Overweight and Obesity among Adults in Same District, Tanzania

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Abstract

Overweight and obesity are malnutrition which needs great attention due to their health consequences. A cross-sectional study was conducted on 362 adults aged 25-55 years in 2012 to examine the prevalence of overweight, obesity and risk factors through; assessing nutritional status, dietary intake and physical activities in lowland and highland areas of Same District, Kilimanjaro Region. Demographic, dietary intake and physical activity were obtained using a structured questionnaire. Weight, height, waist and hip circumferences were determined using standard WHO procedures. Data were analyzed using Statistical Product and Service Solutions version 16, excels and NutriSurvey 2007 program. The prevalence of overweight was 23% and obesity 17%. Women were more than 4 times likely to be overweight and obese compared to men (OR 5.53, 95% CI: 3.11 – 9.82). Lowland had high prevalence of overweight and obesity compared to highland areas (OR 2.034, 95% CI: 1.138-2.952). About 33% of lowland subjects had excess energy intake compared to 23% of highland (p=0.050). Positive energy balance was significantly associated with overweight and obesity (OR 1.12, 95% CI: 0.66 – 1.91). The mean Physical Activity Level for highland was 2.2 compared to 1.87 of lowland areas (p<0.05). Overweight and obesity was significantly related to income, sex, residence, education, farming technology, carrying produce, occupation, employment, energy balance and age (P<0.005). The high prevalence of overweight and obesity especially in lowland may be due to physical activities and energy intake which are controllable. These findings will assist health stakeholders to allow design of appropriate interventions to reduce the problems.

Key words: Overweight, Obesity, Adults, Lowland, Highland, Tanzania

Introduction

Overweight and obesity are conditions of abnormal or excessive fat accumulation in the body to the extent that health may be impaired. These conditions are defined by a body mass index (BMI) based on a person's body weight in kilograms, divided by height in meter squared (BMI = Weight in kg / Height in m^2) (WHO, 2005). The prevalence of overweight and obesity in the world was 39 and 37% respectively. This increases across countries from 0.2 to 4.3 percent between 2010 and 2014 (IFPRI, 2014) revealing that they are increasing at an alarming rate. Also about 1.9 billion adults are overweight or obese (WHO 2015) in the world. In Sub-Saharan Africa, the rates of overweight and obesity are increasing especially among women and people dwelling in urban populations (Kimani-Murage *et al.*, 2011). According to NBS and ICF Macro (2005, 2010), the prevalence of overweight and obesity among women in Tanzania was 18 and 22% respectively. The factors contributing to the accelerating pace of chronic diseases include unhealthy diets and reduced physical activity which are occurring concurrently with the general trends of economic growth, urbanization, modernization and globalization of food markets. This has contributed to changes in eating habits and lifestyle patterns of people

in different areas of the world (WHO, 2005). Same district is divided into low land which is basically peri urban characterized by drought conditions and the high land area mainly rural characterized by green vegetation and adequate rainfall. In this case it is presumed that nutritional status of the subjects from these two areas may be different due to the types of livelihood systems existing. In addition, the types of activities, foods consumed and economic status may be different as well. The study was done to compare the prevalence of overweight, obesity and their risk factors among adults residing in lowland and highland areas of Same District in Kilimanjaro, Tanzania.

Material and Methods

A cross-sectional survey was conducted on 362 adults aged 25-55years and purposive sampling was used to select four wards from highland area (Lugulu, Mtii, Bombo, Vuje) and three wards from lowland area (Kisima, Maore, Ndungu). Four villages from highland area and three streets from lowland area were randomly selected from each ward by using a table of random numbers. Proportionate sampling was used to select subjects from each village and street. In this method the number of subjects to be included from each village was selected according to the respective population size. Weight was measured by using a digital weighing scale (SECA-Germany) where subjects wore only lightweight clothes and no shoes. The measurements were recorded to the nearest 0.1kg. Height was measured by using a harpenden stadiometer (Holtain ltd-UK) which was placed against a wall firmly and subjects were measured without shoes and recorded to the nearest 0.1cm. BMI of the subject was derived by dividing Weight (kg) and Height (m^2) of the subjects and used for classifying subjects to various categories. A subject with BMI<18.5 kg/m^2 was classified as underweight, 18.5-24.9 kg/m^2 as normal, 25-29.9 kg/m^2 overweight and >=30 kg/m^2 obese (WHO, 2005). Waist and hip circumference were measured using a plastic non elastic tape measure and individuals were classified as increased risk with waist of >=94cm for men and >=80cm for women and for waist-hip ratio of >0.90 for males and >0.85 for females (WHO, 2000). Dietary intake was assessed by using Food Frequency Questionnaire (FFQ) which included list of foods associated with risks of obesity and overweight. The subjects were asked on the type, amount and frequency of consumption in a daily, weekly and monthly basis (Kristin and Gale, 2002). A structured questionnaire was constructed and administered through face to face interview to obtain information about demographic characteristics and physical activity level. Basal metabolic rate (BMR) was obtained from the Nutri-Survey (2007) program after entering the values for age, weight, height and sex of the subjects. This was used to calculate energy expenditure as TDEE = BMR x PAL. The PAL was obtained from a 7 days physical activity recall questionnaire where activities were categorized as moderate, sedentary and extraneous (heavy) and the time for each activity were recorded and the average PAL for 24hrs was calculated (FAO/WHO/UNU, 1985). Data collected were edited and analyzed using Statistical Product and Service Solutions (SPSS) version 16. Descriptive statistics such as frequency, means and percentages were obtained. The student t-test was used to compare means of height, weight and BMI between sex and between geographical locations. The BMI was dichotomized and univariate analysis was done to identify variables associated with overweight/obesity whereby Crude odds ratio (OR) and odds ratio (OR) adjusted for age, sex, occupation, use of transports for carrying farm produce, use of farm technology, employment, education and income levels were calculated. Independent association of selected variables with overweight/obesity was done by multivariate analysis whereby all variables shown significant associations with BMI ($P < 0.05$) in the univariate analysis were entered in the model. Information on dietary intake was analyzed by using NutriSurvey (2007) program in which daily energy intake and basal metabolic rates were obtained and disaggregated according to age and sex.

Results

Demographic characteristics

About 67% of the subjects were females and 74% were from the lowland areas. The median

age for the sampled subjects was 43 years. About 41% from the lowland and 50% from highland area were in the age category of 45-55 years. More than 95% of the subjects from the lowland and highland areas had attended school (Table 1). Most of the low income subjects were residing in the highland (66%) compared to lowland areas (58%) (Table1). The non-formal sector employed majority of the subjects in both areas and the main occupation was agriculture, which employed 76% of the subjects in the lowland area and 82% in highland area (Table 1).

Nutritional Status

Nutrition status was determined by using respondent's physical characteristics (height and weight) and body mass index (BMI) and waist and hip circumferences.

Weight and height of respondents

Mean weight and height of the subjects were

Table 1: Demographic characteristics

Characteristics assessed	Lowland		Highland	
Sex	**n**	**Percent**	**n**	**Percent**
Males	61	26.5	55	41.7
Females	169	73.5	77	58.3
Total	**230**	**100.0**	**132**	**100.0**
Age distribution				
25-34 years	72	31.3	32	24.2
35-44 Years	63	27.4	34	25.8
45-55 years	95	41.3	66	50.0
Total	**230**	**100**	**132**	**100.0**
Education level				
Never been to school	13	5.7	5	3.8
Ever been to school	217	94.3	127	96.2
Total	**230**	**100.0**	**132**	**100.0**
Employment status				
Formal Employed	25	10.9	14	10.6
Non formal employed	205	89.1	118	89.4
Total	**230**	**100.0**	**132**	**100.0**
Main occupations				
Farmers	174	75.7	108	81.8
Business people	25	10.9	4	3.0
Carpenters	1	0.4	2	1.5
Nurses/Doctors/teachers/Secretary /Students	26	11.0	10	7.7
Agricultural/Vertenary officers/village leaders	4	2.0	8	6.0
Total	**230**	**100**	**132**	**100**
Income level in Tsh per Month				
High income>500,000	1	0.4	2	1.5
Middle income 100,000-<500,000	96	41.7	43	32.6
Low income <100,000	133	57.9	87	65.9
Total	**230**	**100**	**132**	**100.0**

60.4kg (95% CI: 59-62) and 156cm (95% CI: 155-158) respectively. Subjects residing in lowland area had a significant higher mean weight of 62.5kg (95% CI: 61-64) compared to the subjects residing in highland areas with 56.5kg (95% CI: 54-57) but weight was not different from the two locations with 157cm (95% CI: 156-158) and 157cm (95% CI: 155-158) respectively. Nevertheless, females had significant mean weight compared to males (p=0.049) (Table 2).

Table 2: Weight and height of the subjects

Variables	n	Mean height (cm)	Mean weight (kg)	p-value for (weight)
Overall	362	156	60.4	
Sex				
Males	118	162	58.0	0.049
Females	244	154	61.0	
Place of residence				
Lowland	230	157	62.5	0.000
Highland	132	157	56.5	

*Lowland is an area where the land is at, or near or below the sea level where there are no mountains or large hills and Highland is an area above the sea level with mountains or large hills. *Mean difference are significant P<=0.05 (95%) level

Twenty four percent (95% CI: 20.6%, 25.4%) and 17.4% (95% CI: 14.95%, 19.05%) of the subjects were overweight and obese respectively (Fig. 1), with the overall mean BMI of 24.6kg / m^2 (95% CI: 24-25).

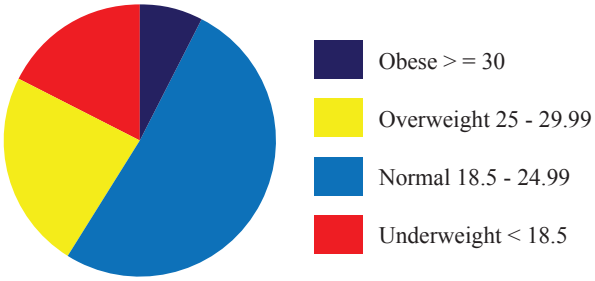

Figure 1: Nutritional status of the subjects

Nutritional status according to residence of the subjects

More subjects residing in the lowland areas were overweight (24%) and obese (23%) compared to those residing in the highland areas 22 and 7% respectively (Fig. 2) and their mean BMI was significantly different (p=0.000) (Table 3). In this case, lowland subjects were 2.04 times at increased risk of overweight and obesity compared to highland subjects even after adjusting for other factors (Crude OR 2.04, 95% CI: 1.30 – 3.18 and adjusted OR 2.05 95% CI: 1.30-3.11) (Table 8).

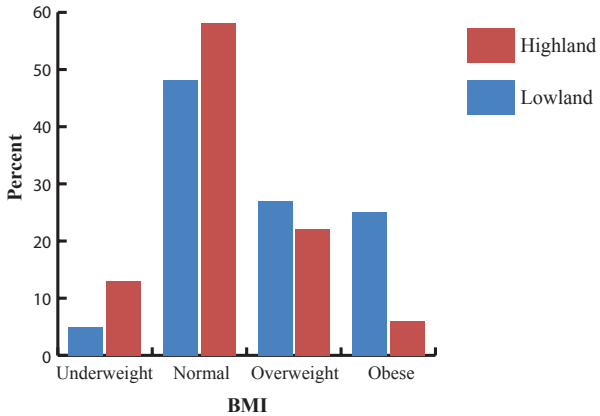

Figure 2: Nutritional status based on residence of subjects

Nutritional status according to sex of the subjects

About 28% of females were overweight and obese (23%) compared to 14% and 6% of males respectively (Fig. 3). The females in lowland areas were more overweight as compared to females in highland areas and their mean BMI was highly significant (p=0.010). The mean BMI between males of lowland and highland areas was not significantly different (p= 0.216) (Table 3). The risk of been overweight and obesity was high among females compared to males (Crude

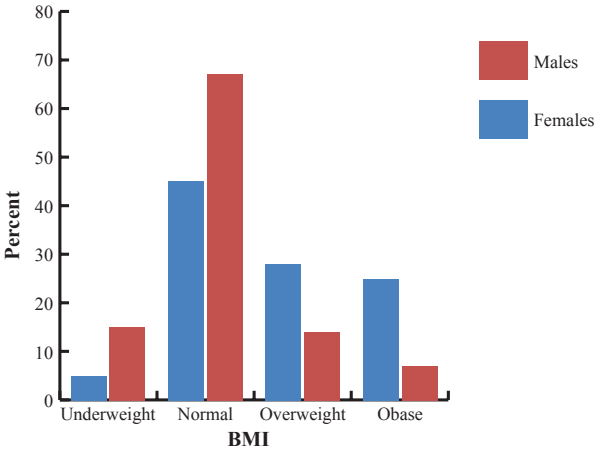

Figure 3: Nutritional status according to sex

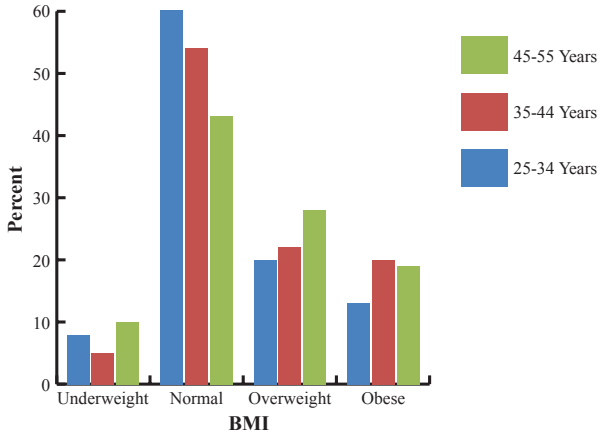

Figure 4: Nutritional status by age of the subjects

OR 4.91, 95% CI: 2.88 – 8.38 and adjusted OR 5.53, 95% CI: 3.11 – 9.82) (Table 8).

Nutritional status based on age of the subjects

Overweight (27.2%) and obesity (19.3%) were more prevalent among adults of 45-55 years followed by the age of 35-44years with 23% overweight and 20% obese people (Fig. 4). Hence the adults with 45-55 years followed by 35-44 years were found to be at increased risk of overweight and obesity as compared to those with 25-34 years even after adjusting for other risk factors (Crude OR 1.89, 95% CI: 1.11 – 3.14 and adjusted OR 2.32, 95% CI: 1.28 – 4.214) and (Crude OR 1.89, 95% CI: 1.05 – 3.33) and (adjusted OR 2.17, 95% CI: 1.13 – 4.16) respectively (Table 8).

Waist and hip circumferences

A total of 37.8% of females had large waist hence, they were at increased risk of non communicable diseases while only 2.6% of males were at increased risk. Nevertheless 10.5% of males and 22.4% of females were substantially at increased risk of the diseases due to high waist-hip ratio ($p < 0.05$). Lowland areas had more subjects (47.3 and 33.5%) with high waist and waist-hip ratio respectively compared to those in the highland areas (28.8% and 22% respectively) ($p<0.05$) (Table 4).

Table 3: Mean BMI comparisons between Lowland and highland areas

BMI	N	Mean	t	*p-value*	95% CI of difference	
Residence					Lower	Upper
lowland	230	25.49	4.37	0.000	1.361	3.589
Highland	132	23.02				
Sex						
Lowland male	62	23.25	3.399	0.216	2.567	0.755
Highland male	56	20.69				
Lowland female	168	26.32	2.164	0.010	1.584	2.732
Highland female	76	24.73				

Energy intake among subjects

The subjects in lowland area had significantly higher mean energy intake 2159Kcal/day (SD 551.1) compared to the highland subjects with a mean of 2040 Kcal/day (SD 601.9) ($p=0.000$). In addition the subjects in highland area had significantly higher mean energy expenditure 2599 Kcal/day (SD 781) compared to the lowland subjects with a mean energy of 2530 Kcal/day (SD 934) at $p=0.052$ (Table 5).

Energy balance among subjects

Energy balance was obtained by calculating the

Table 4: Waist and hip circumferences

Variables	n	Normal		Increased risk		Substantially increased risk		Mean	*P-value*
Waist circumference (cm)									
		n	%	n	%	n	%	n	%
Males	118	108	29.8	8	2.2	2	0.6	78.3	0.002
Females	244	107	29.6	58	16.0	79	21.8	81.1	
Highland	132	94	71.2	26	19.7	12	9.1	76.6	0.000
Lowland	230	121	52.6	40	17.4	69	30.0	83.3	
Waist-hip ratio (WHR)									
Males	118	79	21.5	0	0	38	10.5	0.87	0.000
Females	244	163	45.0	0	0	82	22.4	0.83	
Highland	132	94	78.0	0	0	37	22.0	0.84	0.39
Lowland	230	147	63.9	0	0	77	33.5	0.84	

(Waist circumferences; Normal = <94cm for men and <80cm for women, Increased risk = >=94cm for men and >=80cm for women, substantially increased risk=>=102cm for men and >=88cm for women). (Waist hip ratio; High risk =0.9 for men and 0. 85 for women). Adopted from WHO (2000) cut off points.

Table 5: Energy intake and expenditure among subjects

Variable	n	Mean Energy	SD	*p-value*
Energy intake				
Lowland	230	2159	551.1	0.000
Highland	132	2040	601.9	
Energy expenditure				
Lowland	230	2530	934	0.052
Highland	132	2599	781	

difference between energy intake and energy expenditure. More subjects residing in lowland areas had positive energy balance (33%) compared to those residing in the highland areas (23%) (p=0.05) (Figure 5). The mean differences in energy balance was significantly different (p=0.050). The subjects with positive energy balance were slightly found to have higher risks of overweight and obesity compared to those with negative or normal energy balance. However, after adjusting for other factors the risk was not significant (Crude OR 1.36, 95% CI: 1.86 – 2.15 and adjusted OR 1.12, 95% CI: 0.66 – 1.91) (Table 8).

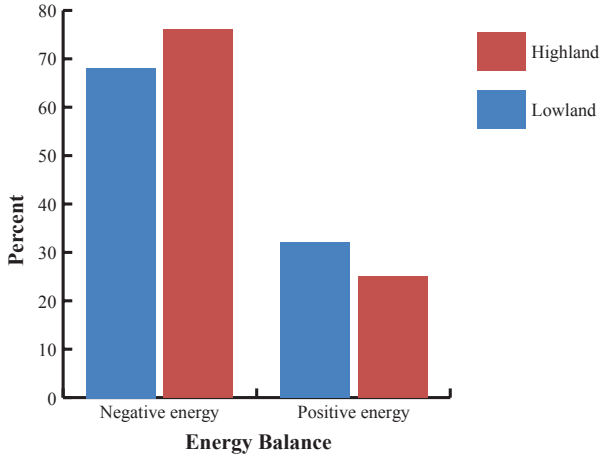

Figure 5: Energy Balance

Alcohol intake among subjects

About 32.2% of the respondents were taking alcohol of which 37.8% were residing in lowland areas while 30.2% were in lowland areas (Table 6). However, alcohol intake was not found to be a risk factor for overweight and obesity among adults (Table 8).

Table 6: Alcohol intake among subjects

Variables	n	Percent
Alcohol consumers	149	41.2
Non alcohol consumers	213	58.8
Total	**362**	**100**
Lowland alcohol consumers	71	30.2
Lowland non alcohol consumers	164	69.8
Total	**235**	**100**
Highland alcohol consumers	48	37.8
Highland non alcohol consumers	79	62.2
Total	**127**	**100**

Table 7: Activities performed by the subjects

Variables	Lowland area		Highland area	
Type of Activity	**n**	**Percent**	**n**	**Percent**
Sedentary work	101	43.9	39	29.5
Hard work	116	50.4	85	64.4
Moderate work	13	5.7	8	6.1
Total	**230**	**100.0**	**132**	**100.0**
Distance to work				
0-<2 kilometers	128	55.2	44	34.3
>=2 kilometers	102	44.8	88	66.7
Total	**230**	**100**	**132**	**100**
Transport to work				
On foot	158	68.7	129	97.7
By transport	72	31.3	3	2.3
Total	**230**	**100.0**	**132**	**100.0**
Farming technology				
By technology (mechanized)	78	33.9	0.0	0.0
Hand hoe	152	66.1	132	100.0
Total	**230**	**100.0**	**132**	**100.0**
Transport of farm produce				
On head	33	14.3	128	97.0
By transport	114	49.6	3	2.3
Both	83	36.1	1	.8
Total	**230**	**100.0**	**132**	**100.0**
The mean Physical Activity Level (PAL)	Mean	Mean SD	95% CI	***P-Value***
Highland	2.2	0.4669	-0.24789-(-0.03125)	0.016
Lowland	1.87	0.5633	-0.25344-(-0.02570)	

*Sedentary works are secretarial, doctor, supervising farm activities, using technology in farming, teaching, learning, office and business activities which do not involve movements and the extraneous activities are working longer distances to work daily, carrying heavy loads by heads, digging by using hand hoe.

Table 8: Risk factors for overweight and obesity among subjects

Risk factors	Univariate analysis OR (95% CI)	*P-value*	Multivariate analysis OR (95% CI)	P-value
Residence				
Highland	1		1	
Lowland	2.04(1.30 -3.18)	0.002	2.05(1.30-3.11)	0.040
Age				
25-34yrs	1		1	
35-44yrs	1.89(1.05 -3.327)	0.034	2.17 (1.13 - 4.16)	0.020
45-55yrs	1.89(1.11 -3.137)	0.019	2.32 (1.28 - 4.215)	0.006
Sex				
Male	1		1	
Female	4.91 (2.875 -8.38)		5.53 (3.11 – 9.82)	0.000
Education level				
Never went to school	1		1	
Went to school	3.74(1.31 – 10.71)	0.014	2.33(0.72-7.54)	0.116
Alcohol intake habits				
No	1		1	
Yes	1.110(0.171 – 1.73)	0.646	0.124(0.73 – 1.65)	0.124
Energy intake				
Negative balance	1		1	
Positive balance	1.36(1.86 – 2.15)	0.016	1.12(0.656 – 1.91)	0.678
Main occupation				
Not formal employed	1		1	
Formally employed	2.49 (1.27 – 4.91)	0.008	1.87(0.79 – 4.42)	0.153
Level of income				
Low income <100,000	1		1	
Middle100,000-<500,000	1.03 (0.359-45.15)	0.259	1.23(0.78 – 1.37)	0.124
High >500,000	2.30(1.48 – 3.54)	0.000	2.22(1.76- 2.48)	0.001
Type of activity				
Vigorous	1		1	
Moderate	3.30(1.33 – 8.23)	0.010	2.10(1.22 – 2.31)	0.050
Light	5.22(3.26 -8.36)	0.000	2.23(1.46 – 3.40)	0. 045
Using Farm technology				
Hand Hoe	1		1	
Mechanized	3.08(1.84 – 5.15)	0.000	2.30(1.026 – 5.17)	0.043
Carrying Farm produce				
By head	1		1	
By transport	2.25(1.45 – 3.48)	0.000	2.38(0.89 – 6.368)	0.116

Physical activities performed by subjects

The types of activities performed by subjects were categorized as sedentary, hard/ extraneous and moderate work. More subjects (44%) in the lowland areas were doing sedentary work such as secretarial, learning, teaching, office works and business which involved minimum movements as compared to subjects in the highland area (29.4%). The subjects who were doing light activities (sedentary) were found to be at the highest risk of overweight and obesity followed by those with moderate activities as compared to those who were doing vigorous activities even after adjusting for other risk factors (Crude OR 5.22, 95% CI: 3.26 – 8.36 and adjusted OR 2.23, 95% CI: 1.46 – 3.40) (Table 8). Majority of subjects (98%) in the highland areas are living more than 2km away from their working areas which makes subjects in the highland areas to use more energy as majority (98%) are going to their working areas by walking compared to 69% of the subjects in the lowland areas. Farmers (100% in the highland areas use a hand hoe as the only farming tool and 66% of the lowland farmers use mechanized agriculture like tractors and plough. The subjects who were using mechanized agriculture had high risk of overweight and obesity as compared to those using hand hoes (Crude OR 3.08, 95% CI: 1.84 – 5.15 and adjusted OR 2.30 95% CI: 1.03-5.17) (Table 8). After harvesting their produce, 97% of the subjects in the highland areas carry their produce from their farms on their heads compared to only 14% of respondents in lowland and the rest use transports like cars, bicycle, Donkeys, pushcart, motorcycles (Table 7). The risk for overweight and obesity was high for the subjects who used transports to carry their produce as compared to those who were using their heads (Crude OR 2.25, 95% CI: 1.45 – 3.48 and adjusted OR 2.38, 95% CI: 0.89 – 6.37) (Table 8). The General mean Physical Activity Level of subjects was high among subjects in highland areas (2.2) compared to those in lowland areas (1.87) (p=0.016) (Table 7).

Other risk factors for overweight and obesity among subjects

The subjects who attended school were at increased risk of overweight and obesity compared to those who have never attended but the adjusted odds ratio shown no significance (Crude OR 3.74, 95% CI 1.31-10.71 adjusted OR 2.33 95% CI 0.72-7.54). Formally employed subjects were at increased risk of obesity and overweight than were the informally employed respondents but after adjusting for other factors it was not significant (Crude OR 2.49, 95% CI: 1.27-4.91 and adjusted OR 1.87, 95% CI: 0.79-4.42). Moreover, the subjects with high income were also at increased risk as compared to the middle and low income people (Crude OR 2.30, 95% CI: 1.48-3.54 and adjusted OR 2.22, 95% CI: 1.76-2.48) (Table 8).

Discussion

Prevalence of overweight and obesity was high among subjects in the study area represented by 24% and 17.4% respectively. This may be due to the factors that showed to be significantly associated with overweight and obesity. This included level of income, sex, residence, level of education, type of technology used for farming, type of transport for carrying farm produce, main occupation, employment status and age. Most of the mentioned risk factors affected the lowland and highland subjects differently.

The prevalence of overweight and obesity increased with age, whereby subjects in the age category of 45-55 years followed by 35-44 years were found to be at increased risk as compared to those with 25-34 years even after adjusting for other risk factors. This may be due to decreased metabolism accompanying aging and reduced physical activities as most of them were doing sedentary activities which involve little movement. Nyaruhucha *et al.* (2003) observed that BMI increases with age and the highest proportion of obesity was at age 41-50 category followed by 31-40 years. The study by Cihangir *et al.* (2004) also observed that, the prevalence of obesity increased significantly with age of the subjects which was partly explained by decrease in physical activity in both male and female subjects as well as decreased metabolism that accompany aging. Female subjects were 5 times at increased risk of overweight and obesity compared to male subjects especially those from

lowland areas. This might be due to fact that in this society, soon after a woman delivers, they take a leave of a minimum of three months from household chores and any other work which may contribute to an increase in the prevalence of overweight and obesity. Weng *et al.* (2004) observed that, the risk of obesity and overweight was increasing in each additional child born.

The subjects residing in the lowland areas were 2.04 times at increased risk of overweight and obesity compared to highland subjects. This may not be due to the assumption that, subjects living in the highland areas are shorter than those living in the lowland areas, because the mean height was not significant difference between lowland and highland subjects while their mean weights differed significantly. Hence the observed differences could be due to different factors shown to be associated with overweight and obesity like the types of activities performed by subjects whereby more subjects in the lowland areas were doing sedentary work as compared to subjects in the highland areas such as secretarial, learning, teaching, office works and business which involve minimum movements. Majority of the subjects in highland areas were performing labour intensive activities like carpentry, non-mechanized agricultural activities (use of hand hoes for cultivation), constructions of buildings, carrying of timbers and farm produce on head, logging and walking long distances (>2km). This makes them to use more energy than their counterparts. In addition, all highland farmers use hand hoe as the only farming tool while most of the lowland farmers use mechanized farming tools like tractors and plough. After harvesting their produce, majority of the subjects in the highland areas carry their produce by heads from their farms while most of the farmers in lowland areas use transports like cars, bicycle, donkeys, pushcart, and motorcycles. The subjects in highland area had significantly higher mean energy expenditure per day and physical activity level compared to the lowland area subjects. A sedentary lifestyle plays a significant role in obesity due to fact that, there is a large shift from heavy and labour intensive physical work to less physically demanding work; hence reduced energy expenditure. In addition, increased use of transportation such as the introduction of motorcycle (bodaboda) has reduced physical activities especially walking and load carrying. Nyaruhucha *et al.* (2003) reported that, occupation was found to be associated with BMI whereby greatest proportion of obese subjects was found among the formally employed workers who are normally doing low energy demanding works.

Majority of the subjects residing in lowland areas had significant excess energy intake (positive energy balance) compared to those residing in the highland areas. This was significantly associated with the increasing rates of overweight and obesity because food consumption patterns have changed from consumption of high fiber food to refined food with high amounts of fat and salt, like fried potato chips. The study observed high consumption of refined maize and maize products, buns and foods with high amount of fats /oils which were eaten daily in lowland than in the highland areas. Subjects in lowland area had significantly higher mean energy intake per day compared to the highland subjects. These types of foods provide high energy leading to excessive energy intake and storage in the body. The total calorie intake has been associated with obesity and most of the extra food energy is due to increased consumption of carbohydrate and fat. This study is in line with Jung (1977) who explains that, it is the total calories intake rather than the frequency of eating that determines the weight change. However, alcohol intake was not found to be a risk factor for overweight and obesity status of the studied adults although it is known to be a rich source of calories. This may be due to fact that very high consumption of alcohol is likely to be associated with poor appetite (Prentice, 1995).

Income level was significantly associated with overweight and obesity whereby those with high income mainly from the lowland areas were 2 times at increased risk of overweight and obesity compared to the middle and low income subjects. This implies that, as income increases overweight and obesity also increases. This is contrary to what was observed in most of the

studies but it should be noted that, the level of education has a linkage to formal employment and sustainable income which were also found to be risk factors in this study. The employed respondents were doing office works with low energy expenditure like secretaries, nurses, doctors, local government leaders and teachers. They have also adopted life styles that have influenced their activities and consumption patterns. Obesity and overweight are not associated only with high income countries but are now also prevalent in low and middle income countries (Campbell and Campbell, 2007).

Conclusion and Recommendation

In concluding, the study revealed high prevalence of overweight and obesity especially in lowland compared to highland areas. The main factors identified to be associated with overweight and obesity are education, income levels, occupations, farming technology, sex, residence, high dietary energy intake, age and carrying of the loads. The main risk factors which make lowland areas to be at increased risk of overweight and obesity are physical activities and energy intake which are controllable. Overweight and obesity increase the risks of developing nutritional related chronic diseases. As nutrition-related chronic diseases become more prevalent, limited resources are used to address them instead of directing efforts in developmental activities. Hence early prevention of overweight and obesity is a necessary, cost-effective means of avoiding high costs of a treatment-based approach to nutrition-related chronic diseases. It is therefore envisaged that these findings will assist stakeholders in health sector to introduce nutrition education and regular nutritional status assessment among adults as well as other age groups to allow design of appropriate interventions.

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