18.6	**54.7**	42.9	2.5
Coffee(with sugar and milk)	82.6	9.6	2.3	1.6	0.4	3.5	**78**	21.8	
Tea (with sugar and milk)	3.9	1.4	5.1	7.8	15.9	**65.9**	**42.7**	53	4.3
Hot chocolate (with sugar and milk)	82.2	9.4	3.9	2.2	1.4	1	**73.3**	26.7	
Pizza	82.6	12.1	3.7	0.8	0.8		**86.5**	13.5	
Burgers	73.4	14.9	6.7	3.9	0.8	0.4	**83.1**	16.9	
Sandwiches	36.8	16	17	12.5	13.9	2.9	40.9	**55.4**	3.7
Cake	70.5	21.3	3.3	3.1	0.6	1.2	**74.2**	24.5	1.3
Flitters	3.1	11	17.6	16.4	**25**	26.8	**81.2**	13.8	5.1
Sweets/chocolate	5.5	4.7	18.8	17.2	23.1	**30.7**	**74.9**	19.3	5.8
Jam	91.4	3.5	2.2	1.2	1.6	0.2	36.4	**59.1**	4.5
Tinned prepared foods	79.5	14.3	2.3	2.5	0.8	0.6	**81.9**	16.2	1.9
French fries	6.8	13.7	14.7	15.7	21.7	**27.4**	37.9	**54.9**	7.2
Cheddar Cheese	82	8.8	2.9	1.6	3.3	1.4	**59.3**	36	4.7
Powdered milk	28.2	25.4	12.1	13.1	12.9	8.2	**82.2**	15.9	1.9
Sweetened yoghurt	60.7	13.9	10.6	8.2	4.5	2.2	**70.4**	28.6	1
Sausages	64.3	20.8	7.1	4.7	2.4	0.8	**61.2**	37.2	1.6
Sugar	2.3	1.4	0.6	5.1	12.1	**78.5**	**82.7**	10.4	6.9
Breakfast cereals	78.6	6.1	3.1	4.7	4.5	2.3	45.9	**48.6**	5.4

Bold indicates consumption of more than 20%.

Table 3 Nutrition status of children

Nutritional parameter	5th percentile	85th percentile	Mean	SD	95% CI
Body weight (kg)	17.28	41.9	30.41	9.613	29.58 to 31.29
Height (cm)	109	148	130.47	14.446	129.22 to 131.73
Mid-upper arm circumference (cm)	15	22	19.72	8.821	18.86 to 20.06
Body mass index (kg/m^2)	12	20	17.01	3.074	16.75 to 17.28

Predictors for BMI among children

Multinomial logistic regression analysis identified significant associations between specific factors and the likelihood of malnutrition outcomes among school-aged children (table 4). Children who consumed fizzy drinks were more likely to be underweight (β=1.071, Wald χ^2 (1)=8.377, p=0.004, OR=2.919, 95% CI 1.413 to 6.028). Sausage consumption was associated with overweight (β=0.226, Wald χ^2 (1)=3.988, p=0.046, OR 1.254, 95% CI 1.004 to 1.566). The child's age significantly predicted the likelihood of being overweight (β=−1.358, Wald χ^2 (1)=25.868, p=0.003). Children aged 7–10 were less likely to be overweight (adjusted OR: 0.257, 95% CI 0.152 to 0.434). The child's location significantly predicted the likelihood of being underweight (β=−4.507, Wald χ^2 (1)=7.441, p=0.006). Children from area 25 had a protective effect on becoming underweight (adjusted OR 0.011, 95% CI 0.000 to 00.281).

Predictors for BMI among children

The model fit statistics indicated a good fit. There was a significant decrease in unexplained variance from the baseline model (−2 LL=656.533) to the final model (−2 LL=506.885) (p<0.001). The decrease of 149.648 in unexplained variance suggests that the model explains a significant portion of the original variability and is an improvement over the original.

DISCUSSION

This study investigated the association between UPF consumption and nutritional status among school-aged children in Malawi. Our findings highlight a concerning trend of high UPF consumption across all participants, with specific variations based on age and residential location.

The study documented a daily intake of UPFs, particularly those high in sugar, among the participating children. This aligns with existing research highlighting the increasing popularity of UPFs globally.[11–16] This widespread consumption is likely attributed, in part, to aggressive marketing strategies employed by UPF manufacturers.[17 18] However, in Malawi, the situation appears to be further exacerbated by the ease of availability and affordability of these foods compared with healthier alternatives. Notably, while UPF consumption remains substantial in urban areas, our findings also suggest an upward trend in rural regions.[19]

The specific UPF categories most frequently consumed by the children varied compared with other studies. Unlike research conducted elsewhere that reported high consumption of less common UPFs like burgers, pizzas and canned products,[20–22] our findings revealed a focus on pastries, sweets, chocolates, prepackaged canned foods, French fries and breakfast cereals in area 36. Conversely, children in area 25 exhibited a higher intake of sugar, coffee, tea, hot chocolate and processed juices. These variations can likely be attributed to underlying economic disparities between the two regions. Area 36 is characterised as moderately underdeveloped, with residents likely drawn towards more affordable UPF options like French fries ('zigege') priced at US$0.012 compared with US$0.062 for flitters ('mandasi') in area 25.

The high consumption of UPFs, particularly those rich in sugar and caffeine (like tea), raises concerns about potential health consequences for children. These foods are less nutrient dense, with high calorie which may contribute to undernutrition and hyperactivity among school-aged children. In addition, diets high in sugar and caffeine have been linked to dental caries, sleep disorders and anaemia, respectively.[19 23] Furthermore, excessive UPF intake can contribute to malnutrition and the development of non-communicable diseases in the long term.[14 21 22 24 25] This aligns with findings from a study conducted in India, which observed a correlation

Table 4 Predictors for BMI among children

Variable	B	Wald X^2	P value	OR	95% CI
Fizzy drinks	1.071	8.377	0.004	2.919	1.413 to 6.028
Sausage	0.226	3.988	0.046	1.254	1.004 to 1.566
Child's age	1.358	25.868	0.003	0.257	0.152 to 0.434
Child's location	4.507	7.441	0.006	0.011	0.000 to 0.281

BMI, body mass index.

between undernutrition and areas with a higher prevalence of UPF consumption.[13]

BMI data analysis revealed that children aged 11–14 were more likely to be overweight, while those aged 7–10 fell within the first-class MUAC category. This finding aligns with expectations, considering the increased UPF consumption among older children. Research consistently demonstrates a positive association between UPF consumption and overweight/obesity due to the high sugar and fat content of these foods.[13 21 26 27] This raises concerns about the potential for these children to develop obesity and hypertension later in life.[26]

The study's findings regarding the influence of sociodemographic factors on UPF consumption were somewhat nuanced. While a significant association was not observed between caregiver occupation and UPF intake, residential location emerged as a crucial factor. Children residing in area 36, characterised as less economically developed, demonstrated a higher consumption of specific UPFs like pastries and French fries, which tend to be more affordable in that area. Conversely, children in area 25, situated closer to an industrial area and with a likely higher average income, preferred sugar-containing beverages like tea, coffee and processed juices. These findings suggest that economic disparities between the two regions significantly shape UPF consumption patterns.

Acknowledging limitations in how sociodemographic factors were measured in this study is important. The reliance on self-reported data, as opposed to observational methods or dietary recall techniques employed in other studies,[12 13 17 18 20 24 28 29] may have introduced some bias. Future research efforts could benefit from incorporating a more comprehensive approach to capturing sociodemographic information.

The study revealed a link between age and UPF consumption patterns. Older children (aged 11–14) consumed more UPFs than their younger counterparts (aged 7–10). This aligns with research suggesting that dietary preferences differ by age and gender.[30] This variation in UPF consumption habits based on age is likely influenced by increased independence and exposure to marketing messages among older children.

Conclusion

This study revealed high consumption of UPFs among school-age children in Lilongwe, with potential implications for developing diet-related chronic conditions. Notably, the consumption of UPFs, such as sausages, correlates with overweight among school-aged children. Conversely, the consumption of fizzy drinks is linked to a higher likelihood of being underweight. Furthermore, sociodemographic factors, such as the geographical location of residence, exhibit a discernible influence on UPF consumption patterns and are associated with an increased risk of underweight. Additionally, age and the type of caregiver emerge as significant factors contributing to the prevalence of overweight in this population. These findings reveal the dietary habits of school-age children and highlight the need for targeted interventions to mitigate the potential health risks associated with high UPF consumption.

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Patient consent for publication Not applicable.

Ethics approval The study adhered to the ethical considerations according to the Declaration of Helsinki. The National Health Sciences for Research Committee (NHSRC) approved this research with Approval Ref Number 21/04/2693.

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Data availability statement Data are available on reasonable request. The data can be accessed from the corresponding author PK: triciakamz@gmail.com. The data available include descriptive data.

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