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Socio-demographic and economic determinants of obesity among day secondary school students in selected sub-counties of Machakos county, Kenya

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Abstract

Context: Obesity among adolescents is a growing public health concern worldwide, including in Kenya. Despite its growing prevalence, there is limited evidence on the determinants of obesity among day secondary school students in Machakos County. This study sought to assess socio-demographic and economic determinants of obesity among day secondary school students in selected sub-counties of Machakos County, Kenya.
Methods: This study used an analytical cross-sectional design with a mixed-methods approach. Associations between dependent and independent variables were assessed using binary and multivariate logistic regression ($p \leq 0.05$), while qualitative data were analyzed thematically.
Results: From this study, the prevalence of obesity was 8.5%. Students aged 15–18 years (aOR = 2.18, 95% CI: 1.273–3.721, p = 0.002), Students with mothers who had primary education (aOR = 2.2, 95% CI: 1.862–3.322, p = 0.02), and students with employed fathers (aOR = 2.4, 95% CI: 2.131–3.995, p = 0.001) had significantly higher odds of obesity, whereas spending less than two hours per day on screen-based activities reduced the odds of obesity (aOR = 0.6, 95% CI: 0.273–0.742, p = 0.01).
Conclusion: This study highlights that adolescent obesity remains a growing public health concern influenced by socio-demographic and lifestyle factors. The findings demonstrates the significant role of family structure, parental education, and lifestyle habits in influencing students' weight outcomes. The study recommends that schools integrate nutrition and physical activity programs into their curricula, while engaging parents, especially those with demanding jobs or in single-parent households, through community-based education on healthy lifestyles.

Keywords: Adolescent, Determinants & Obesity.

Introduction

Obesity is a chronic, complex disease characterized by excessive fat accumulation that presents a health risk[1]. For adolescents (roughly age 10-19 years), obesity is defined by the World Health Organization (WHO) as having a Body Mass Index (BMI) for age and sex that is > 2 standard deviations above the WHO Growth Reference median[2]. As of 2022, over 390 million children and adolescents aged 5-19 years were overweight globally, including about 160 million who were living with obesity[1]. The prevalence of overweight (including obesity) among 5-19-year-olds rose from about 8% in 1990 to 20% in 2022[1]. High-income countries still report the highest absolute prevalences, but middle-income regions and many small island states have experienced the steepest recent rises, driven largely by shifts toward energy-dense, ultra-processed diets and declines in

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physical activity[3]. Pooled analyses of studies from many countries put the overall prevalence of obesity in children and adolescents at roughly 8–8.5%, with wide variation between countries and regions[4].

Across Africa, overweight and obesity among children and adolescents have risen substantially over the last two decades, producing a mixed but worrying picture across regions and countries[5]. Recent WHO analyses warned that, if current trends continue, one in ten children and teenagers in several high-burden African countries could be living with obesity by the end of 2023, signalling a clear shift in the region's nutritional landscape[5]. Among children & adolescents in Africa, obesity prevalence is projected at 5% to 16.5% if current trends continue[6]. A systematic scoping review of Sub-Saharan Africa found that among school-going adolescents (11–18 years), the combined prevalence of overweight and/or obesity in central Ethiopia was 10.3%; in high school adolescents in Hawassa (urban Ethiopia), overweight prevalence was about 12.9% and obesity 2.7%[7].

Another study in SSA across 7 African countries found that overweight prevalence among adolescents ranged from 8.7% (Ghana) to 31.4% (Egypt), while obesity ranged from 0.6% to 9.3% in those countries[8]. In their study among late adolescent girls (East African countries, 2010-2016), they reported a very low obesity (overnutrition) magnitude of about 2.41% in that cohort(9). By the mid-2010s, adolescent overweight/obesity rates varied widely across Africa, about 21% in South Africa (higher among girls) versus 10–12% in urban Ethiopia and other East African areas 6. More recent school-based surveys in selected SSA settings sometimes find even higher figures (for instance, combined overweight/obesity near 15–25%) in urban and peri-urban school populations, especially among girls and among adolescents from higher socioeconomic backgrounds[9]. Global models and rankings show wide variation in child obesity across Africa, with rates very high in some islands and higher income nations, low in many low income countries, yet the overall trend is increasing continent-wide[10].

In Kenya, recent statistics highlight a concerning trend: the prevalence of overweight and obesity among adolescents has risen from 4% nationally in 2014 to 7% in 2022, with some urban counties reporting rates above 10% figures that are comparable to or even higher than those observed among younger children and rivaling adult obesity rates[11]. In Machakos County, adolescent obesity is estimated at 8–9%, slightly above the national average, yet localized studies remain scarce[12]. There is limited research on the determinants of obesity among day secondary school students in Machakos County, Kenya. Few studies have explored socio-demographic and socioeconomic factors, and comparative county-level data, especially for peri-urban settings like Machakos, remain scarce. As a result, this study aimed to assess socio-demographic and economic determinants of obesity among day secondary school students in selected sub-counties of Machakos County, Kenya.

Methods

Study area

Machakos County, located in Kenya's Eastern Region, covers approximately 6,208 km² and lies between latitudes 0°45′ S and 1°31′ S and longitudes 36°45′ E and 37°45′ E. According to the 2019 census, the county has a population of about 1.42 million, with an estimated 204,799 adolescents (13–19 years)[13]. The local climate is characterized as semi-arid, featuring hilly terrain at an altitude ranging from 1000 to 2100 meters above sea level. In this semi-arid environment, subsistence agriculture is predominantly practiced, with crops such as maize and drought-resistant varieties like millet and sorghum grown.

Study design

This study employed an analytical cross-sectional research design, which allowed for testing the relationships between the dependent and independent variables. The design was appropriate for examining the socio-demographic and economic determinants of obesity among day secondary school students in selected sub-counties of Machakos County. For triangulation purposes, both qualitative and quantitative data were obtained in this study.

Study population

The study population for this study were secondary school students in selected Sub-Counties of Machakos County in Kenya.

Inclusion and exclusion criteria

The research comprised adolescents who were enrolled in day secondary schools in the designated

Machakos County sub-counties at the time of gathering data. Participating in this research was limited to those who provided consent, and for minors, whose parents or guardians gave informed consent to ensure ethical compliance, while the students gave assent. Concern appears to be maintained through many processes, as per research, whereby avoidance acts to inhibit habituation such that fear is ultimately maintained. IU on the side increases uncertainty and vigilance as the likelihood of detecting and retaining the threats is fostered by the attentional biases, which a person has. The intervention of metacognition in the creation of meta-worry is likewise presented, and the processes strengthen each other and cause individuals not to take preventative actions. The research excluded students enrolled in boarding schools or non-formal education programs. Adolescents with chronic illnesses, endocrine disorders, or physical disabilities that could influence weight status or limit physical activity were also excluded. Additionally, respondents who declined participation or whose parents or guardians withheld consent were not considered.

Sample size

The sample size was determined using Yamane's formula for estimating a single population proportion[14].

The sample size was calculated using the formulae used by Yamane et al (1973).

Yamane's Formula (1973) was used to determine the sample size from this population of 10,000 secondary school adolescents as follows:

$n = N/1+Ne^2$

Where n is the estimated study sample

e= is the desired precision at a 0.05 level of significance

N is the number of secondary school adolescents in the age group, which is 10,000

$n = 10,000/(1+(10,000 \times (0.05)^2 = 384.8 = 385$ participants.

A total of three hundred and eighty-five (n = 385) participants were selected from the target population. An additional 10% of the population (10/100 x 385 = 39) were selected to account for the non-response rate, making the total sample size of this study 424 study respondents.

Sampling technique

Machakos County was purposively selected as the study area because of its demographic and socioeconomic diversity. From its six sub-counties, one secondary school was purposively selected in each to ensure geographic representation. Within these schools, students were organized into strata based on grade level and sex, after which proportionate stratified random sampling was applied to determine the number of participants from each stratum. Finally, simple random sampling was used to select respondents from each stratum for inclusion in the study.

Data collection tools and procedures

Data collection was conducted using structured questionnaires administered by trained research assistants to ensure accuracy and consistency. The research assistants offered guided support during the interview process, including clarifying and interpreting questions when necessary, to accommodate variations in literacy levels and ensure reliable responses. The questionnaire was developed after reviewing relevant literature and adapting items from validated tools used in similar nutrition studies. Content experts reviewed the draft to ensure clarity and relevance. The questionnaire was then pretested on 10% of a comparable population to assess comprehension and flow, and necessary adjustments were made. The final structured questionnaire was standardized for consistent administration by trained research assistants. The questionnaire comprised three sections: Section A captured respondents' sociodemographic characteristics; Section B assessed the nutritional status of the study respondents, where Body Mass Index (BMI) was assessed using WHO BMI-for-age Z-score (BAZ) cut-offs for individuals aged 5–19 years; and Section C focused on socioeconomic factors associated with obesity. In addition, focus group discussion (FGD) guides and key informant interview (KII) guides were employed to capture qualitative data. Three FGDs were initially conducted, each comprising 8–12 participants, and were continued until data saturation was reached. Furthermore, five key informant interviews were carried out with the County Director of Education, school heads, and teachers selected from the Ministry of Education, as these stakeholders were directly involved in education service delivery at the school level.

Statistical analysis

Data was cleaned, coded, and analyzed using the Statistical Package for Social Sciences (SPSS) version 29. Associations among the research variables were first assessed using the bivariate logistic regression analysis. Variables that were significant in the bivariate analysis were subsequently included in a multivariate logistic regression model to control for potential confounding effects. A p-value ≤ 0.05 was considered statistically significant. The analyzed data were presented in tables and charts for ease of interpretation. Thematic analysis was employed to identify and interpret key patterns and themes within the qualitative data, which was presented narratively.

Ethical consideration

Ethical approval for this study was obtained from the Mount Kenya University Ethics and Review Committee (MKU/ISERC/2753). Authorization to conduct the research was subsequently granted by the National Commission for Science, Technology, and Innovation (NACOSTI) (NACOSTI/P/23/26449). In addition, permission to carry out the study was secured from the Machakos County Government, Department of Education (MKS/ED/CDE/R/4/Vol.4/315). Participation in the study was entirely voluntary, and informed consent and assent were obtained from all participants before data collection. Privacy and confidentiality were strictly maintained throughout the research process, with all data anonymized to protect respondents' identities. Finally, the study findings were shared with Machakos County authorities to inform and support appropriate policy and programmatic actions.

Results

Demographic characteristics of the study respondents.

Table 1 presents the demographic characteristics of the study respondents. More than half of the participants were female (n = 225, 53%), while slightly fewer were male (n = 199, 47%). Regarding age, the vast majority (n = 410, 97%) were between 15 and 18 years old, with only a small proportion (n = 14, 3%) aged above 18 years. Similarly, most respondents (n = 414, 98%) identified as Christians, whereas a small fraction (n = 10, 2%) were Muslims. Concerning parental marital status, more than half (n = 240, 57%) of respondents' parents were married, while only a few (n =14, 3%) were widowed. In terms of class level, over one-third (n = 157, 37%) were in Form Four, approximately one-third (n = 140, 33%) were in Form Three, and a smaller proportion (n = 28, 7%) were in Form One.

Table 1: Demographic characteristics of the study respondents.

Variable	Category	n	%
Gender	Male	199	47
	Female	225	53
Age in years	15-18	410	97
	above 18	14	3
Parents' marital status	Single	99	23
	Married	240	57
	Separated	71	17
	Widowed	14	3
Religion	Christian	414	98
	Muslim	10	2
Class (form)	Form 1	28	7
	Form 2	99	23
	Form 3	140	33
	Form 4	157	37

Prevalence of obesity

Figure 1 presents the prevalence of obesity among the study respondents. From this study, the prevalence of obesity was 8.5% (n = 36), while the majority of respondents (n = 388, 91.5%) were not obese.

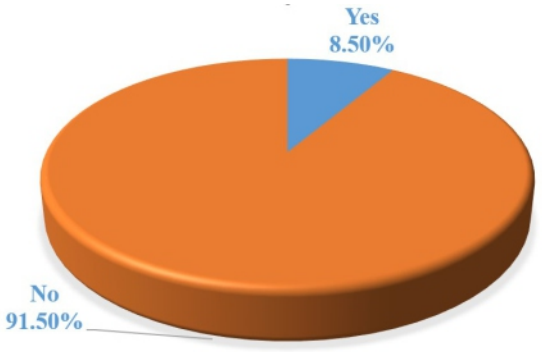

Figure 1: Prevalence of obesity

Influence of socio-demographic factors on obesity

From this study, as shown in Table 2, the following sociodemographic factors showed a statistically significant association in the bivariate analysis: students aged 15–18 (OR = 3.12, 95% CI: 2.322–5.324, p = 0.004). Students from single-parent households (OR = 2.5, 95% CI: 1.129–3.528, p = 0.004), Christians respondents(OR = 2.80, 95% CI: 2.306–4.964, p = 0.02). Form One and Form Three students (OR = 1.80, 95% CI: 1.535–3.253, p = 0.05 and OR = 2.30, 95% CI: 1.630–3.739, p = 0.02, respectively) and female students (OR = 1.24, 95%

CI: 1.102–3.137, p = 0.03). These variables were subsequently included in the multivariate logistic regression analysis to control for potential confounding effects.

As shown in Table 4, students aged 15–18 years had over two times the odds of being obese compared to those aged 19 years and above (aOR = 2.18, 95% CI: 1.273–3.721, p = 0.002). Students from single-parent households were 1.9 times more likely to be obese (aOR = 1.9, 95% CI: 1.324–3.193, p = 0.02). Class level was also significant: Form Three students showed higher odds of obesity compared to Form Four students (aOR = 2.1, 95% CI: 1.214–3.802, p = 0.008).

These findings agreed with the qualitative narratives, where one of the key informants noted that:

"Allow me to say that Form 3 students appear more likely to be obese than Form 4 students due to differences in lifestyle patterns, academic pressure, and physical activity levels. Most Form 3 students experience a relatively relaxed academic schedule compared to Form 4 candidates, who are intensely focused on preparing for their final examinations……" (KII 2, County Director of Education, 2025).

Table 2: Influence of socio-demographic factors on obesity

Variable		P.value	Odds Ratio	95% Confidence Interval	
	Category			Lower	Upper
Gender	Females	0.03	1.24	1.102	3.137
	Male		*Ref*		
Age in years	15-18	0.004	3.12	2.322	5.324
	Above 18		*Ref*		
Parents marital status	Single	0.004	2.45	1.129	3.528
	Separated	0.34	1.112	0.295	1.619
	Widowed	0.07	1.68	0.757	2.774
	Married		*Ref*		
Religion	Christians	0.02	2.84	2.306	4.964
	Muslims		*Ref*		
Class level	Form 1	0.05	1.8	1.535	3.253
	Form 2	0.31	1.23	0.642	1.842
	Form 3	0.02	2.3	1.630	3.739
	Form 4		*Ref*		

Ref Reference group

Influence of socioeconomic factors on obesity

From this study, as provided in Table 3, the following socioeconomic factors showed a statistically significant association with obesity in the bivariate analysis: As shown in Table 3, students whose fathers had primary education (OR = 1.8, 95% CI: 1.484–4.835, p = 0.03) or secondary education (OR = 2.5, 95% CI: 2.321–5.941, p = 0.005) Students with mothers who had primary education (OR = 2.2, 95% CI: 2.004–4.939, p = 0.02),non-employed mothers (OR = 2.1, 95% CI: 1.873–3.892, p = 0.04), students from households with five members (OR = 2.3, 95% CI: 1.943–3.684, p = 0.02). Respondents spending less than two hours on screens daily (OR = 0.5, 95% CI: 0.334–0.754, p = 0.01) and students with employed fathers (OR = 2.8, 95% CI: 2.392–4.443, p = 0.005). These variables were subsequently included in the Multivariate logistic regression analysis to control for potential confounding effects.

As shown in Table 4, students whose fathers had primary education (aOR = 1.5, 95% CI: 1.383–2.032, p = 0.01) or secondary education (aOR = 2.1, 95% CI: 1.783–3.964, p = 0.002) were more likely to be obese compared to those whose fathers had university-level education. Similarly, mother's education was a significant factor, with primary education linked to higher odds of obesity (aOR = 2.2, 95% CI: 1.862–3.322, p = 0.02) compared to secondary or university education. Overall, higher parental education levels were associated with lower obesity odds. For mothers, non-employment status was associated with increased obesity risk (aOR = 1.9, 95% CI: 1.543–2.963, p = 0.008). Household size also played a role: students from households with five members had the highest obesity odds (aOR = 2, 95% CI: 1.893–2.432, p = 0.001) compared to those from smaller households. Respondents spending less than two hours on screens daily were 40% less likely to be obese than those spending over five hours (aOR = 0.6, 95% CI: 0.273–0.742, p = 0.01). Regarding parents' occupations, students with employed fathers had significantly higher odds of obesity (aOR = 2.4, 95% CI: 2.131–3.995, p = 0.001) compared to those whose fathers were self-employed.

These findings agreed with the qualitative narratives, where one of the participants in the focused group discussion noted that:

"Fathers who are formally employed often have higher and more stable incomes, which means their families can afford more processed and high-calorie foods. These students also tend to have more pocket money to spend on snacks at school……" (FGD 1, Respondent 3,2025).

Another focus group discussant noted that;

"Let me say, Employed fathers generally have higher

Table 3: Influence of socioeconomic factors on obesity

Variable		P.value	Odds Ratio	95% Confidence Interval	
	Category			Lower	Upper
Fathers education	Primary	0.03	1.8	1.484	4.835
	Secondary	0.005	2.5	2.321	5.941
	University		*Ref*		
Mothers education	No formal education	0.08	1.6	0.753	2.944
	Primary	0.02	2.2	2.004	4.939
	Secondary	0.09	1.5	0.575	1.984
	University		*Ref*		
Fathers occupation	Employed	0.005	2.8	2.392	4.443
	Non-employed	0.18	1.3	0.852	1.873
	Self-employed		*Ref*		
Mothers occupation	Employed	0.06	1.7	0.773	2.243
	Non-employed	0.04	2.1	1.873	3.892
	Self-employed		*Ref*		
Household size	2 members or fewer	0.1	1.4	0.622	1.993
	3 members	0.14	1.9	0.861	2.182
	4 members	0.07	1.6	0.554	1.759
	5 members	0.02	2.3	1.943	3.684
	6 members or more		*Ref*		
TV watching	2 hours or less	0.01	0.5	0.334	0.754
	2-3 hours	0.12	0.9	0.562	2.328
	3-5 hours	0.09	0.5	0.341	1.922
	Over 5 hours		*Ref*		
Phone chatting	2 hours or less	0.12	0.3	0.112	1.882
	2-3 hours	0.23	0.9	0.436	2.454
	3-5 hours	0.07	0.7	0.511	1.632
	Over 5 hours		*Ref*		

Ref= Reference group

Table 4: Multivariate analysis on social demographic and economic factors

Variable		P.value	Adjusted Odds Ratio	95% Confidence Interval	
	Category			Lower	Upper
Gender	Females	0.534	1.12	0.783	1.615
	Male		*Ref*		
Age in years	15-18	0.002	2.18	1.273	3.721
	Above 18		*Ref*		
Parents marital status	Single	0.017	1.89	1.324	3.193
	Separated	0.287	0.97	0.795	1.554
	Widowed	0.785	0.92	0.513	1.675
	Married		*Ref*		
Religion	Christians	0.13	1.54	0.306	1.944
	Muslims		*Ref*		
Class level	Form 1	0.406	1.3	0.747	2.127
	Form 2	0.09	1.6	0.932	2.786
	Form 3	0.008	2.1	1.214	3.802
	Form 4		*Ref*		
Fathers education	Primary	0.01	1.5	1.383	2.032
	Secondary	0.002	2.1	1.783	3.964
	University		*Ref*		
Mothers education	No formal education	0.14	1.3	0.564	2.563
	Primary	0.02	2	1.862	3.322
	Secondary	0.09	1.2	0.644	1.843
	University		*Ref*		
Fathers occupation	Employed	0.001	2.4	2.131	3.995
	Non-employed	0.23	1.1	0.783	1.738
	Self-employed		*Ref*		
Mothers occupation	Employed	0.33	1.4	0.652	1.758
	Non-employed	0.008	1.9	1.543	2.963
	Self-employed		*Ref*		
TV watching	2 hours or less	0.004	0.6	0.273	0.742
	2-3 hours	0.53	0.9	0.831	1.938
	3-5 hours	0.14	0.5	0.383	2.824
	Over 5 hours		*Ref*		
Household size	2 members or fewer	0.27	1.3	0.761	2.652
	3 members	0.45	1.6	0.573	2.168
	4 members	0.21	1.3	0.736	2.022
	5 members	0.001	2	1.893	2.432
	6 members or more		*Ref*		

Ref= Reference group

and more stable incomes, enabling families to afford energy-dense foods such as fast foods, soft drinks, and snacks, which are commonly linked to weight gain. These families are also more likely to rely on private transport, reducing their children's physical activity levels....." (FGD 1, Respondent 5,2025).

Discussion

The obesity prevalence of 8.5% found in this study aligns with global estimates from meta-analyses of children and adolescents(4). Whereas other African contexts like Ethiopia show somewhat higher obesity prevalence (11.3%)[15]. The variation can be attributed to differences in study settings and study design.

From this study, students aged 15–18 years had over two times the odds of being obese compared to those aged 19 years and above. These findings were contrary to those of a Kenyan study, where obesity was noted in older adolescents compared to younger adolescents[16]. This may be attributed to lifestyle changes and increased sedentary behavior, such as prolonged screen time and reduced physical activity, which are more common among mid-adolescents (15–18 years) compared to older adolescents. Students from single-parent households were 1.9 times more likely to be obese; these findings were in harmony with 2 other studies done in Kenya[16,17]. This may be due to reduced parental supervision and guidance on healthy eating and physical activity in single-parent households.

Lower parental education was associated with obesity. Findings agreed with those of a study done in Germany[18]. This may be because parents with lower education levels often have limited knowledge about nutrition and healthy lifestyle practices, which can influence their children's dietary habits and activity levels. Household size also played a role: students from households with five members had the highest obesity odds compared to those from smaller households. These findings were contrary to those of a study done in Ethiopia[19]. This may be linked to resource allocation and food distribution patterns in larger households, where some children may have

greater access to energy-dense foods or less supervision over dietary choices.

Regarding parents' occupations, students with employed fathers had significantly higher odds of obesity compared to those whose fathers were self-employed. The findings agreed with those of a study done in Kenya and Nigeria[20,21]. This may be because employed fathers often have higher and more stable incomes, which can increase household access to calorie-dense foods and reduce time for supervising children's dietary and physical activity habits.

Students who spent less than two hours per day on screen-based activities had approximately 40% lower odds of obesity compared to those spending over five hours daily. This aligns with findings from studies in Ethiopia and global meta-analyses showing that higher screen time is a significant risk factor for adolescent overweight and obesity[22,23]. This may be because excessive screen time is associated with sedentary behavior and increased snacking, both of which contribute to higher obesity risk.

Limitations of the study

The study had several limitations. First, the use of self-reported data may have introduced response bias, as some respondents might have underreported or overreported certain parameters due to social desirability or recall challenges. Second, the cross-sectional design of the study limited its ability to establish causal relationships between the identified determinants and obesity; the findings, therefore, reflect associations rather than cause-and-effect relationships. Third, the study focused exclusively on day secondary school students in selected sub-counties of Machakos County, which may limit the generalizability of the results to other regions, boarding schools, or different age groups.. The study also relied on the assumption that respondents fully understood all questions and measurement procedures, yet variations in comprehension could have affected data accuracy.

Conclusion

This study found that obesity among students was strongly influenced by age, parental education, family structure, and lifestyle factors. Adolescents aged 15–18 years, those from single-parent households, and those with less educated or employed parents were more likely to be obese. Longer screen time also increased the likelihood of obesity. To address this, schools should promote physical activity and healthy eating habits through structured health education programs. Parents should be encouraged to model healthy lifestyles at home, and awareness campaigns should target families with lower education levels. Policymakers should support school-based interventions and create community initiatives that reduce sedentary behavior among adolescents.

Authors' contribution: A.K. played a key role in data analysis and manuscript writing, A.K., J.J. & K.M. in the review of the manuscript. All authors read and approved the final manuscript draft.

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