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Original Article

Association of obesity and physical activity in adult males of Dharan, Nepal

Vaidya A[1], Pokharel PK[1], Nagesh S[1], Karki P[2], Kumar S[1], Majhi S[3]
[1]Departments of Community Medicine, [2]Internal Medicine and [3]Biochemistry, B.P. Koirala Institute of Health Sciences, Dharan, Nepal

Abstract

Objectives: Obesity is one of the most apparent-yet most neglected public health problems. Physical activity is a crucial element in the development of obesity but still its importance in the occurrence of obesity varies in different populations. This paper aims to study the burden of obesity and its association with physical activity was carried out in a rapidly urbanizing town.

Methods: A cross-sectional study to investigate the prevalence of obesity and its association with physical activity was carried out in one thousand adult males of Dharan municipality. Tools of data collection included interview and physical measurements such as blood pressure, height and weight measurements, and waist and hip circumferences. Odds ratios (ORs) and their 95% confidence intervals for obesity were computed across various demographic and other variables without adjusting and then adjusting for physical activity.

Results: The prevalence of overweight and obesity in the population was 32.9% and 7.2% respectively. The study showed that physical inactivity is more importantly associated with obesity in the older population. The trend of young being more obese is reversed after adjusting for physical activity so that those in the older age were more obese than the younger ones. Similarly, those in to the business, vocational and clerical works, those who were more literate and those in the higher socio-economic status were significantly associated with obesity even after correcting for physical activity.

Conclusion: The prevalence of overweight and obesity is high in the males of Dharan. The value and effect of physical activity seem to vary across different age-groups and socio-economic status and occupations. The young, the technical persons or businessmen and the more prosperous ones probably need to bring down their calorie intake along with emphasis on physical activity in order to bring down their weight and cardiovascular risk.

Obesity is one of the most apparent-yet most neglected public health problems. Globesity i.e. an accelerating global epidemic of overweight and obesity - paradoxically co-exists with under nutrition and is taking over many parts of the world including the developing countries. In 1995, about 200 million adults worldwide were estimated to be obese which rose sharply to over 300 million by 2000, out of which 115 million people dwell in the developing countries. There are more than 1 billion overweight adults worldwide and at least 300 million who are estimated to be clinically obese.[1] Obesity poses a major risk for serious diet-related non-communicable diseases such as diabetes mellitus, hypertension and other cardiovascular disease, stroke, and some cancers.

Obesity is defined as an excessively high amount of body fat or adipose tissue in relation to lean body mass. It can be estimated by measuring anthropometric measures such as skin-fold thickness, body mass index (BMI), waist-to-hip circumference ratios (WHR), or by radiological techniques. BMI is a common measure expressing the relationship (or ratio) of weight-to-height. It is a mathematical formula in which a person's body weight in kilograms is divided by the square of his or her height in meters (i.e., weight/ (height) ^{2} . The BMI is more highly correlated with body fat than any other indicator of height and weight.

The aetiological basis of obesity is a complex one with multifactorial and inconsistent determinants, of which an imbalance in the calorie intake and energy expenditure is an important factor. Physical activity accordingly is a crucial element in the development of obesity as the lack of it contributes to accumulation of extra calories in the body as fats.[2,3]

Correspondence
Dr. Paras K. Pokharel,
Additional Professor,
Department of Community Medicine, B.P.K.I.H.S., Dharan, Nepal
Email: paras_k_pokharel@yahoo.com

But still, its importance in the occurrence of obesity varies in different populations. As for example, physical inactivity and not the intake of high calorie diet was the dominant cause behind the increasing prevalence of obesity in the British population. [4]

Excepting a few hospital data, information on obesity in the general population is scarce in Nepal. The problem of obesity has been particularly increasing in rapidly urbanizing areas and Dharan municipality is an apt prototype of such towns in Nepal. Thus, a cross-sectional study to investigate the burden of obesity and its association with physical activity in this population was carried out.

Objectives

1. To estimate the extent of obesity according to BMI in the adult males of Dharan.
2. To investigate the associations of obesity with different variables such as demographic, dietary and life-style factors including the physical activity.
3. To study the contribution of physical inactivity to obesity in the study population.

Materials and methods

Dharan, one of the three municipalities in the Sunsari District of Eastern Nepal, lies in the foothills of Eastern Mountains. The total population of Dharan municipality is 116 491according to the 2001 census. The majority of the inhabitants of this fast urbanizing town are the hill natives which includes the ex-British soldiers called *Lahures* who are socially well off. A deliberate objective of the present study was to see the lifestyles of these ex-patriots which would be reflected in the result.

This was a population-based cross-sectional study of a year's duration (2004-2005) in which one thousand males aged 35 years or more were enrolled. Simple random sampling method with population proportionate to size technique was applied to select the households from the 19 wards of the municipality, with an assumption that there will be at least one adult male in each household. All the households were visited by the principal investigator himself and informed consent was taken from all the subjects.

A pre-tested semi-structured questionnaire was used to collect information. Tools of data collection included interview about demographic profile, socio-economic profile, dietary profile, physical activity score, stress history, tobacco and alcohol taking habits; and physical measurements such as blood pressure, height and weight measurements, and waist and hip circumferences. BMI was calculated applying the standard method.

Physical activity was measured using a standard Physical Activity Score in which physical activity of a person at workplace, leisure-time and in the household works was noted and each individual was assigned the highest score in each category that he merited. [5] The final score was reckoned as the highest in any category attributed to him.

Physical measurements were taken with standard instruments and techniques. A standard mercury sphygmomanometer with an adequate cuff size was used to measure blood pressure. Systolic pressure (SBP) was taken by the first heard sound (Korotkoff phase I). Diastolic pressure (DBP) was recorded at the level when the sound just disappeared (Korotkoff phase V). Two readings were taken on the right arm at least five minutes apart. Subjects were resting for at least 5 minutes, and had not smoked for at least 30 minutes before this measurement. Standing height was measured with the subject in bare feet, back-square against the wall and eyes looking straight ahead. It was measured to the nearest 0.5 cm. Weight was measured in light indoor clothing without shoes using a platform weighing scale, to the nearest 0.2 kg. The scale was standardized to 0 before each use. Waist and hip circumferences were measured to the nearest 0.1 cm using a non-stretchable standard tape measure kept horizontal. Waist circumference was taken over the unclothed abdomen at the smallest diameter between the costal margin and the iliac crest. Subject was relaxed with arms held loosely by the side. Hip circumference was measured over light clothing at the level of the greater trochanters (usually the widest diameter around the buttocks).

Collected data were analysed with SPSS version 11.5. Odds ratios (ORs) and their 95% confidence intervals (CI) and corresponding p-values (set at 5% significant level) were computed. Analysis was done with multinomial logistic regression analyses with obesity as the dependent variable and other factors and the independent variables. The analysis was done firstly without adjusting for physical activity and again with physical activity as a co-variate to adjust for the effect of the physical activity over obesity.

Results

The characteristics of the study population are given in Table 1.

Table 1: Baseline characteristics of the study population consisting of adult males of Dharan *(N=1000)*

Characteristics	N (%)	Characteristics	N (%)
Age		**Dietary habit**	
35-49 years	475 (47.5)	Vegetarian	106 (10.6)
50-64 years	325 (32.5)	Non-vegetarian	894 (89.4)
65 years and above	200 (20.0)	**Fruit consuming habit**	
Ethnicity		Rare (< a week)	328 (32.8)
Major hill caste	485 (48.5)	1-2 times/ week	494 (49.4)
Hill native	416 (41.6)	3-5 times/week	129 (12.9)
Hill occupational caste	76 (7.6)	Regular (4 -7 days a week)	49 (4.9)
Terai caste	23 (2.3)	**Fat consumption**	
Religion		Non-refined oil [f]	718 (71.8)
Hinduism	538 (53.8)	Refined oil [g]	282 (28.2)
Kirat	288 (28.8)	**Physical activity**	
Buddhism	152 (15.2)	Sedentary to light	441 (44.1)
Others [a]	22 (2.2)	Moderate to heavy	559 (55.9)
Literacy status		**Stress history**	
Illiterate	240 (24.0)	More often [h]	221 (22.1)
Primary education [b]	243 (24.3)	Less often [i]	779 (77.9)
Secondary education [c]	349 (34.9)	**Tobacco use**	
Post-school education	168 (16.8)	Current users [j]	510 (51.0)
Current job status		Past users [k]	230 (23.0)
Employed	671 (67.1)	Non-users [l]	260 (26.0)
Retired	329 (32.9)	**Alcohol intake**	
Occupation		Never	294 (29.4)
Landlords	162 (16.2)	Occasional(1-4 times/ month)	113 (11.3)
Lahures	132 (13.2)	Frequent (> once a week)	407 (40.7)
Business, vocational, clerical	414 (41.4)	Previously drinking	186 (18.6)
Labour	233 (23.3)	**Waist Hip ratio**	
Others [d]	59 (5.9)	Increased (≥ 0.95)	512 (51.2)
Socio-economic status [e]		Normal (less than 0.95)	488 (48.8)
High	82 (8.2)	**Blood pressure status (mm Hg)**	
Middle	470 (47.0)	High [m]	227 (22.7)
Low	448 (44.8)	Normal [n]	773 (77.3)

a: Muslims, Christians, and Jains
b: up to class 3
c: up to class 10
d: politicians, priests, writers, artists
e: Based on Kutty's classification [6]
f: unprocessed mustard oil, ghee or butter
g: soybean, sunflower oil
h: > 5 episodes in a month
i: < 5 episodes in a month
j: who is currently smoking on a regular basis or currently using any form of tobacco.
k: one had smoked cigarettes, etc or chewed any form of tobacco in the past but not currently
l: who has never smoked cigarettes, etc or chewed any form of tobacco
m: SBP ≥ 140 or DBP ≥90
n: SBP <140 or DBP <90

Table 2: Categorization of the study population according to their BMI status

BMI (kg/m ^{2})[7]	N (%)
Underweight (<18.5)	25 (2.5)
Normal (18.5-24.9)	574957.4)
Overweight (25.0-29.9)	329 (32.9)
Obese (>30.0)	72 (7.2)

Table 3: Demographic characteristics of the study population with odds ratios and 95% CI for obesity, unadjusted and after adjustment for physical activity

Characteristics	Unadjusted for physical activity		Adjusted for physical activity	
	Odds Ratio (95% CI)	p-value	Odds Ratio (95% CI)	p-value
Age				
35-49 years	1.786 (0.891 - 3.583)	0.102	0.673 (0.521 - 0.867)	**0.031**
50-64 years	1.079 (0.493 - 2.364)	0.849	2.187 (1.076 - 4.447)	0.518
65 years & above*	. . .	.		
Ethnicity				
Major hill caste	0.992 (0.220 - 4.473)	0.991	0.875 (0.192 - 3.986)	0.863
Hill native caste	1.410 (0.312 - 6.378)	0.656	1.318 (0.289 - 6.013)	0.721
Hill occupational caste	0.163 (0.394 - 1.917)	0.149	0.164 (0.138 - 1.930)	0.151
Terai caste*	. . .	.		
Religion				
Hindu	1.400 (0.179 - 10.975)	0.749	1.271 (0.161 - 10.036)	0.820
Kirat	2.028 (0.253 - 16.225)	0.505	1.874 (0.233 - 15.099)	0.555
Buddism	2.987 (0.366 - 24.373)	0.307	2.790 (0.340 - 22.920)	0.340
Others*	. . .	.	. . .	.
Educational status				
Illiterate	0.353 (0.147 - 0.847)	**0.020**	0.382 (0.158 - 0.921)	**0.032**
Primary school	0.905 (0.432 - 1.896)	0.791	0.918 (0.437 - 1.929)	0.821
Secondary school	1.042 (0.527 - 2.063)	0.905	1.045 (0.527 - 2.073)	0.899
Post school*	. . .	.	. . .	.
Current job status				
Employed	1.431 (0.807 - 2.535)	0.220	0.682 (0.511- 0.909)	**0.009**
Retired*	. . .	.	. . .	.
Main occupation				
Agriculture	0.532 (0.165 - 1.714)	0.291	0.455 (0.139 - 1.490)	0.193
Lahure	2.744 (1.074 - 7.012)	**0.035**	2.374 (0.913 - 6.175)	0.076
Business, vocational, clerical	3.113 (1.566 - 6.188)	**0.001**	2.462 (1.172 - 5.171)	**0.017**
Others	0.430 (0.377 - 3.447)	0.427	0.328 (0.319 - 2.696)	0.300
Labour*	. . .	.	. . .	
Socioeconomic status				
High	6.478 (2.855 - 14.698)	**<0.001**	5.952 (2.606 - 13.595)	**<0.001**
Middle	3.461(1.925 - 6.225)	**<0.001**	3.126 (1.719 - 5.685)	**<0.001**
Low*	. . .	.	. . .	.

CI: confidence interval * Reference category

Given in the table 2 are the descriptions of BMI and the extent of overweight and obesity in the study population. The mean (standard deviation) of BMI in the study population was 24.28± 3.68 Kg/m^2 (Range: 12.53-36.07). Table 3 shows the odds ratios with 95% confidence interval of obesity across various demographic variables, unadjusted and then adjusted for physical activity. People in the 35-49 years age group were almost twice as likely to be obese than those aged 65 years and above but after adjusting for physical activity, those in the latter age-group were about 1.3 times more likely to be obese (p=0.031) signifying that physical activity was probably protective against obesity in the older age. Obesity was seen almost equally in all ethnic groups and though those belonging to Hindu, Kirat or Buddist religion were more likely to obese than others, the difference was not statistically significant. Similarly, the illiterates were almost three times less likely to be obese than those who had post school education (p = 0.020), the association remained significant after adjusting for physical activity as well (p=0.032**)**.

Those who were currently employed had almost one and a half times more likelihood of being obese than those who were retired from work but the association was not statistically significant. However after adjusting for physical activity, a reverse trend was observed with the retired more likely to be obese than the employed (p = 0.009). In comparison to those involved in labor work, those who were Lahures or those who were into business, vocational and clerical

work had almost three times more probability of being obese(p=0.035 and 0.001), which declined to about two and half times after adjusting for physical activity (p=0.076 and 0.017 respectively). Obesity was more than six times common in the high socioeconomic group than the low socioeconomic group (p<0.001); even in the middle socioeconomic group the odds ratio was high at 3.4 (p<0.001). The odds ratios remained high even after adjustment for physical activity (p<0.001).

Table 4 illustrates the odds ratios with 95% confidence interval of obesity across various dietary, lifestyle and anthropometric characteristics, unadjusted and then adjusted for physical activity. In terms of dietary habits, there was not much difference across the difference strata of diet and fruit consumption. However, takers of non refined fat were twice as probable to be obese than those using refined oil (p=0.001). Similarly, those who were sedentary were twice as likely to be obese than those involved in moderate or heavy activity (p=0.006) there was no significant difference in prevalence of obesity in terms of stress history tobacco or alcohol consumption. In the anthropometric measurements, those with an increased hip ratio had six times higher probability of being obese than those with the normal ratio (p<0.001) and the OR dropped to three after adjusting for physical activity (p<0.001). Similarly, obesity was twice as common in the hypertensives (p=0.033) and remain so even after adjusting for physical activity (p=0.046).

Table 4: Dietary, lifestyle and anthropometric characteristics of the study population with odds ratios and 95% CI for obesity, unadjusted and after adjustment for physical activity

Characteristics	Unadjusted for physical activity		Adjusted for physical activity	
	Odds Ratio (95% CI)	**p-value**	**Odds Ratio (95% CI)**	**p-value**
Dietary habit				
Vegetarian	0.843 (0.371- 1.917)	0.684	0.745 (0.325 - 1.705)	0.485
Non-vegetarian*	. . .	.	. . .	.
Fruit consumption				
Rare	0.485 (0.167 - 1.407)	0.183	0.550 (0.188 - 1.607)	0.275
1-2 times/week	0.636 (0.229 - 1.769)	0.386	0.683 (0.244 - 1.909)	0.468
3-5 times/week	0.882 (0.282 - 2.758)	0.830	0.893 (0.285 - 2.804)	0.847
Everyday*	. . .	.	. . .	.
Fat consumption				
Non-refined	2.322 (1.403 - 3.842)	**0.001**	1.862 (1.091 – 3.174)	**0.023**
Refined*	. . .	.		
Physical activity				
None/Light	2.005 (1.217 - 3.304)	**0.006**	-	
Moderate/ heavy	. . .	.		
Stress history				
More often	0.670 (0.357 - 1.258)	0.213	0.658 (0.350 - 1.239)	0.195
Less often*	. . .	.	. . .	.
Tobacco consumption				
Current users	0.583 (0.327 - 1.037)	0.066	0.589 (0.330 - 1.051)	0.073
Past users	0.807 (0.416 - 1.564)	0.525	0.779 (0.401- 1.516)	0.463
Non users*	. . .	.	. . .	.
Alcohol drinking				
Never	0.982 (0.474 - 2.035)	0.962	1.068 (0.513 - 2.223)	0.860
Occasional	0.735 (0.280 - 1.932)	0.532	0.826 (0.312 - 2.186)	0.700
Frequent	1.036 (0.519 - 2.069)	0.920	1.172 (0.582 - 2.359)	0.657
Past drinker*	. . .	.	. . .	.
Waist hip ratio				
Increased (>0.95)	6.287 (3.426 - 11.537)	**<0.001**	3.192 (2.397 - 4.251)	**<0.001**
Normal*	. . .	.	. . .	.
Blood pressure status				
High	2.195 (1.064 - 4.528)	**0.033**	2.095 (1.013 - 4.334)	0.046
Normal*	. . .	.	. . .	.

CI: confidence interval * Reference category

Discussion

The mean BMI of the subjects in our study population was 24.28 Kg/m^2 which is slightly high than the average for South Asian population. This study revealed that of the 1000 males aged 35 years or more, 401 had BMI higher than 25 kg/m^2 out of which 72 were obese (BMI > 30 kg/m^2). Pandey had used Broca's index to estimate obesity in his four-region hypertension study and had found 24.3% of his study population to be overweight. [8] The proportions for rural hills of Kathmandu, rural Terai, and mountain area were 12%, 9.2% and 8.3% respectively. So a 40.1% of overweight male adults is a high figure compared to other parts of Nepal. The estimation for BMI > 25 kg/m^2 in the Dharan cardiac camp reported by Rawat was a close 44%, meaning that overweight is apparently common in both cardiac patients and general population in Dharan. [9]

In comparison, the proportion of obese population was less (24.5%) in the Jaipur Heartwatch -2 study; the cut-off was also slightly high at 27 kg/ m^2 in the study. But the proportion of truncal obesity was fairly similar (51.2% in our study and 57.4% in the Jaipur study). The BMI profile of male adults of Dharan in our study is also much higher than urban Delhi (23.6%), or Asian immigrants in London (25.7%) or the Europeans (25.9%).[10] The difference could be due to difference in dietary habits, cultures and lifestyles.

The study has suggested that probably physical inactivity is more importantly associated with obesity in the older population. The trend of young being more obese is reversed after adjusting for physical activity (table 3) so that the older age group (65 years & above, and retired) were more obese than the younger ones (35-49 years, and employed). This can perhaps be explained by less intake of calorie in the older age-group as compared to the young. Similarly, those in the business, vocational or clerical works, those who were more literate and those in the higher socio-economic status had significant obesity even after correcting for physical activity pointing probably to increased calorie intake in these groups. Non-significant association obesity with smoking and alcohol habits in our study is consistent with other studies as well. [11,12]

Conclusion

The present study revealed that male population of Dharan has high prevalence of obesity which is correlated significantly with their sedentary lifestyles. Although the importance of physical activity can not be underestimated, its value and effect seem to vary across different age-groups and socio-economic status and occupations. Thus the young, those in the business, vocational or clerical works, and the more prosperous ones probably need to bring down their calorie intake along with emphasis on physical activity in order to bring down their weight and cardiovascular risk. A longitudinal study to see the effects of calorie reduction and increased physical activity in this population could bring about more evidence in the cardiovascular and other non-communicable diseases trend in an urbanizing town like Dharan.

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