

Obesity Epidemic in Urban Tanzania: A Public Health Calamity in an already Overwhelmed and Fragmented Health System.

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Abstract

Background Worldwide, the epidemiological and demographic transitions have resulted in nutrition shift characterized by an increased consumption of sugar-sweetened beverages and energy-dense fast food products. In just over 3 decades, overweight and obesity rates have nearly tripled to currently affecting over a third of the global population. Notwithstanding the ever present under-nutrition burden, sub Saharan Africa (SSA) is witnessing a drastic escalation of overweight and obesity. We aimed to explore the prevalence and associated factors for obesity among residents of Dar es Salaam city in Tanzania.

Methods Participants from this study were recruited during a community screening conducted in Dar es Salaam. Sociodemographic and clinical data were gathered using a structured questionnaire during enrollment. Dietary habits, anthropometric measurements and blood pressure were assessed. All statistical analyses utilized STATA v11.0 software. Pearson Chi square and Student's T-test were used to compare categorical and continuous variables respectively. Linear logistic regression analyses were used to assess for factors associated with $BMI \geq 25$. All tests were 2-sided and $p < 0.05$ was used to denote a statistical significance.

Results A total of 6691 participants were enrolled. The mean age was 43.1 years and males constituted 54.2% of all participants. Over two-thirds of participants were alcohol consumers and 6.9% had a positive smoking history. Eighty eight point three percent of participants were underactive, 4.7% had a history of diabetes mellitus and 18.1% were known to have elevated blood pressure. Overweight and obesity were observed in 34.8% and 32.4% of participants respectively. Among overweight and obese participants, 32.8% had a misperception of having a healthy weight. Age ≥ 40 , female sex, a current working status, habitual breakfast skipping, poor water intake, high soft drink consumption, regular fast food intake, low vegetable and fruit consumption, alcohol consumption and elevated blood pressure were found to be independent associated factors for obesity.

Conclusion A sizeable proportion of participants were overweight or obese. Concomitantly, the rates of physical inactivity and unhealthy eating are disproportionately high. In view of this, community-based and multilevel public health strategies to promote and maintain healthy eating and physical activity require an urgent step-up in urban Tanzania.

Background.

Globally, the obesity epidemic is soaring and presage a serious public health threat. In just over 3 decades, overweight and obesity burden has nearly tripled to currently affecting over a third of the global population.¹ With the current pace, obesity is projected to affect more than half of the world population coming 2030.^{2,3} Obesity is associated with elevated risk of literally every chronic condition. For instance, 14% of heart failure, 23% of ischemic heart disease, 44% of diabetes, 70% of hypertension and up to 41% of cancer burden is attributable to excess body weight.⁴⁻⁶ Furthermore, obesity carries an increased individual all-cause mortality risk and claims about 4 million lives annually.^{7,8} As the obesity pandemic

escalates, its health consequences are inevitably accompanied by an overwhelming economic threat. At present, the global economic impact of obesity amount to \$2 trillion annually (i.e. 2.8% of global GDP) making it among the top three most costly manmade burdens of all times.^{2,9}

Similar to many other low and middle income countries (LMICs), sub Saharan Africa (SSA) is witnessing a rapid transition from a predominantly underweight population to an overweight one.^{10,11} Currently, about 35% of SSA inhabitants have excess body weight and the World Health Organization estimates an up-to 50% prevalence in the urban areas.¹²⁻¹⁴ Community studies from urban Tanzania have revealed escalating overweight and obesity rates between 24.1%-34.5% and 19.2%-23.4% respectively.¹⁵⁻¹⁸ Owing to the enormous heterogeneity and unique genetic diversity within SSA region, it is pivotal to comprehensively study and quantify the burden and resultant effects of obesity for formation of feasible, effective and cost-effective strategies to address this pandemic before it becomes insurmountable. We aimed to explore the prevalence and associated factors for obesity among residents of Dar es Salaam city in Tanzania.

Methods.

Recruitment process and Definition of terms

Participants from this study were recruited during the Dar es Salaam International Trade Fair between July 2018 and August 2019. Jakaya Kikwete Cardiac Institute (JKCI) conducted this free community screening at the Sabasaba grounds as part of its corporate social responsibility. Participants of this study didn't have prior information regarding the screening and thus their inclusion was not only voluntary but also random. Aside screening, JKCI staff also provided health education pertaining to NCDs and nutrition to all participants. Sociodemographic and clinical data were gathered using a structured questionnaire during enrollment. Height and weight measurements were taken from consented participants to calculate body mass index (BMI). Physical activity was assessed using the Physical Activity Vital Sign (PAVS) whereby reported moderate-vigorous physical activity of 0min/week, <150min/week, or ≥ 150 min/week was used to categorize participants as inactive, underactive or active respectively. Hypertension was defined as systolic blood pressure (SBP) >140mmHg and/or diastolic blood pressure (DBP) >90 mmHg or use of blood pressure medications. Several dietary habits were assessed during this study including, breakfast consumption, water intake, soft drinks intake, fast food consumption, vegetables & fruits intake, and alcohol drinking. For the purpose of this study we regarded breakfast taking in ≥ 5 days/week, water intake of ≥ 2 L/day, soft drink consumption in ≤ 2 days/week, fast food intake of ≤ 2 days/week and a >4 days/week fruit and vegetable consumption as healthy cut-offs.

Statistical analysis

All statistical analyses utilized STATA v11.0 software. Pearson Chi square and Student's T-test were used to compare categorical and continuous variables respectively. Linear logistic regression analyses were used to assess for factors associated with $BMI \geq 25$. Stepwise and forward selection procedures were used to add and assess the statistically significant variables in the multivariate regression model. The regression models were fitted with baseline covariates associated with overweight/obesity by bivariate analysis at the <0.05 significance level. All tests were 2-sided and $p < 0.05$ was used to denote a statistical significance.

Results.

Study Population.

A total of 6691 participants were enrolled in this study. Table 1 displays their sociodemographic and clinical characteristics. The mean age was 43.1 years and males constituted 54.2% of all participants. About 72% of participants had at least secondary school education and 82.4% had a regular income generating activity. Approximately 25% of all participants had a health insurance and 25.9% had a health check-up at least once in their life time. Over two-thirds of participants were regular alcohol consumers and 6.9% had a positive smoking history. Less than 12% of participants were physically active and 4.7% had a history of diabetes mellitus.

Weight perception, Unhealthy habits and Excess body weight.

The mean BMI was 27.9. Overweight and Obesity were observed in 34.8% and 32.4% of participants respectively. Among overweight and obese participants, 67.2% had a perception of having excess body weight. Table 2 displays a comparison between $BMI < 25$ and $BMI \geq 25$ on various sociodemographic and clinical characteristics. Participants with a $BMI \geq 25$ were significantly older compared to their counterparts with $BMI < 25$ (45.4 vs 38.3, $p < 0.001$). Apart from the age group 18-33 which had predominantly $BMI < 25$, all other age groups had at least twice as much overweight and obese individuals compared to their counterparts with normal weight. Females consistently displayed higher rates of overweight and obesity compared to males (72.0% vs 63.1%, $p < 0.001$) across all age groups. Participants with \leq primary education and those with regular income generating activity displayed higher rates of excess body weight compared to their counterparts (70.9% vs 65.7%, $p < 0.001$ and 68.9% vs 59.1%, $p < 0.001$ respectively). Regarding dietary habits, participants with $BMI \geq 25$ displayed higher frequencies of skipping breakfast, less water intake, more soft drinks consumption, frequent fast food intake, less vegetable and fruit consumption and more alcohol intake compared to participants with normal body weight.

A total of 1212 (18.1%) participants had a positive history of hypertension. Of these, 387 (31.9%) were on regular use of anti-hypertensive medications and 254 (21.0%) had attained a blood pressure control (i.e. BP<140/90 mmHg). A total of 1798 (32.8%) were newly diagnosed with hypertension during this screening. Participants with excess body weight displayed a higher likelihood of having both an elevated blood pressure (25.3% vs 16.0%, p<0.001) and poor blood pressure control (16.4% vs 7.6%, p<0.001) compared to their counterparts with normal weight.

Table 3 display the results of logistic regression analyses for factors associated with excessive body weight. During bivariate analysis, all 13 characteristics that were included in our regression model showed a significant association with excess body weight. We then ran multivariate logistic regression analyses during which 10 out of the 13 factors proved to be independently associated with excessive body weight. These included: age \geq 40 (OR 2.3, 95% CI 1.8-3.0, p-value <0.001), female sex (OR 1.8, 95% CI 1.4-2.3, p-value <0.001), a current working status (OR 1.8, 95% CI 1.4-2.5, p-value <0.001), habitual breakfast skipping (OR 1.6, 95% CI 1.3-2.1, p-value <0.001), poor water intake (OR 24.2, 95% CI 18.4-31.7, p-value <0.001), high soft drink consumption (OR 75.1, 95% CI 57.6-98.0, p-value <0.001), regular fast food intake (OR 11.2, 95% CI 8.8-14.4, p-value <0.001), low vegetable and fruit consumption (OR 10.1, 95% CI 7.7-13.3, p-value <0.001), alcohol consumption (OR 1.7, 95% CI 1.3-2.2, p-value <0.001) and elevated blood pressure (OR 1.3, 95% CI 1.0-1.7, p-value <0.05).

Discussion.

Worldwide, the epidemiological and demographic transitions have resulted in nutrition shift characterized by an increased consumption of sugar-sweetened beverages and energy-dense fast food products.^{1-4, 8,11,13,15} Consequently, the world is now heavier than ever before in the existence of mankind. The drivers of obesity are complex and multifactorial and poses a substantial clinical challenge in both its prevention and management. With over 2 billion people affected worldwide, obesity is attributed to an array of adverse health-related outcomes including increased morbidity, decreased productivity, impaired quality of life, excessive healthcare utilization and increased all-cause mortality risk.^{2,4-9} Notwithstanding the ever present under-nutrition burden, sub Saharan Africa is witnessing a drastic escalation of overweight and obesity.¹⁰⁻¹⁸

In this present study, the mean BMI of study participants fell on the overweight range (i.e. 27.9kg/m²) and about one third were found to be obese. These rates are substantially higher compared to findings from studies conducted in the same region in 1996, 2008 and 2012 which revealed obesity rates of 12.6%,¹⁹

19.2%¹⁶ and 23.4%¹⁷ respectively. Simultaneously, overweight/obesity rates among children is apparently rising at an alarming pace in Dar es Salaam.²⁰⁻²³ While a large majority (94.7%) of individuals with normal weight had an accurate perception regarding their weight, approximately a third of individuals with excess body weight had a misperception that they have a healthy weight. In unison to our findings, earlier studies^{17,24} conducted in this region revealed similar rates of weight misperception among participants with excess body weight. Nonetheless, despite of the existing controversy regarding how the perception of being overweight relates to weight related lifestyle behaviors; right perception on one's body image is likely to have a positive influence on health behaviors.²⁵⁻²⁷ Conversely, cultural and social influences particularly in SSA have been shown to impact body image perception.²⁸ For instance in some communities where excess body weight is perceived as a sign of beauty, health, fertility, power and/or financial prosperity, exacerbation of eating disorders is observed.²⁹⁻³²

Similar to previous studies in many other settings, obesity was found to increase exponentially with increasing age.¹⁵⁻²⁴ Moreover, across all age groups (except for 18-33 years), we observed a disproportionate predominance of overweight and obese individuals. Ominously, the preponderance of obesity across most age groups is a warning sign that if not intervened urgently, we are likely to witness an overweight/obesity domination across all population subgroups. Additionally, an increasing body of knowledge is suggesting that obesity may speed up the aging process by inducing senescence.³³⁻³⁵ Women displayed an 80% increased likelihood of having excess body weight compared to men in this present study. In contrast to high income countries, women living in lower and middle income countries bear a disproportionate burden of obesity.^{11,15-24} Several factors including sociocultural dynamics, physical activity patterns, pregnancy, parity and menopause have been implicated in the body weight disparities between women and men residing in the developing world.^{36,37}

Owing to urbanization, residents of the developing world are exposed to less energy-demanding jobs, increased sedentary lifestyles, and adoption of a western diet which are convincingly implicated as causative factors in the accelerating obesity epidemic.^{10-18,38,39} Physical inactivity is among the primary contributors to the obesity epidemic all over the globe. Nearly 90% of participants in this study were categorized as being inactive or underactive. Contrary to our findings, earlier local studies revealed physical activity rates between 83.2%¹⁶ to 92.6%⁴⁰. Such discrepancy could partly be explained by the variation in the assessment tools used to assess for physical activity among studies, however, based on the observed obesity rates such rates are likely to be a true reflection. Although we observed a negative association between smoking and obesity, alcohol consumption in this study was associated with a 70% increased likelihood of having excess body weight. Correspondingly, numerous studies all over the globe have revealed higher obesity rates among alcohol drinkers compared to non-drinkers.⁴¹⁻⁴³

Several unhealthy eating habits including skipping breakfast, poor water intake, high consumption of soft drinks and fast foods, and low intake of vegetables and fruits were observed in this present study. Skipping breakfast has been shown to increase one's risk of becoming obese in various studies.⁴⁴⁻⁴⁷ Participants who skipped breakfast for at least 4 days in a week displayed a 60% increased likelihood of being obese in this present study. Adequate hydration is known to reduce overeating and increase lipolysis thus promoting a healthy weight.⁴⁸ Despite of a low evidence for a causal association, numerous longitudinal studies have demonstrated a significant association between inadequate hydration and elevated BMI/obesity.^{49,50} In this current study, participants who reported an average water intake of ≤ 2 L/day had a 24 times odds of being overweight or obese compared to their counterparts who consumes more than 2L a day.

Globally, the consumption of sugar-sweetened beverages has increased in recent times. Participants who consumed beverages for ≥ 3 days/week displayed a 75 times increased likelihood of having excess body weight compared to those who drinks in 2 days or less. Studies from different parts of the globe have also demonstrated how sweetened beverages is accelerating obesity rates in various communities.⁵¹⁻⁵³ Likewise, mushrooming of franchised fast food particularly in the developing world is concomitantly fuelling the obesity epidemic.⁵⁴⁻⁵⁷ Participants who consume fast food for 3 or more days in a week displayed an 11 times chance of being overweight or obese compared to their counterparts who seldom consumes fast food. Currently in Dar es Salaam the price of soda is similar to that of bottled drinking water while on average fast food is cheaper than a healthy locally-made meal. Several previous studies have also demonstrated an inverse association between fruit/vegetable consumption and body adiposity.⁵⁸⁻⁶² Study participants with low fruit/vegetable consumption displayed a 10 times odds of having excess body weight compared to regular fruit/vegetables consumers. Overall, consistent with earlier studies on this topic, similar unhealthy habits have been associated with increasing obesity rates in this African population. More worryingly though is the rapid transformation, escalation and adoption of the unhealthy lifestyle habits observed in this present study compared to studies conducted in the same setting some years ago.

Conclusions.

The burden of obesity in urban Tanzania has reached the boiling point. Parallel to this, reciprocal trajectories of NCDs are also expected to intensify if measures to curb the obesity epidemic are not taken timely and aggressively. These findings have imperative public health ramifications and call for urgent and collaborative efforts from healthcare workers, government agencies and policy makers to combat the escalating obesity crisis before it becomes unabated. Community-based and multilevel public health

strategies to promote and maintain healthy diet and physical activity including price reduction for healthy foods, increasing the price of unhealthy foods, incorporating nutrition health education and physical activity programs in schools and workplace, and initiation of social support interventions for physical activity (i.e. walking groups, jogging clubs, and exercise buddy system) require an urgent step-up in urban Tanzania.

Strength And Limitations.

The strengths of our study include a sufficiently large sample to estimate the prevalence of obesity and to explore subgroup (i.e. sex and age-specific) burdens with adequate precision. Furthermore, we used rigorous and standardized protocols for data collection and utilized qualified and competent personnel in all measurements. Despite our efforts, this study is not short of limitations. The cross-sectional nature of this study dictated our risk-factor assessment particularly dietary habits and physical activity to rely on self-reported measures thus recall bias and reverse causation cannot be precluded. Moreover, BMI was the only measure of adiposity utilized in this study. Nevertheless, it remains the most frequently used measure in epidemiologic studies. Additionally, owing to the less comprehensive dietary intake data, our association results should be interpreted with some caution. Lastly, single-occasion BP measurements (as taken in this study) has the potential to overestimate the hypertension burden.

Abbreviations

95% CI, 95% Confidence Interval; BMI, body mass index; BP, blood pressure; DBP, diastolic blood pressure; GDP, Gross Domestic Product; JKCI, Jakaya Kikwete Cardiac Institute; LMIC, low and middle income countries; NCDs, non-communicable diseases; OR, Odd Ratio; PAVS, Physical Activity Vital Sign; SSA, sub Saharan Africa; SBP, systolic blood pressure; WHO, World Health Organization.

Declarations

Ethical consideration

The study was approved by the Directorate of Research of the Jakaya Kikwete Cardiac Institute and the permission to conduct the study was obtained from the Temeke municipality authorities. All the participants provided a written informed consent.

Availability of Data and Materials

The final version of data set supporting the findings of this paper is submitted together with this manuscript to the editorial committee. All the raw data is included in this manuscript. There are no ethics restrictions preventing the sharing of the raw data.

Consent to Publish

Not applicable

Competing interest

The authors have no conflict of interest to declare

Author contributions

PP and MJ conceived the study. LK, AO, RM, SM, and FM conducted all the interviews, as well as anthropometric and blood pressure measurements. NRH, HJS, SB, TLM, AK and PP performed physical examinations, interpreted client's measurements and offered health education. LM, ZSM and JM performed data entry. PP performed all the data cleaning and analysis. The corresponding author (PP) wrote the first draft of the manuscript, and other authors contributed to and approved it. All authors made the decision to submit the manuscript for publication. All authors undertake responsibility for the accuracy and integrity of the analysis.

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Tables

Table 1: Sociodemographic and Clinical Characteristics (N= 6691)

Characteristic	Frequency
Age	
Mean (SD)	43.1 (14.2)
Range	18-95
Age Group	
18-33 years	1978 (29.6%)
34-49 years	2540 (38.0%)
50-65 years	1699 (25.4%)
>65	474 (07.0%)
Sex	
Male	3625 (54.2%)
Female	3066 (45.8%)
Education	
No Formal	205 (3.1%)
Primary	1692 (25.3%)
Secondary	2155 (32.2%)
University	2639 (39.4%)
Occupation	
Jobless	612 (9.1%)
Student	285 (4.3%)
Self Employed	3605 (53.9%)
Employed	1907 (28.5%)
Retired	282 (4.2%)
Health Insurance	
Yes	1678 (25.1%)
No	5013 (74.9%)
Medical check-up (lifetime)	
Yes	1733 (25.9%)
No	4958 (74.1%)
Alcohol intake	
Yes	4447 (66.5%)
No	2244 (33.5%)
Smoking status	
Never	6229 (93.1%)
Past	184 (2.8%)
Current	278 (4.1%)
Physical Activity	
Inactive	3892 (58.2%)
Underactive	2016 (30.1%)
Active	783 (11.7%)
Body Mass Index	
Mean	27.9 (5.8)
BMI Categories	
Underweight	181 (2.7%)
Normal	2014 (30.1%)
Overweight	2327 (34.8%)
Obese	2169 (32.4%)
Morbid obesity	203 (09.4%)
Chronic Illness History	

	Hypertension	1212 (18.1%)
	Diabetes	311 (4.7%)
Blood Pressure		
Negative Hypertension History		
	<i>Normotension</i>	1595 (29.1%)
	<i>Pre-hypertension</i>	2086 (38.1%)
	<i>Hypertension</i>	1798 (32.8%)
Positive Hypertension History		
	<i>Awareness</i>	1212 (40.3%)
	<i>Treatment</i>	387 (31.9%)
	<i>Control</i>	254 (21.0%)

Table 2: Comparison between BMI<25 & BMI≥25 (N= 6691)

Characteristic	BMI<25 (n = 2195)	BMI≥25 (n = 4496)	p-value
mean, SD)	38.3 (15.3)	45.4 (13.1)	<0.001
Groups			
18-33*	1074 (54.3%)	904 (45.7%)	-
34-49	620 (24.4%)	1920 (75.6%)	<0.001
50-65	347 (20.4%)	1352 (79.6%)	<0.001
>65	154 (32.5%)	320 (67.5%)	<0.001
Sex			
Female	858 (28.0%)	2208 (72.0%)	<0.001
Male	1337 (36.9%)	2288 (63.1%)	
Education level			
≤ primary education	552 (29.1%)	1345 (70.9%)	<0.001
≥ secondary education	1643 (34.3%)	3151 (65.7%)	
Employment status			
Currently working	1713 (31.1%)	3799 (68.9%)	<0.001
Not working (students, jobless, retired)	482 (40.9%)	697 (59.1%)	
Dietary habits			
Breakfast intake (days/week)	3.7	4.2	<0.001
Water intake (liters/day)	2.7	1.4	<0.001
Soft drinks consumption (days/week)	1.9	4.7	<0.001
Fast food consumption (days/week)	2.3	4.2	<0.001
Vegetables & Fruits intake (days/week)	4.6	2.3	<0.001
Alcohol drinkers	617 (28.1%)	1627 (36.2%)	<0.001
Smoking History			
Ever smokers	172 (37.2%)	290 (62.8%)	0.04
Never smokers	2023 (32.5%)	4206 (67.5%)	
Physical Activity			
Inactive/Underactive	1906 (32.3%)	4002 (67.7%)	0.01
Active	289 (36.9%)	494 (63.1%)	
Hypertension history			
Positive	243 (20.0%)	969 (80.0%)	<0.001

<i>Negative</i>	1952 (35.6%)	3527 (64.4%)	
ted Blood Pressure			
<i>Normal</i>	1573 (39.4%)	2419 (60.6%)	<0.001
<i>Elevated</i>	622 (23.0%)	2077 (77.0%)	
ption about current body weight			
<i>perceiving themselves as overweight/obese)</i>	116 (5.3%)	3022 (67.2%)	<0.001

*: reference group

Table 3: Associated Factors for Excessive Body Weight.

Characteristic	Comparative	OR	95% CI	p-value	Adj.OR	95% CI	p-value
0	Age<40	3.0	2.7-3.3	<0.001	2.3	1.8-3.0	<0.001
	Male	1.5	1.4-1.7	<0.001	1.8	1.4-2.3	<0.001
y Education	≥ Secondary Education	1.3	1.1-1.4	<0.001	1.2	0.9-1.5	0.27
7 Working	Unemployed	1.5	1.3-1.7	<0.001	1.8	1.4-2.5	<0.001
	Active	1.2	1.1-1.4	<0.01	1.4	0.97-2.0	0.07
ps breakfast (≥ week)	Regular takers (<4days)	1.7	1.5-1.9	<0.001	1.6	1.3-2.1	<0.001
ake <2L/day	Intake ≥2L/day	22.4	19.2-26.1	<0.001	24.2	18.4-31.7	<0.001
ks intake >2days /week	≤2days/week	67.0	57.0-78.7	<0.001	75.1	57.6-98.0	<0.001
l intake >2days/week	≤2days/week	9.9	8.8-11.1	<0.001	11.2	8.8-14.4	<0.001
es & Fruits intake week	>4days/week	11.9	10.4-13.7	<0.001	10.1	7.7-13.3	<0.001
alcohol history	Non-drinkers	1.5	1.3-1.6	<0.001	1.7	1.3-2.2	<0.001
history of Hypertension	Negative history	2.2	1.9-2.6	<0.001	1.2	0.9-1.7	0.30
BP	Normal BP	2.2	1.9-2.4	<0.001	1.3	1.0-1.7	<0.05

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [DataSheetObesityFinal.csv](#)
- [STROBEChecklist.doc](#)
- [SUP.docx](#)