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Prevalence and Perception of Obesity in Adolescents from Private and Public Schools, Northern Mozambique

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Abstract: ***Background: Obesity is a worldwide growing non - transmissible chronic disease resulting from abnormal fat accumulation in different tissues, mainly in white adipose tissue. Thus, we determined prevalence of obesity in adolescents and evaluate their perception related to the disease. Material and Methods: Analytical and observational cross - sectional study with quantitative approach was conducted in public and private schools in Nampula. We applied systematic casual sampling technique and screened 317 students. Nutritional status and perception were determined through anthropometric measurements and application of questionnaires, respectively. Results: Overall prevalence of obesity, based on the international sex - specific cut - off points for body mass index (BMI), is 7.3% and overweight, 8.5%. Higher prevalence of obesity (20%) was found in private school and lowest (5%) in one of public schools. Male tended to be more obese (9.5%), while females are more overweight (12%). Overall perception of obesity is 72.6% and physical activity and exercise is 65.3%. Lower perception was registered in private school. Conclusion: Despite perception of obesity and overweight is low, paradoxically overall prevalence of obesity and overweigh is low as well. Thus, lack of perception and mild exercises may be major factors for obesity, but are not solely determinant, implying consideration of factors beyond environmental.***

Keywords: Obesity, Overweight, Perception level, Adolescents

1. Introduction

Obesity is a worldwide growing non - transmissible chronic disease resulting from energy imbalance. Obesity and overweight are defined as abnormal fat accumulation in different tissues, mainly in white adipose tissue. Implication of overweight and obesity has been quite investigated and are far - reaching. They include hypertension, heart disease, dyslipidemia, liver steatosis, gallstones, osteoarthritis, type 2 diabetes mellitus, certain types of cancer, aesthetic problems, premature death [1], depression [2], and high triglycerides and cholesterol levels. In children and adolescents overweight and obesity are associated to early development of cardiovascular disease, type 2 diabetes mellitus (T2DM), and psychological dysfunction. In addition, it causes impairing posture, musculoskeletal abnormalities what brings social and economic disadvantages [3]. Adiposity is correlated with chronic inflammation and increases concentration of Interleukin - 6 (IL - 6) in circulation [4]. Finally, away from the disease itself, lack of knowledge appears to be another major problem. In fact, a particular literature study has shown, for instance, that most of care givers have no perception child's weight to be potential health problem [5].

To our best knowledge, better approach to deal with obesity and overweight still remains on prevention. Strategies such as lifestyle adjustments should be adopted, once genetic or epigenetic profiles so far cannot be widely modified. To this end, assembly of information about obesity may be important for its control. Against the above background, we investigated prevalence and then perception of obesity in adolescents of private and public schools in Nampula, Northern Mozambique. Thus, we carried out a comparative approach to screen obesity in two socio- economical different groups of adolescents and, we hint that prevalence and perception of obesity should not be addressed fully in a linear cause - effect relationship.

2. Literature Survey

Obesity is simply defined as excess of body weight by height [2]. It ranks one of major public health problems worldwide causing morbidity and mortality. The World Health Organization (WHO) estimates approximately 1.6 billion adults all over the world were overweight and 400 million obese in 2005. The projection pointed the number could reach 2.3 billion and 700 million, respectively by 2015 [6]. Obesity is a complex and multifactorial disease with genetic or environmental ground or resulting from an interaction among both factors. However, it is been disclosed that susceptibility in obesity is different from one to another individual. Recent advances in Molecular Biology and Translational Science suggest implication of epigenetic on triggering a couple diseases including obesity [7]. If secular trends continue by 2030 an estimated 38% of the world's adult population will be overweight and another 20% will be obese. Morbidity of obesity continues to ascent both in developed and developing countries and is affecting people of all ages [3]. Thus, early diagnosis is vital in preventing morbidity [8]. In the USA, for instance, most dire projections of secular trends point to over 85% adults being

overweight or obese by 2030 [2]. Although the biochemical and physiopatological basis of obesity remain not fully understood, it is established that obesity occurs when energy intake exceed energy expenditure. Multiple factors for the imbalance are described, but no single factor can be attributed to the rising prevalence of obesity [3], [9]. Genetic profile influence susceptibility to a given individual, but often environmental factor is required for expression. Hence, lifestyle and culture seem to play important role for development of obesity. On the other hand, genes that causes leptin deficiency or medical condition such as hypothyroidism and growth hormone deficiency may influence *obesitogenesis* [3].

3. Methods and Material

3.1 Study Design and Participants

Analytical and observational cross - sectional study with quantitative approach was conducted in two public schools and one private in Nampula city, Northern Mozambique. We applied a systematic casual sampling technique, and screened 317 students of both sexes, with 15 to 18 years - old. Nutritional status and perception were determined through anthropometric measurements and application of self - administered questionnaire, respectively. Participation in this study was fully voluntary based on signature of informed consent form. Weight categorization was compiled through BMI - for - age reference for boys and girls from 0 to 18 years of age stablished by the World Health Organization. Thus, individuals were classified as eutrophic, underweight, overweight or obese. Obesity was defined based on the BMI $\geqslant$30.

For nutritional status data collection, participants were measured weight, with minimum clothing possible (weighing scale *SECA*, max weight: 150 kg, Mfd.2016), height (stadiometer, *Electromed* Ltd, precision 0.1, max height: 210 cm), arm and waist circumferences, arm length and skin folds of triceps and sub scapularis (adipometer *CIMA*, max fold: 20 mm, Mfd.2015). Nutrition state was determined through the BMI from which participants were classified in four categories: *overweight, obese, eutrophic and malnourished*. Malnutrition was, thereafter, classified into *moderated acute malnutrition* (MAM), *severe acute malnutrition* (SAM).

Because bone structure and muscle mass often confound determination of overweight and obesity, we measured skin folds as a tool of confirmation only for individuals with high BMI in order to prevent misperception of the nutritional status. Finally, perception of obesity and physical activity and exercise questionnaires were applied independently to all participants. All data collection tools were calibrated to ensure reliability. Perception level of nutritional knowledge was classified according to parameters established by Harnack and Cols [10]. Practice of physical activity and exercise was determined through application of a short form of the International Physical Activity Questionnaire (IPAQ).

We assessed the applicability of the questionnaire through a pretest including 32 students at Muatala Secondary School. All ethic procedures were observed, based on the World Medical Association Declaration of Helsinki Ethical, Principles for Medical Research Involving Human Subjects, 2013.

3.2 Data Analysis

We used the statistical software (SPSS, v.20) for data treatment and chi - square test was performed to correlate qualitative variables. We applied inferential method and fixed confidence level of 95% and probable error of 5% ($p = 0.05$). To assess normality of quantitative variables Kolmogorov - Smirnov test was employed. This procedure further helped us to perform parametric tests.

4. Results and Discussion

Participants in both schools were 317, male (39.7%, n= 126) and female (60.3%, n= 191). The age ranged from 15 to 18 years - old (mean value, 17 years - old). Overall BMI in this study was fixed between 15.89 and 39.72 kg/m^2. Of 317, most of the students in the three schools were eutrophic. However, 5, 9.4 and 20% at Nampula Secondary School, Nampula Industrial Institute and Pythagoras medium school, respectively, were obese. Others were categorized as overweight and malnourished individuals (Table 1). We found that the more the BMI the more the sum of skin fold, implying a correlation between the BMI and adiposity. Results of obesity prevalence, perception level and physical activity practice are summarized in the following table. Low perception was registered in public schools and intermediate in private. Conversely, the private school had higher prevalence of obesity.

Table 1: Prevalence, perception level of obesity and physical activity and exercise among adolescents. The results depict evidence of low perception level of obesity in adolescents in all schools. Thus, lack of knowledge can be associated with the relative increased prevalence of overweight and obesity observed in private school

Schools	Sample	Prevalence (%)				Perception level (%)			Physical activity and exercise (%)		
		Euthrophic	Overweight	Obese	Malnutrition	Low	Moderate	High	Mild	Moderate	Rigorous
Nampula Secondary Schol	179	82.7	10.1	5	2.2	70.4	19.6	10	73.2	12.8	14
Nampula Industrial Institute	128	83.5	6.3	9.4	0.8	59.4	32	8.6	71.8	14.1	14.1
Pytagoras medium school	10	50	10	20	20	50	40	10	80	10	10
Sample size	317										

SAM - Severe Acute Malnutrition BMI - for - age (< - 3 SD); MAM - Moderate Acute Malnutrition BMI for age (≥ -3 and < - 2 SD); Eutrophic or Normal BMI - for - age ($\geq$ - 2 and $\leq +1$ SD); Overweight BMI - for - age (>+1 and $\leq +2$ SD) and Obesity BMI - for - age) (> +2 SD). Source: WHO, 2007; adapted by the Ministry of Health of Mozambique, 2018.

Overall Obesity Prevalence in Public and Private Schools is Low

The overall prevalence of overweight and obesity in private and public schools, based on WHO criteria, is 8.5 and 7.3%, respectively. Thus, most of the adolescents are eutrophic. Moderate acute malnutrition, in a low prevalence, was also diagnosed (Figure 1). The overall obesity prevalence found in adolescents is 7.3%. The minimum BMI found was 15.89 kg/m^2 and maximum 39.72 kg/m^2, pretty similar to what Ngwenya (2017) found: 14.8 kg/m^2 and 43.57 kg/m^2 [11]. The data demonstrates a wide range of the nutritional status among participants, starting from underweight to obesity. The resemblance should be explained by the similarity of individuals subject to studies or probably due to equality on diagnosis criteria (WHO criteria).

A comparative analysis of obesity among schools show that private school has relative higher prevalence (20%) than the two public schools together 14.4% (5 and 9.4% each; mean value, 7.2%). Overall overweight rate did not differ significantly in the private and one of public school. Surprisingly, moderate acute malnutrition was high (20%) in the private school compared to the public schools together (3%). Results are in line with a study by Nagar (2015) (12) where high prevalence of obesity in private and relatively low in public schools was found (45.2% and 10.5%, respectively). Equally, Katkuri et al., (2015) [13] found in a private school obesity rate of 21.09%. However, a slight difference (16.9%) was described by Ogden (2014) [14] working also in a private school. The similitude might be explained bearing in mind socioeconomics differences among adolescents in private and public system. On the other hand, it should be noted that Ogden worked with individuals from the age of 2 to 19 years - old, probably explaining the minor discrepancy.

We also found overall overweight rate of 8.5% among adolescents. This result is contradictory to a study carried out by Terres (2006) [15], where also working with adolescents between 15 to 18 years - old the prevalence of overweight was high (20.9%). Although the authors do not mention in their report, we assume that the discrepancy may result from the point that they have been analyzing for long period of time a relatively huge number of adolescents or from difference on diagnosis criterion. We also found substantial difference of overweight by sex. Female tended to be more overweight than male, equally to Ngwenya (2017) [11]. However, inconsistency is found when considering obesity by sex. In our study, while male show slightly higher rate of obesity, Ngwenya reported high rate of obesity in female.

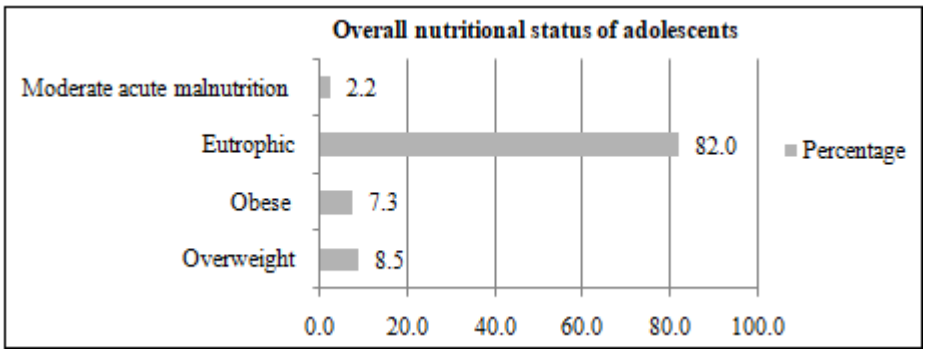

Figure 1: Adolescent's nutritional status. The BMI indicates low prevalence of obesity, relative higher prevalence of overweight. We also detected the occurrence of malnutrition in the participants. No severe acute malnutrition was found.

Perception Level of Obesity is Low in Public Schools, but Intermediate in Private School

We examined perception of obesity among the participants in order to correlate perception and prevalence of obesity. In this regard, we found in both private and public - school low level of perception (Figure 2) suggesting high risk of obesity. Conversely, the overall prevalence of obesity is not as high as could be predicted. A statistical test showed significant association between perception of obesity and the nutritional status ($p = 0.04$). The largest difference between observed and expected frequencies was found among obese participants (12.3%), allowing to state that participants with obesity had low perception. The association was moderately strong with Cramer's $V = 0.263$. In addition, we found no association with sex regarding to perception of obesity, $p = 0.06$, what allow us to state that for this study, low, moderate, and high perception of obesity did not depend on sex.

Regarding the perception of obesity, private and public schools showed low level, though, paradoxically, adolescents in public school had lower obesity prevalence. The fact may be due to differences in socioeconomic status among students. In wide - ranging context, students in private school are economically stable compared to public schools. Nonetheless, they may have enough information about obesity they are more likely to have unhealthy dietary habits associated with easy - access of food, sedentary lifestyle or be subject of mild physical activity. In fact, low physical activity and exercise was disclosed in the private school. Similar result was found by Okop and coworkers (2016) [16]. The authors stress in their report low perception as a threat for obesity among overweight women. Another study by Young - hyman and coworkers (2000) [17] also concluded that perception level among care givers was low (44%), though higher than ours. Care givers are, in a wide - ranging, more experienced. So, it seems enough to understand they might have relatively basic knowledge compared to adolescents subject to this study. Inconsistently, Hardus et al., (2003) [18], describe a sophisticated perception of obesity among lay people. The authors applied sampling by convenience hinting that such group of participants has previous basic knowledge of obesity, differently to ours.

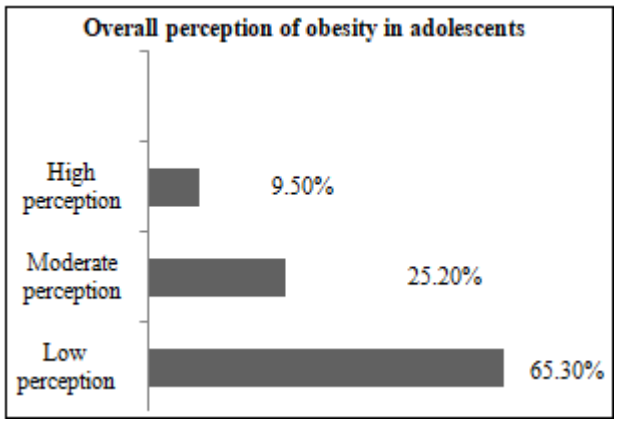

Figure 2: Perception of obesity among adolescents. Great number of adolescents showed low level of perception of the diseases, nevertheless the prevalence of overweight and obesity is low as well.

Physical Activity and Exercises are Mild Among the Participants

Physical activity and exercises play important role on prevention or non - pharmaceutical treatment of overweight and obesity. It helps on energy expenditure avoiding abnormal fat storage in the organism. We explored practice of physical activity and exercise among adolescents in order to predict their health status. Adolescents in both schools showed mild physical activity and exercise (Figure 3). The lowest level of physical activity and exercise practice was detected in private school, where female had lower practice (data are not shown). Chi - square independence test was performed to screen relationship between physical activity and exercises, and nutritional status of the participants. We found statistically significant association (p. > 0.05) suggesting that prevalence of overweight or obesity of adolescents in this study was related to low physical activity and exercise.

We explored practice of physical activity and exercise. Results show that most of adolescents (72.6%) had mild physical activity and practice. Likewise, Alves and others (2011) found lower physical activity and exercise (83%) in women aged 20 to 60 years - old [19]. Differently to ours, the authors covered a wide range of age. It was to expect that elderly are aware of the importance of positive lifestyle change, to prevent obesity and other morbidities. In this way, other studies are suggested in order to disclose social, psychological or other relevant reasons to explain this paradox. The lowest rate was detected in private school (80% mild physical activity and exercise), probably explaining relative high prevalence of obesity in this group. Indeed, several studies have reported that sedentary lifestyle is directly associated with increment of obesity prevalence [20], [21]. In summary, we found that despite perception of obesity and overweight is low, overall prevalence of obesity and overweight is low as well. Thus, lack of perception and exercises shouldn't be linearly determinant factors for prevalence of obesity in those groups.

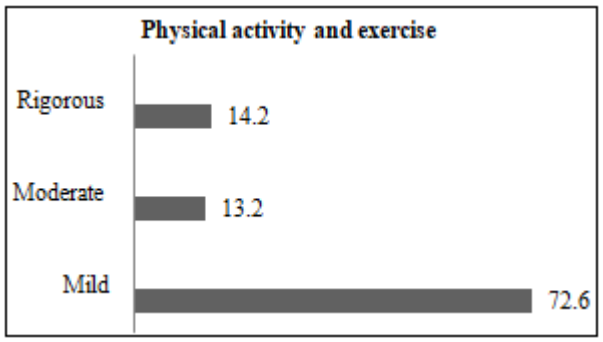

Figure 3: Physical activity and exercise. Mild physical activity and exercise was detected in all schools subject to this study. Moderate and rigorous physical activity and exercise were almost equal.

When assessed the relationship between sex and practice of physical activity and exercise, we found an association of the variables ($p = 0.01$) with Cramer $V = 0.233$ considered moderately strong. In the context of this research, female adolescents tended to practice less physical activity and exercises compared to male (data are not shown). Adolescents with mild physical activity and exercise had also lower perception of obesity compared to those with moderate and rigorous physical activity and exercise, $p = 0.01$. Thus, we speculate that due to lack of perception about contours of obesity, adolescents usually practice less physical activity and exercise what lead to sedentary lifestyle. Pearson's correlation result ($r = 0.63$) is within the range ($r = 0.60 - 0.80$) showing a high correlation between BMI and the sum of skinfolds of overweight or obese adolescents.

Prevalence of Obesity and Overweight Show no Differences by Sex

In this study, female tended to practice low physical activity and exercise. Taken this, we examined difference of obesity prevalence by sex. No association between sex and development of obesity was found among the adolescents ($p = 0.03$), meaning that prevalence of obesity did not depend on the sex, though male tended to be more obese than female. Conversely, when assessed overweight by sex, female presented higher prevalence (Figure 4). Once, generally, overweight reflects a stage of body fat accumulation, the result allows us to assume confidently that obesity prevalence in female will increase, if no differential intervention is taken. On the contrary, Garawi, Devries & Uauy, 2014 [22] studied obesity across 192 countries and found gendered patterning of obesity across the countries, female with greater prevalence and greater heterogeneity than men.

In theory, low perception of contours of obesity plus mild physical activity and exercise leads to high prevalence of overweight and obesity. Nonetheless, this linear relationship was not found hinting that factor away from genetic and environment should be considered in order to explain the inconsistency. Indeed, reports are recently highlighting the role of epigenetics background for explanation of the phenomenon of obesity and overweight.

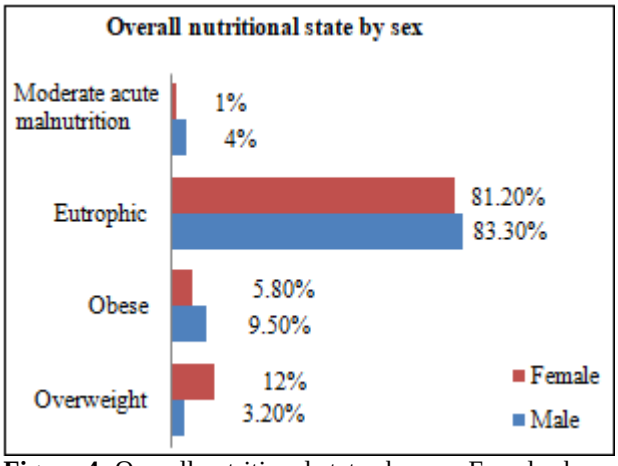

Figure 4: Overall nutritional status by sex. Female show higher rate of overweight than male, while males are slightly more obese than female. There is a significant difference of overweight by sex. Malnutrition was higher in male than female

5. Conclusion and Future Scope

Overall prevalence of obesity among adolescents, based on the international sex - specific cut - off points for BMI, is low. However, we found that prevalence of obesity is relatively higher in adolescents of private school compared to public schools. Regarding to perception of obesity, adolescents showed low level of perception and most of them practice mild physical activity and exercise. In addition, obese individuals have particularly low perception of the disease.

Our results suggest that in epidemiological studies, a linear cause - effect relationship between perception, physical activity and prevalence of obesity may not fully be applied to all situations. Cases must be treated as an individual case accordingly. Thus, we speculate that beyond genetic and environmental basis of obesity and overweight, factors outside genetics, such as epigenetic profile, may play a role in development of obesity. So, further complementary studies are encouraged to be carried out.

6. Conflict of Interest

The authors declare no conflict of interest regarding the publication of this paper.

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