

Overweight and Obesity in Women: Factor Analysis of Data from the Kenya Demographic and Health Survey

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Abstract

Background: Overweight and obesity are emerging public health challenges in low-to-middle-income countries. Factors such as urbanization, physical inactivity, changing diets, and harmful consumption of alcohol contribute to this global growth in overweight and obesity, particularly in African countries. This study aimed to identify factors most predictive of overweight and obesity in adult women in Kenya.

Methods: We conducted a cross-sectional study of data from the Kenya Demographic and Health Survey (KDHS) to calculate descriptive statistics and used data reduction techniques to identify key predictive factors of overweight and obesity among non-pregnant women ≥ 20 years old responding to the KDHS.

Results: We included 5,169 women in the study, with a mean age of 31.9+8.4 years. Five factors (social advantage; schooling; employment; economic hardship; and smoking) extracted from a principal component analysis on 23 indicators comprised our model. These variables loaded strongly, with all at 0.8 or higher. Cronbach's alpha and inter-reliability coefficients were 0.748 and 0.796, indicating a strong relationship among the variables within each factor.

Conclusion: These results facilitate understanding of the impact of multiple, distinct social dimensions on overweight and obesity among Kenyan women. The data also provide salient information for reducing rates of overweight and obesity among women during economic transition periods of a low-to-middle-income country.

Keywords: Kenya; Obesity; Women; Factor Analysis; Low to Middle Income Countries

Introduction

Obesity is a major emerging public health problem in low-to-middle-income countries like Kenya, particularly when examined by gender [1]. The higher rate of obesity among women is often linked to the disproportionate representation of women in lower socioeconomic (SES) categories [2]. However, low SES, as traditionally defined using indicators of income, education or occupation, has been consistently associated with higher obesity in wealthier countries [3]. Whether these social and demographic determinants apply to non-wealthy countries is a less examined concept.

The economic transition that Kenya has undergone is characterized by increased urbanization, modified nutritional intake, and subsequent increasing incidence in overweight and obesity, underscoring the importance of gender and ethnicity for reducing disparity. However, assessing the role of SES in overweight and obesity within women is important. Thus, the study of women and socio-demographic determinants is particularly important during this transition period.

In addition, there is little consensus on prevalence of overweight and obesity in African settings. Conceptualizing the inter-relationships of many life variables and overweight and obesity can be challenging. Gender associations with health are often adjusted by socioeconomic indicators to determine the extent to which these variables they "explain" overweight and obesity. However, inadequate or improper specification of predictors can bias estimates toward independent effects related to gender [4]. Since research showing that African countries experience diminishing returns in translating better SES into better health, exploring gender and ethnic differences in relationships between SES and health can provide insight on ethnic disparities. Thus, our strategy was to investigate ethnic and SES differences in the association of women with overweight and obesity.

In summary, we used exploratory factor analysis (EFA) to define a multi-dimensional measure of obesity in a diverse sample of Kenyan women. We then examined the association between these multiple variables and SES, with the hypothesis that they would cluster around specific factors that explain the variation in obesity among the sample of women.

Materials and Methods

Study Population and Design

We used data from the KDHS 2008-2009, a nationally representative study of health behaviors in adults, followed with multiple interview waves of individuals. This national health survey used a multi-stage, stratified, cluster sampling design, supplemental with special samples and collected under protocols approved by the institutional review board (IRB) within the Ministry of Health (MoH). Our analytic sample was drawn from the pool of women who responded to the survey (n=8,444). Women who were ≥ 20 years old and not pregnant were eligible for inclusion. Our cut-off was 20 years due to age-clustering of the KDHS data in 5-year age-groups [1]. Therefore, we could not include adult women who were 18 and 19 years old, as they were grouped with adolescents of 15-17 years. These were all the women who agreed to complete household interview, including the biometric measurements included in the study. Inclusion criteria were limited to ages 20-49 years. Exclusion criteria were age < 20 years, pregnancy, puerperium, and underweight (body mass index (BMI) $< 18.5 \text{ kg/m}^2$).

Definition of Variables

Overweight: overweight was defined using the adult BMI cut-point of 25-29.9 kg/m^2 . These were documented by the interviewers when visiting the household.

Obesity: obesity was defined using the adult BMI cut-point of $\geq 30 \text{ kg/m}^2$.

Wealth Index: the wealth index is a composite measure of a household's cumulative socioeconomic status. KDHS calculates the wealth index using easy-to-collect data on a household's ownership of specific assets such as television sets, bicycles, and access to types of water and sanitation facilities.

Demographics: self-designated ethnicity, religion, and other socio-behavioral variables were used to classify respondents and their partners (where indicated) into specific ethnic categories, smoking categories, employment, and occupational categories. Age (as of last birthday) was self-reported.

A large set of indicators of adult women was selected from the KDHS to represent major domains of socio-economic, socio-cultural, socio-behavioral, and socio-demographic domains. These indicators represented three key domains of material wealth, skills and knowledge, and the status, power, and abilities available in the household. We used EFA to summarize the relationships among these variables into a small set of factors without restrictions in number of factors or variable composition. Patterns that emerged from the analysis were driven by the responses of the women in the KDHS. Our multidimensional measure of overweight and obesity in Kenyan women comprised the set of factors that emerged from our analysis. The full procedure and listing of variables are presented in the "Factor Analysis" section.

Data Analysis

Statistical analyses were carried out using SPSS version 22 (IBM Corp, 2015). Our strategy was to create a model to estimate determinants that explain variations in overweight and obesity in this group of women using EFA and to investigate demographic differences in rates of overweight and obesity.

Correlation Analysis

We ran a correlation matrix and if the 23 variables in the matrix did not correlate with another variable at > 0.3 , then that variable was excluded from further analysis. We also tested for skewness and kurtosis of the variables and used the standard cut-offs of ± 3 for kurtosis and ± 2 for skewness [5].

Outliers

After the initial data cleaning and bridging, we calculated descriptive statistics for the mean score and standard deviation of all the variables. We ran bivariate correlations for all of the items to assure that the items were appropriate for PCA. Each item had to have a correlation of at least 0.30 with at least one other item to make sure it fit in a PCA with the other items.

Factor Analysis

The PCA method was used to find the least number of factors to account for the common variance of a large set of social and demographic variables. Beginning with 1044 indicators in KDHS, we iteratively reduced the variable set to 23 indicators to optimize the analysis. We conducted a bivariate correlation analysis of all independent variables and excluded all those that did not correlate with another independent variable at a minimal level > 0.3 .

We used SPSS to conduct PCA to see if the factors or subscales that emerged with this data set were the same as those identified and validated by other studies [1]. We used PCA to allow for extraction of as many significantly separate factors as possible from the data set generated by the survey respondents. The number of factors with eigenvalues greater than 1.0 were identified for factor retention. Items with factors loadings of more than 0.35 and those that did not load on more than one factor, i.e., that did not cross-load, were retained for analysis. PCA with varimax rotation was used to determine the maximum number and nature of the factors comprising that the modified KDHS survey items defined. Reliability of the final scale was assessed using Cronbach's alpha and the mean inter-item correlation, an indicator of item homogeneity in a scale.

Results

Sample Characteristics

There were 5,169 women who met inclusion criteria and were included in the analysis, with a mean age of 35.20+8.25 years, mean wealth index score of 2.78+/-1.45, and mean BMI of 24.2+/-4.6 kg/m². Most of the women (87%) had a primary education and two-thirds of the women were married and lived in a rural area. According to our analysis, 33.69% of the sample was overweight or obese. Additional descriptive data are outlined in (Table 1).

Variables		N	%
Ethnicity	Embu	103	1.99
	Kalenjin	436	8.44
	Kamba	409	7.92
	Kikuyu	1067	20.65
	Kisii	296	5.73
	Luhya	794	15.37
	Luo	692	13.39
	Masai	49	0.95
	Meru	254	4.92
	Mijikenda/Swahili	406	7.86
	Somali	304	5.88
	Taita/Taveta	91	1.76
	Other	266	5.15
BMI category	Normal (18.5-24.9 kg/m ²)	3409	66.31
	Overweight/obese (>25 kg/m ²)	1732	33.69
Residence	Rural	3340	64.62
	Urban	1829	35.38
Age category (years)	20-29	2301	44.76
	30-49	2840	55.24
Wealth index	Middle	869	16.81
	Poor	723	13.99
	Poorest	804	15.55
	Rich	1039	20.10
	Richest	1734	33.55

Table 1: Descriptive characteristics of the sample of women included in the study (n=5,169)

Multivariate Results

All variables correlated with at least one other variable at >0.3, so none was excluded from further analysis. None of the variables had kurtosis >3.0 and none had skewness >2, so none were excluded from subsequent analyses. The EFA, after iterations, generated a final solution of 5 factors that included 9 of the original 23 variables included in the initial model, which explained 67% of the variation noted in BMI (Table 2).

Factor 1 loaded 7 of the variables, which were primarily socio-economic variables of educational attainment, wealth index, and frequency of watching television, health insurance, and work status. The 2nd factor loaded 2 variables of respondent's occupation and whether the respondent was currently working. The 3rd factor loaded one variable of sex of head of household. The 4th factor loaded 3 socio-cultural and behavioral variables of ethnicity, religion, and use of tobacco. The 5th and final factor loaded one variable, smokes cigarette.

Variable	Component matrix ^{a,b}				
	1	2	3	4	5
Partner's education level	.852	-.175	.093	-.011	-.095
Partner's educational attainment	.847	-.183	.113	-.011	-.109
Highest education level	.797	-.137	-.018	-.011	.008
Wealth index	.707	-.171	.021	.093	.045
Frequency of watching TV	.645	-.187	-.100	.148	.110
Covered by health insurance	.462	-.163	-.110	.294	.015
Respondent's occupation	.258	.918	-.131	.028	.020
Partner's occupation	.211	.880	-.111	.061	.013
Respondent currently working	.400	.791	-.089	.025	.009
Sex of household head	-.063	.130	.800	.193	-.153
Current marital status	.030	.210	.784	.205	-.020
Ethnicity	-.287	-.069	-.134	.698	-.029
Religion	.018	-.136	-.178	.641	.072
Chewing tobacco	-.215	.110	-.140	.474	-.272
Smokes cigarettes	-.033	.022	.158	.116	.929

Extraction method: principal component analysis

^a5 components extracted

^bOnly cases for which currently pregnant = "No" or "unsure" are used in the analysis phase

Table 2: The five factors resulting from exploratory factor analysis iterations, based on how strongly the variables loaded on to each component

Internal Consistency of Factors - Reliability

To determine how well the scale items reliably measured the factors associated with overweight and obesity, we ran a reliability test to get a value for Cronbach's alpha coefficient of each scale. The higher the score, the more reliable the generated scale will be [6]. Many researchers indicate that 0.7 to be an acceptable reliability coefficient but lower thresholds are sometimes used [7]. The actual Cronbach's alpha values for this study are higher (.75 and .78). This indicates that each item is measuring the same construct as the rest of the items in the factor.

Discussion and Conclusion

The factors associated with overweight and obesity cut across the various socio-demographic categories, which is consistent with studies by in Nigeria and other parts of sub-Saharan Africa [8,9]. Our results show that Kenya needs to address the current health problem of overweight and obesity that seem to be outcomes of its rapid economic transformation, including rapid urbanization and economic development. Our results point to a need for more targeted public awareness on obesity prevention and advocacy for improved access to places for physical activity at the local level.

This study was not without limitations. All factor analysis results depend on the set of variables initially included in the original KDHS. However, inclusion of a large set of demographic and geographical indicators covering a breadth of personal domains offered us the opportunity to choose many appropriate variables to include in our analyses. The nationally representative sample provides confidence in our results. Other study strengths include the large sample size, the wide range of data on socio-economic, -cultural, -behavioral, and -demographic indicators; and the ability to make nationally representative estimates. EFA provided a mechanism for clarifying predictors of overweight and obesity in adult women living in Kenya.

Although preliminary, the study's findings suggest that aspects of socio-economic as well as behavioral and cultural factors play a significant role in predicting overweight and obesity in Kenyan women. This study presents a small step toward understanding how the vital mix of human psychology, economics, culture, and ethnicity converge to affect an important health outcome.

Understanding how these factors can be shaped and modified will be a critical aspect of determining how and where to intervene to affect the most change to develop community-level interventions to mitigate the growth of overweight and obesity in Kenya. Conversely, examining the role of these factors in community health outcomes is critical to understanding how inter-personal, household, and environmental factors impact health, well-being, and health outcomes.

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