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Age, Educational Attainment and Household Socio-Economic Status Influence the Risk of Overweight and Obesity Among Women in Uganda

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Abstract: Obesity is a leading non-communicable disease pandemic of the digital revolution period, associated with increased risk of morbidity and mortality from myriad of chronic diseases, high healthcare costs and disproportionately affects more women than men in Uganda. The extent to which age, educational attainment and household socio-economic status influence the risk of overweight and obesity are less investigated in Uganda. This study examined the effect of age, educational attainment and household socio-economic status on overweight and obesity among 5,397 non-pregnant women aged 15-49 years that participated in the 2016 Uganda Demographic and Health Survey. The outcomes (overweight and obesity) were measured using body mass index. Self-reported age, educational attainment and household socio-economic status were the exposure variables of interest. Binary logistic regression models adjusted for confounding variables were employed to determine association between exposure and outcome variables. Results showed that 16.6 and 7.1% of the women were overweight and obese respectively. The largest proportion (23.74%) of women was aged that in the age group of 15-19 years. 56.6% attained primary level education, 24% were living in the richest households. Being in the age group of 45-49 years was associated with increased risk of overweight (OR 2.45; 95% CI, 1.39-4.33) and obesity (OR 10.59; 95% CI, 4.08 -27.52).There was inadequate evidence to demonstrate existence of an association between educational attainment and overweight and obesity. Household socio-economic status was associated with increased risk of overweight (OR 2.22; 95% CI, 1.68-2.93) for women in rich households and (OR 3.07; 95% CI, 2.26-4.18) for women in the richest households compared to those living in poor households. Similarly household socio-economic status was associated with increased risk of obesity (OR 4.96; 95% CI, 2.96-8.31) for women in rich and (OR 14.97; 95% CI, 8.77-25.57) for those in the richest households in comparison with women in poor households respectively. Conclusively, whereas there seems to be no relationship between educational attainment and overweight and obesity, age, and household socio-economic status are positively associated with overweight and obesity among non-pregnant women of reproductive age in Uganda.

Keywords: Overweight, Obesity, Women, Age, Education, Household Socio-Economic Status, Uganda

1. Background

Obesity is the leading non-communicable disease pandemic of the post-industrialization and ongoing digital revolution period. Recent trend analysis (1975-2016) showed an increasing trend in the prevalence of overweight and obesity among adults, adolescents and children across the world [1] with an estimated obesity cases of 670 million adults and 124 million young people aged 5-19 years in 2016 [1]. Despite of these high estimates, critiques still argued that the figures might have been much higher if different diagnostic criteria for overweight and obesity other than body mass index (BMI) were used [2]. This upward trend in the prevalence of obesity among adults is indicative of a progress towards earlier global projection of 1.35 billion cases of obesity by the year 2030 [3]. With rapidly mushrooming and poorly planned urban centers, improving economic prospects and ongoing nutrition transition, sub-Saharan Africa is experiencing an upsurge in the prevalence of overweight and obesity, especially among women of reproductive age [4, 5]. Uganda isn't an exception. Over the last 15 years, the prevalence of overweight/obesity among women aged 15-49 years nearly doubled from 17% in 2006 to 24% in 2016, while among men aged 15-54 years the prevalence of overweight/obesity was relatively low (9%) in 2016 [6]. Obesity is a serious threat to health and longevity because it's associated

with increased risk of several chronic conditions/diseases and all-cause mortality in adults. The diseases or conditions associated with obesity include but not limited to obstetric complications in women [7-9], infertility [10], cancers [11], cardiovascular diseases [12], hypertension [13], type 2 diabetes [14], depression [15], all-cause mortality [16] etc. The economic costs of obesity are equally enormous. Recent estimates showed lifetime cost of €16,229 for girls and an average healthcare cost of €132,977 per individual, hence a threat to survival of affected individuals and families in societies [17].

Several causal pathways have been suggested for overweight and obesity, implicating the interaction of a wide range of component causes from biological to environmental factors in various causal pies. To list but not exhaustive, the following factors were found to be associated with overweight and obesity in adult men and women and in both developed and developing countries; genetics, epigenetics, age, sex, race, marital status, parity, hormonal contraceptives use, educational attainment, occupation, socio-economic status, psychological stress, place of residence, intake of high calorie foods, sedentary lifestyle and culturally driven factors such as women`s body size and shape, gender specific dietary preferences, gender roles in communities and poor urban planning with no or limited facilities for physical activities [18-29]. Although some biological factors associated with overweight and obesity apply to all humans across the globe, the distribution of socio-cultural, economic and environmental factors tend differ within and between countries and so is the burden of overweight and obesity. However most of the above factors have not been investigated in Ugandan context and especially the relationship between age, educational attainment, household socio-economic status and overweight/ obesity.

To begin with, age has been shown to have a positive association with overweight and obesity in adults [30]. Age related gender disparities in the burden of overweight and obesity might be linked to the effect of brown adipose tissue that regulate fat mass and energy homeostasis in mammals [31]. Women in particular were found to have more brown adipose tissue mass than men, and existing evidence also showed an association between body mass index and brown adipose tissue mass with the later shown to moderately decline with age in women and more rapidly with increasing age in men [31]. A Ugandan cross sectional study conducted in surveillance sites found that adults aged 34-44 and 45-54 had twofold and threefold increase in the risk of obesity/overweight compared to those aged 18-24 years respectively, however this study was conducted only in Eastern Uganda and had heterogeneous study population [32]. Likewise in another nationally representative Ugandan cross-sectional study, age difference in the risk of obesity among women was conflated as age categories and reference groups weren't specified [33]. A systematic review of studies conducted among indigenous Australian children also found an increasing prevalence of obesity with age [34], this might imply increasing age in natural aging process probably increase the likelihood of overweight and obesity in humans. Despite of this existing literature on the relationship between age and overweight/obesity, most studies adjusted for age as a confounding variable rather than an explanatory variable [35-37] hence investigating the independent effect of age on overweight and obesity might be relevant for development of targeted overweight and obesity prevention interventions in a life course perspective.

The second exposure variable of interest in this study is formal educational attainment. Education has long been used as a proxy measure for individual socio-economic status in most epidemiological studies, yet on its own, has different implications for health and longevity. It has been associated with both positive and negative health outcomes. Its positive effect on health was linked to the benefits derived from social status, income and health knowledge [38, 39]. Systematic reviews of studies conducted in developing countries found a positive association between educational attainment and obesity [40, 41]. Sex was found to be an effect modifier in many studies conducted in sub-Saharan Africa, however most of these studies did not control for comprehensive list of known confounding variables [41]. On the contrary a Ugandan cross-sectional study found an inverse relationship between educational attainment and obesity/overweight, however this study had a heterogeneous study population as alluded to earlier on hence the findings can't be generalized to all women of reproductive age in Uganda [32]. Similarly a nationally representative cross-sectional Ugandan study based on 2011 UDHS data reported a protective effect of education on overweight/obesity however obesity/overweight were used as one outcome variable, therefore reported results might be having residual confounding since all levels of educational attainment were grouped into one category and compared with a reference group of no education [33], it wasn't therefore clear whether educational attainment had beneficial or deleterious effect on overweight and obesity among women in Uganda.

The third exposure variable of interest in this study is household socio-economic status. In most developing countries socio-economic status was positively associated with overweight and obesity [40]. However majority of the epidemiological studies known to us investigated the effect of individual socio-economic status on overweight and obesity as opposed to household socio-economic status [42-44]. In a study that used the demographic and health survey data from 32 sub-Saharan African countries [5], findings showed that household socio-economic status was a strong positive predictor of overweight and obesity among adult women. A Ugandan cross-sectional study also found a positive association between household socio-economic status and overweight and obesity [33], however this same study had a heterogeneous study population, therefore findings can't be inferred to all women of reproductive age in Uganda. Similar positive association was also found between household socio-economic status and overweight and obesity in a cross-sectional in Kenyan study conducted in urban area and among men and women aged 40-60 years old [45], the gap also lies in heterogeneous study population and in controlling for comprehensive list of confounding variables. Reducing gender disparities [46] in the burden of overweight and obesity in Uganda and across the globe is essential and will contribute to improved maternal and child health, and accelerate the achievement of WHO`s goals of reducing non-communicable disease morbidity and mortality across the globe [47]. This however requires identification of factors predisposing

different groups of people to overweight and obesity. This study examined the effect of age, educational attainment and household socio-economic status on overweight and obesity among women of reproductive in Uganda with the aim of contributing towards overweight and obesity knowledge pool and development of informed obesity prevention and control interventions in Uganda.

2. Methods

2.1. Study Design, Data Collection and Setting

This is a cross-sectional study based on secondary data from the nationally representative Uganda Demographic and Health Survey (UDHS) of 2016. The 2016 UDHS is the 6th in series of the UDHS conducted since 1988/89. The objectives of these serial surveys kept on changing based on subsequent changes in national development indicators, however the goal remained unchanged. The 2016 UDHS was aimed at collecting information on domestic violence, fertility preferences, knowledge and attitudes towards HIV/AIDS, maternal and child health, and maternal and child mortality. The survey respondents were women aged 15-49 years and men aged 15-54 years. A nationally representative sample of 20,910 households from 697 sample clusters nation-wide was selected through two stage stratified cluster sampling method. A total of 18,506 women participated [48]. Data was collected using standard structured questionnaires dispensed through face-to-face interviews by trained survey enumerators. The overall response rate was 97% and rural-urban response rates for women were 95% and 90% respectively. Detailed sample selection, questionnaire design and standardization procedures can be found here http://www.dhsprogram.com.

2.2. Study Population

The analytical sample for this study consisted of 5,415 (weighted 5,397) non-pregnant women aged 15-49 years who participated in the 2016 UDHS and had all information on height and weight measurements, as well as other relevant characteristics. Women who had either height or weight or both measurements missing, flagged or were pregnant at the time of the survey in 2016 were excluded in the data analysis.

2.3. Outcomes

Overweight and obesity were defined as body mass index (BMI) $\geq$ 25 Kg/m^2 and $\geq$ 30Kg/m^2 respectively based on the most recent WHO adult BMI classification [49]. BMI is an index calculated by dividing individual women's weight in kilograms (Kg) by their heights in meters squared. Women's heights and body weights were measured using standard internationally accepted procedures. Height was measured using calibrated stadiometers and recorded to the nearest 0.1cm and weight was measured using calibrated solar powered scales and recorded to the nearest 0.1kg. To minimize measurement errors and maximize accuracy in anthropometry (height and weight measurements), survey enumerators underwent rigorous training [50].

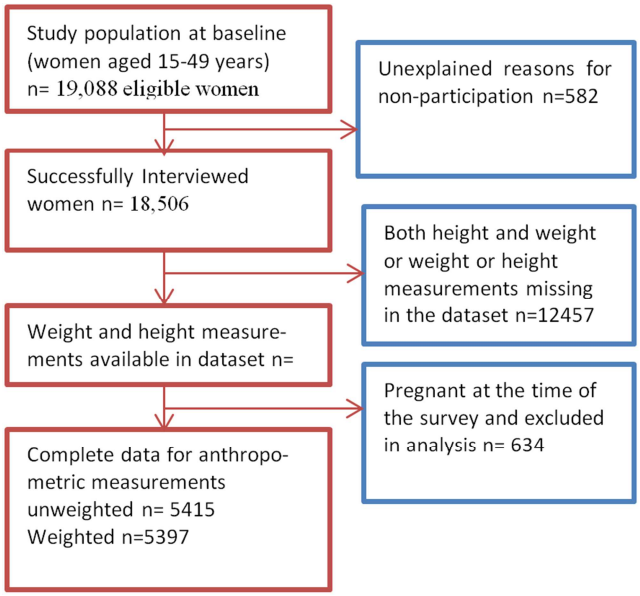

Figure 1. *Flow chart for the selection process of 5415 (weighted 5397) women aged 15-49 years with valid anthropometric measurements in the 2016 Uganda Demographic and Health Survey dataset.*

2.4. Exposure Definition

Self-reported age, formal educational attainment and household wealth index were used in the analysis as exposure variables. By answering the question, "How old were you at your last birthday?" women stated their age in complete years. Women`s age was recorded in absolute numbers, then age categories: 15-19, 20-24, 25-29, 30-34, 35-39, 40-44 and 45-49 years were created. The 15-19 year age-group was used as the reference group in the statistical analysis. By answering two of the following inter-linked questions during the survey, 1) Have you ever attended school? 2) What is the highest level of school you attended? Women stated their formal education attainment as: Never attended school, stopped in primary, secondary (either ordinary level or A' level) and tertiary level education (ranged from professional certificates to PhD). Comparisons of the risk of overweight and obesity were then made between women that attained some level of formal education to those that had no formal education. Household wealth index is a composite variable that measures household socio-economic status. Survey respondents were asked to list their household characteristics and assets that included but not limited to sources of water, sanitary facilities, types of buildings and their construction materials and possession of assets such as vehicles, TVs, bicycles, radios, etc. Then a statistical method of principle component analysis was used to calculate household wealth index variable that was divided into five categories, which grouped women into the top 20% richest to bottom 20% poorest households. For meaningful statistical analysis we combined two categories of the household wealth index; the poor and poorest households into one group, recorded it as poor households and used it as the reference group in comparison of the risk of overweight and obesity.

2.5. Covariates

Socio-demographic characteristics were included in the analysis as potential confounders based on theoretical causal model for health inequalities and empirical evidence on risk factors for overweight and obesity in developing and developed countries [41, 51, 52]. These included current marital status, parity, current breastfeeding status, contraceptive use, occupation, type of place of residence and ethnicity. Information on these potential confounders was collected using the standard 2016 UDHS questionnaires. Current marital status was categorized into married, living with a male partner, divorced, separated, widow, and never married/lived with a male partner. We merged separated and divorced marital status categories into one and labeled it "separated". Never married/lived with a male partner was used as the reference group. Parity, which refers to the number of live births by individual women at the time of the survey, was recorded in absolute values. Then three categories for the variable parity were created; never given birth, delivered 1-4 live babies, and ≥ 5 live babies. Never given birth was used as the reference group. Current breastfeeding status was recorded as a binary variable, 1 if the woman was breastfeeding at the time of the survey, 0 otherwise. Contraceptive use was grouped according to mode of action of the contraceptives: None users, Folk methods, sterilization, barrier, and hormonal methods with non-contraceptive users recorded as 0 and used as the reference. Women's occupations were listed according to international occupational groups [53] Due to small number of women in some occupation categories; we merged occupations with similar tasks together creating fewer categories than recorded in the original dataset. The final variable for occupation was divided into professional/technical/managerial, clerical, sales, agriculture, household/domestic worker, services. Professional/technical/managerial occupation category was used as the reference. Type of place of residence was recorded as a binary variable: 1 if the woman resided in urban area and 0 if she lived in rural area. Lastly ethnicity was re-categorized into three: Nilotic, Bantu and others with nilotes coded 0 and used as the reference.

3. Statistical Analysis

Standard complex survey data analysis procedures were applied to account for stratification and clustering introduced by the survey design. All reported results were weighted unless specified. Bivariate analysis was performed and chi-square test used to determine differences in distribution of categorical exposure variables and covariates with respect to the outcomes. Binary logistic regression models were fitted to examine the association between each of the three exposure variables (age, educational attainment, and household wealth index), and the outcomes (overweight and obesity). First we fitted the unadjusted binary logistic regression models, and then adjusted for each potential confounder that showed statistically significant relationship with the outcomes at bivariate analysis level. Other variables that showed statistically non-significant relationship with outcomes at bivariate analysis were later included to assess their contribution to the models and were retained if they had substantial contribution. Women with missing values for exposure, covariates and outcome variables were excluded from the analysis.

4. Ethical Consideration

Standard ethical procedures were followed during and after the survey data collection exercise. Before individual interviews and anthropometric measurements were done, participants granted written informed consent. Survey procedures and questionnaires were reviewed and ethical approval was by ICF International (Calverton, MD, USA) ICF International Institutional Review Board (IRB). Use of the data for purpose this study was approved by the Demographic and Health Survey Data Archivist, authorization letter 117078.

5. Results

Table 1 shows the socio-demographic characteristics of women by body mass index cut-off points for underweight, normal weight, overweight and obesity. Majority of the women were residing in rural areas (73.6%) and the largest proportion were aged 15-19 years (23.74%). More than half attained primary level education (56.6%), and 36.7% were working in the agricultural sector. There were more married women (29%) among the study participants, close to half (44.1%) had given birth to at least 1 to 4 live children in their life-time. Most (80%) were not breastfeeding, and 65% were not using contraceptives. There was relatively similar distribution of women by household wealth index categories. Women that lived in the richest households were slightly more (24%). 16.6 and 7.1% of the women were overweight and obese respectively.

Table 2, shows the crude and adjusted odds ratios for overweight and obesity by women`s age groups. In the final adjusted Model 2 γ, compared to women aged 15-19 years, those aged 40-44 and 45-49 years had increased risk of overweight, OR: 2.69 (1.60-4.51) and OR: 2.45 (1.39-4.33) respectively. Similarly in comparison to women aged 15-19 years, those aged 35-39, 40-44, and 45-49 years, had corresponding higher risk of obesity OR; 9.80 (4.20-22.86), OR; 09.48 (3.89-23.13) and OR; 10.59 (4.08-27.54) respectively.

Table 3 shows the crude and adjusted odds ratios and their corresponding 95% confidence intervals for overweight and obesity among women by educational attainment. In the final Model 3 Ж, compared to women with no formal education, those with primary, secondary and tertiary level education had decreased risk of overweight OR: 0.89 (0.66-1.21), OR: 0.95 (0.65-1.37) and OR: 0.93 (0.60-1.44) respectively. Similar odds ratio patterns were observed for obesity across levels of educational attainment in comparison to women with no formal education with exception of tertiary level education that showed no risk difference. Primary, OR: 0.86 (0.50-1.48), secondary, OR: 0.89 (0.46-1.70), and tertiary level education, OR: 1.00 (0.45 - 2.23). On the same Table 3, presented were the results of the final adjusted Models 2 ¥, showing the effect of household wealth index on overweight and obesity. Compared with women living in poor households, those in middle, rich, and the richest households had higher risk of overweight; OR: 1.92 (1.48 -2.48), OR: 2.22 (1.68-2.93), and OR: 3.07 (2.26-4.18) respectively. Similarly there was

increased risk of obesity among women that lived in the middle, rich and richest households; OR: 2.75 (1.44 - 5.23), OR: 4.96 (2.96-8.31), and OR: 14.97 (8.77-25.57) respectively

Table 1 *Socio-demographic characteristics of 5,397 women by body mass index.*

		Body Mass Index*			
Characteristics (% weighted) Ÿ	**Total Sample n = 5,397**	**Underweight (BMI <18.5 Kg/m^2) (n=463)**	**Normal (BMI ≥18.5 to < 25 Kg/m^2) (n=3,655)**	**Overweight (BMI ≥25 & < 30 Kg/m^2) (n=896)**	**Obese (BMI >30Kg/m^2) (n=383)**
Respondents Age (Years)					
15-19	1281 (23.74)	163 (35.10)	978 (26.80)	127 (14.20)	013 (03.40)
20-24	1011 (18.73)	078 (16.90)	744 (20.40)	153 (17.10)	035 (09.10)
25-29	0897 (16.62)	055 (11.80)	607 (16.60)	168 (18.70)	067 (17.50)
30-34	0706 (13.08)	044 (09.50)	449 (12.30)	137 (15.30)	076 (19.80)
35-39	0597 (11.06)	047 (10.00)	356 (09.70)	115 (12.70)	080 (20.70)
40-44	0529 (09.80)	046 (09.90)	301 (08.20)	119 (13.30)	064 (16.60)
45-49	0376 (06.97)	030 (06.50)	219 (06.00)	077 (08.60)	049 (12.80)
Educational attainment					
No education	0534 (9.90)	064 (13.90)	353 (09.70)	084 (09.40)	032 (08.40)
Primary	3054 (56.60)	297 (64.10)	2156 (59.00)	441 (49.20)	160 (41.80)
Secondary	1404 (26.00)	087 (18.80)	924 (25.30)	271 (30.30)	122 (31.70)
Tertiary	0405 (07.50)	015 (03.20)	221 (06.10)	100 (11.10)	069 (18.10)
Occupational					
Professional	0411 (07.60)	013 (02.80)	220 (06.00)	106 (11.80)	072 (18.80)
Clerical	0034 (00.60)	002 (00.40)	014 (00.40)	008 (00.90)	011 (02.90)
Sales	0467 (08.70)	032 (06.90)	256 (07.00)	118 (13.10)	061 (15.90)
Agriculture	1976 (36.70)	171 (37.00)	1479 (40.50)	252 (28.10)	075 (19.50)
Household/domestic work	0157 (02.90)	009 (01.90)	110 (03.00)	033 (03.70)	005 (01.30)
Services	0267 (04.90)	018 (03.80)	156 (04.30)	060 (06.70)	033 (08.50)
Skilled manual	0660 (12.20)	074 (16.00)	429 (11.70)	110 (12.30)	047 (12.30)
Unskilled manual	0194 (03.60)	018 (03.90)	117 (03.20)	037 (04.10)	022 (05.70)
Not working	1223 (22.70)	126 (27.40)	866 (23.80)	172 (19.20)	058 (15.20)
Marital Status					
Never in Union	1491 (27.60)	165 (35.70)	1095 (30.00)	189 (21.10)	042 (10.90)
Married	1629 (29.00)	134 (28.80)	1051 (32.80)	294 (32.80)	150 (39.20)
Living with partner	1507 (27.90)	098 (21.10)	0998 (27.30)	273 (30.50)	138 (36.00)
Widowed	163 (03.00)	017 (03.70)	0104 (02.80)	029 (03.30)	013 (03.30)
Separated	607 (11.30)	049 (10.60)	0407 (11.10)	111 (12.40)	041 (10.60)
Parity					
Never delivered	1413 (26.20)	161 (34.70)	1042 (28.50)	177 (19.80)	033 (08.60)
≤ 4 deliveries	2381 (44.10)	161 (34.80)	1592 (43.50)	431 (48.10)	197 (51.30)
≥ 5 deliveries	1604 (29.70)	141 (30.40)	1022 (27.90)	288 (32.10)	154 (40.00)
Currently Breastfeeding					
No	3891 (71.90)	333 (70.40)	2573 (75.50)	676 (80.60)	309 (72.10)
Yes	1506 (27.90)	130 (28.10)	1082 (29.50)	220 (24.50)	074 (19.40)
Contraceptive Use					
Does Not use	3522 (65.20)	351 (75.90)	2467 (67.50)	518 (57.80)	186 (48.50)
Hormonal	1315 (24.40)	079 (17.00)	0832 (22.80)	272 (30.40)	132 (34.50)
Barrier	0208 (03.90)	015 (03.30)	0142 (03.90)	040 (04.40)	011 (02.90)
Sterilization	0110 (02.00)	002 (00.50)	0064 (01.80)	020 (02.30)	023 (05.90)
Folkloric	0242 (04.50)	015 (03.30)	0150 (04.10)	045 (05.10)	031 (08.10)
Type of place of resident					
Rural	3971 (73.60)	366 (79.10)	2815 (77.00)	584 (65.20)	205 (53.50)
Urban	1427 (26.40)	97 (20.90)	0840 (23.00)	311 (34.80)	178 (26.40)
Wealth Index					
Richest	1298 (24.10)	054 (11.70)	750 (20.50)	308 (34.40)	186 (48.60)
Richer	1142 (21.20)	077 (17.00)	749 (20.50)	209 (23.40)	107 (27.90)
Middle	1076 (19.90)	083 (17.90)	748 (20.50)	190 (21.30)	055 (14.30)
Poorer	0933 (17.30)	088 (19.00)	711 (19.40)	109 (12.20)	025 (06.40)
Poorest	0948 (17.60)	161 (34.80)	697 (19.10)	079 (08.80)	011 (02.80)
Body mass index (kg/m2)					
Less than 18.5	0463 (08.60)	NA	NA	NA	NA
≥18.5 to < 25	3655 (67.70)	NA	NA	NA	NA
≥25 to < 30	0896 (16.60)	NA	NA	NA	NA
≥ 30	0384 (07.10)	NA	NA	NA	NA

*P-values for trend across four categories of educational attainment for all covariates ($p < 0.001$)

Ÿ percentages weighted for sampling method used in 2016 UDHS**.**

NA, not available

Table 2. *Crude and adjusted Odds Ratios (OR) and 95% Confidence Intervals (CI) for Overweight and Obesity by Age groups in 5397 Women Aged 15-49 years.*

Women's Age Groups	Overweight Women (n=5397) OR (95% CI)	Obesity Women (n= 5397) OR (95% CI)
Crude		
15-19	1.00	1.00
20-24	1.62 (1.21 - 2.16)	03.51 (1.67 -07.37)
25-29	2.08 (1.54- 2.81)	07.93 (4.11 -15.30)
30-34	2.18 (1.59 - 2.97)	11.77 (6.15-22.53)
35-39	2.15 (1.57 - 2.95)	15.02 (7.94 -28.42)
40-44	2.62 (1.89 -3.64)	13.39 (6.85-26.19)
45-49	2.35 (1.63 -3.39)	14.70 (7.31 -29.58)
Model 1 δ		
15-19	1.00	1.00
20-24	1.69 (1.20 - 2.38)	03.84 (1.87-07.90)
25-29	2.19 (1.52 - 3.17)	08.86 (4.45-17.62)
30-34	2.32 (1.59 - 3.39)	13.80 (6.94-27.44)
35-39	2.37 (1.62 - 3.48)	18.05 (8.95-36.41)
40-44	3.02 (2.02 - 4.51)	16.16 (7.86-33.20)
45-49	2.85 (1.84 - 4.41)	19.56 (8.90-42.99)
Model 2 γ		
15-19	1.00	1.00
20-24	1.38 (0.96-1.98)	02.13 (0.97-04.71)
25-29	1.70 (1.12-2.56)	04.08 (1.99-08.35)
30-34	1.84 (1.17-2.89)	06.62 (2.86 -15.25)
35-39	1.99 (1.24-3.22)	09.80 (4.20 -22.86)
40-44	2.69 (1.60-4.51)	09.48 (3.89-23.13)
45-49	2.45 (1.39-4.33)	10.59 (4.08-27.52)

δ Model 1 adjusted for current marital status and contraceptive use only
γ Model 2 additionally for current breastfeeding status, parity, educational attainment, occupation, wealth index, ethnicity, type of place of residence.

Table 3. *Crude and adjusted Odds Ratios (OR) and 95% Confidence Intervals (CI) for Overweight and Obesity by Educational Attainment and Household Wealth Index in 5397Women Aged 15-49 years.*

Educational attainment	Overweight Women (n=5397) OR (95% CI)	Obesity Women (n= 5397) OR (95% CI)	Household Wealth Index	Overweight Women (n=5397) OR (95% CI)	Obesity Women (n= 5397) OR (95% CI)
Crude			Crude		
No education	1.00	1.00	Poor	1.00	1.00
Primary	0.90 (0.68 -1.20)	0.86 (0.52 -1.42)	Middle	2.02 (1.56-3.16)	03.07 (1.61 – 5.84)
Secondary	1.28 (0.92 -1.78)	1.47 (0.85 -2.52)	Rich	2.42 (1.85-3.16)	05.54 (3.35 – 9.16)
Tertiary	1.74 (1.20 – 2.52)	3.20 (1.74 -5.90)	Richest	3.41 (2.74 - 4.25)	14.52 (8.93-23.63)
Model 1†			Model 1§		
No education	1.00	1.00	Poor	1.00	1.00
Primary	1.13 (0.85 - 1.51)	1.39 (0.82 - 02.36)	Middle	1.97 (1.53-2.55)	02.89 (1.49 – 5.58)
Secondary	1.81 (1.30 - 2.54)	3.41 (1.84 - 06.28)	Rich	2.42 (1.85-3.16)	05.61 (3.37 – 9.32)
Tertiary	2.10 (1.45 – 3.05)	5.69 (2.90 - 11.18)	Richest	3.53 (2.83-4.39)	17.58 (10.67-28.96)
Model 2 ‡			Model 2 ¥		
No education	1.00	1.00	Poor	1:00	1:00
Primary	1.03 (0.76 - 1.39)	1.16 (0.69 - 1.97)	Middle	1.92 (1.48 -2.48)	02.75 (1.44 - 5.23)
Secondary	1.33 (0.91 – 1.94)	1.84 (0.97 - 3.48)	Rich	2.22 (1.68-2.93)	04.96 (2.96 - 8.31)
Tertiary	1.40 (0.90- 2.16)	2.39 (1.10 - 5.31)	Richest	3.07 (2.26-4.18)	14.97 (8.77 - 25.57)
Model 3 Ӿ					
No education	1.00	1.00			
Primary	0.89 (0.66-1.21)	0.86 (0.50 - 1.48)			
Secondary	0.95 (0.65-1.37)	0.89 (0.46 - 1.70)			
Tertiary	0.93 (0.60-1.44)	1.00 (0.45 - 2.23)			

† Model 1 adjusted for age only
‡ Model2 additionally adjusted for current breastfeeding status, current marital status, contraceptive use, parity, occupation, ethnicity, type of place of residence.
Ӿ Model 3 additionally adjusted for wealth index.
§Model 1adjusted for age only.
¥ Model 2 additionally adjusted for current marital status, current breastfeeding status, contraceptive use, parity, educational attainment, occupation, ethnicity and type of place of residence (urban-rural).

6. Discussion

This study examined the effect of age, educational attainment and household socio-economic status on the risk of overweight and obesity in non-institutionalized women of reproductive age in Uganda. The findings provide evidence of a positive association between age and each of the two outcomes (overweight and obesity). An increasing trend in the

risk of overweight and obesity by age groups was also evident. Compared to women in the youngest age group of 15-19 years, those in the age groups of 40-44 and 45-49 years had 169% and 145% increase in the risk of overweight. Likewise women in the age groups ranging from 20-24 to 45-49 were found to have higher risk of obesity compared to their counterparts in the youngest age group of 15-49 years. Notably those in the age groups of 30-34, 35-39, 40-44 and 45-49 had fivefold, eightfold, eightfold and nine-fold increase in the risk of obesity. This positive association between age and overweight/obesity might be explained by the underlying biological, socio-cultural, and environmental factors operating at individual, family and societal level. Biologically there is often increase in adiposity and progressive loss of muscle mass from the age ≥ 30 years in both women and men [54]. Other existing evidence also linked brown adipose tissue that regulates fat mass and energy homeostasis in mammals to obesity. Brown adipose tissue mass tends to decline slowly with age in women than in men [31], this might provide an explanation of the observed association between women's age and overweight/obesity. In socio-cultural perspective, middle aged African women and especially those living in urban areas tend to lead sedentary lifestyle than their younger counterparts who are often more involved in physical activities such as sports, and leisure activities e.g. social dancing [28, 55]. Similarly, in Ugandan context, increased adiposity in men and women is often interpreted as a sign of financial success, making overweight or obese women and men enjoy peer and community member`s respect. In addition the latest trend in dressing fashion that facilitates visibility of women`s anatomical structures often aimed at aesthetic impression of the opposite sex might be unknowingly/knowingly pushing women to having more meals or increased food ration sizes in the quest to develop the desired body size assumed to be attractive to men. On the same note, Ugandan women tend to have preference for high calorie foods such as fried chicken and chips, pork, sweetened beverages e.g. coca cola products, etc. hence the unhealthy diet especially among urban women might also provide an explanation for the observed positive association between age and overweight/obesity since the ability to afford these junk foods is dependent on financial capacity of women that tend to improve with increasing age in Uganda. This finding is consistent with that of a Ugandan cross-sectional study that found an increasing trend in the risk of overweight/obesity by age [33], precisely a two-fold and three-fold increase in the risk of obesity/overweight among women aged 34-44 and 45-54 years compared to those aged 18-24 years respectively. The only inconsistency being between this study and the above previous study was the use of overweight and obesity in the previous study as a composite outcome variable. Another previous study conducted among women elsewhere had similar findings to the results of this study; however it used age as a continuous variable [30]. The only study that showed conflicting results to this one was a Chinese cohort study that found no association between age at menarche and obesity in women [56].

As shown in Model 2 ‡, Table 3, after taking into account confounding by factors other than household wealth index, there was an increased risk of overweight among women with primary, secondary and tertiary level educational attainment in comparison with those that had no formal education. Similar results were also found for the risk of obesity among women across educational attainment levels but an association was only found between tertiary level educational attainment and obesity. However when household wealth index was adjusted (Table3 Model 3 ⁂) a decreased risk of overweight among women across all levels of educational attainment compared to those with no formal education was found. Likewise when adjusted for household wealth index and other confounders in the final model, the deleterious effect of educational attainment on obesity turned into beneficial one with 14 and 11% decrease in the risk of obesity among women with primary and secondary level educational attainment respectively. Despite of this risk reduction, in the above levels of educational attainment, no obesity risk difference was found when women with tertiary level education were compared to those with no formal education. This bi-direction in the effect of educational attainment on overweight/obesity with and without adjusting for household wealth index might be due to of confounding or modification of the effect of educational attainment by either household wealth index or level of Uganda`s economic development since previous studies found positive association between educational attainment and obesity in developing countries and an inverse association in developed countries [41]. However in some middle income countries such as Mexico, household socio-economic status influence social patterning of obesity by educational attainment [42] In Ugandan context we might further speculate that educated women in rich households have more health knowledge on the deleterious effects of overweight and obesity, therefore they may be more involved in changing lifestyles and diet than their uneducated counterparts. The effect of educational attainment on overweight and obesity might have also been modified by diet and physical activity pattern among women [57]. However despite of the bi-directional change in the risk of overweight and obesity by educational attainment there was insufficient evidence to conclude absence of an association between educational attainment and either overweight or obesity. This finding tends to agree with Mirowsky and Ross's hypothesis that the effect of education on health is high in the event of scarcity of other socio-economic resources [58] and might also mean the country is shifting from positive association between educational attainment and overweight and obesity to an inverse one observed in developed countries [41]. Similarly our finding also partially agree with that of a cross-sectional Ugandan study that found a beneficial effect of educational attainment on overweight and obesity [32], the difference with our study might be in finding no evidence of association between educational attainment and overweight and obesity. Lastly the ongoing nutrition transition and economic development in Uganda might have modified the effects of educational attainment on overweight and obesity [41, 42].

Another relationship examined in this study was that of household socio-economic status and the two outcomes; overweight and obesity. Comparing women in the middle, rich and richest households to those in poor households, a positive

association between household socio-economic status and both overweight and obesity was found. An increasing trend in the risk of overweight and obesity by household socio-economic status was equally overt. The highest risk of obesity was found among women living in the richest households, who had 13 times the risk of obesity in comparison with women living in poor households. This finding might imply that women in the richest households were the most at risk group. However the higher odds ratio interpreted as risk ratio might also reflect lack of adjustment for some known confounding variables. On the other hand these findings might reflect the reality that most women living in affluent households in Uganda tend to lead sedentary lifestyle, often driven or use public transport systems most of the time, eat more animal protein and refined foods, in current shift of dietary patterns to meet western or so called civilized lifestyle and social class difference in Ugandan context. It should also be noted that in Uganda, household socio-economic status does not depend on educational attainment of household members. This therefore means a considerable proportion of women living in rich households might be lacking health knowledge acquired through formal education or reading health information relevant for lifestyle and dietary changes, the vehicles to weight gain control and prevention. Other cultural factors such as preference of big body size in Ugandan context as alluded to earlier on might partially explain the association between household socio-economic status and overweight and obesity. This finding is in agreement with results of a pooled analysis of demographic and health survey data from 32 sub-Saharan African countries that showed strong relationship between household socio-economic status and overweight and obesity among women of reproductive age [5] and so was the case with a Ugandan cross-sectional study that was based on 2011 UDHS [32]. Other studies that focused on analysis of country specific gross domestic product (GDP) also found that as a country`s GDP increases and so will the body mass index of their population [59, 60]. This implies the richer a country becomes the higher the burden of overweight and obesity in developing country context.

7. Conclusion

The findings of this study suggest social patterning in the risk of overweight and obesity among non-pregnant women of reproductive age in Uganda. It points to the importance of considering non-pregnant women of reproductive age above 30 years and women living in affluent families as potential target group for public health policy and interventions. Further investigations might be needed to examine possible effect modification of educational attainment on overweight and obesity by household socio-economic status and the country`s level of economic development.

Strengths and Limitations

This study was based on non-institutionalized non-pregnant women with nationwide coverage. The findings can therefore be generalized to all women aged 15-49 years in Uganda. Based on self-reported age, educational attainment and household socio-economic status, misclassification of the exposures with respect to the primary and secondary outcome cannot be rule out. Women`s questionnaire for the 2016 UDHS did not measure certain characteristics related to nutrition and physical activity. Although this means known confounders like level of physical activity and dietary diversity score weren't adjusted for in the modeling process, women's occupation and type of place of residence might intrinsically include women's level of physical activity in Ugandan context. For example, a considerably large proportion of Ugandan women whose occupation is predominantly peasantry agriculture and live in rural areas might be more involved in rigorous physical activities such as 4-6 hours of cultivation using non-motorized agricultural tools, and also walking over an hour or more to fetch water for domestic use. These activities might be equivalent to the WHO recommended 150 minutes of moderate to vigorous intensity physical activity per week for adults aged 18-64 years [61]

Conflict of Interest

The author has no conflict of interest to declare.

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