Distribution and correlates of Body Mass Index in the elderly residents of the Colombo District

R. Perera[1] , L. Ekanayake[2]

Abstract

Objective:
To determine the distribution and correlates of body mass index in the elderly residents of the Colombo District.

Methodology:
The sample consisted of 452 subjects aged 60 years and above residing in the Colombo district of Sri Lanka. Data collection included a physical examination and an interviewer administered questionnaire.

Results:
The mean BMI was significantly higher in females and the 60-70 year olds compared to males and >70 year olds. Of the sample, 46% was normal weight while 20, 16 and 18% were under weight, over weight and obese respectively. Age, gender and ethnicity were associated with being obese while ethnicity was associated with being overweight.

Conclusion:
The results indicate that the prevalence of under nutrition and overweight/ obesity was high in this sample of the elderly.

Key words: BMI, the elderly, obesity, overweight, under weight

Introduction

Population ageing; a universal phenomenon is considered as one of the important demographic events of the twentieth century. It also has major socio-economic, political and health consequences (1).Old age is usually accompanied by increased vulnerability to illness and the elderly are particularly at risk for inadequate dietary intake and malnutrition. According to Brownie (2), ageing is associated with the decline in several physiological conditions that can have an impact on the nutritional status including the lean body mass.

The Body Mass Index (BMI) is a simple index of weight-for-height that is widely used to measure the nutritional status of individuals and communities. It is also considered as the anthropometric indictor of choice to determine the nutritional status and the risk of morbidity and mortality in the elderly (3). Several studies have assessed the correlates of BMI in the elderly and evidence indicates that socio-demographic, life style factors and co-morbidities are associated with the BMI in this group (4,5,6).

Sri Lanka is considered as one of the fastest ageing countries in the world. In 2006, the over 60 year old population in Sri Lanka was 2.1 million and represented 11% of the total population (7). Though the percentage of the elderly is high in Sri Lanka, there is a paucity of information related to their nutritional status including the body mass status. A recent study on the prevalence of adult obesity in Sri Lanka revealed that overweight/obesity is high among the elderly in Sri Lanka (8). However there is no published data on the prevalence of underweight in this group.

It has been reported that in many developing countries there is a double burden of malnutrition; a high prevalence of both underweight and overweight/obesity (9). In order to determine whether a similar situation exists among the Sri Lankan elderly, it is necessary to obtain information about the distribution of BMI in this group. Therefore the present study was conducted with the aim of determining the distribution and correlates of body mass index in the elderly residents of the Colombo district.

Methodology

The data for the present paper was obtained from a broader study that was carried out to assess tooth loss and its effects on the well-being of an adult population aged 20 years and above residing in the Colombo district.

Ethical clearance for the study was obtained from the Ethical Review Committee of the Faculty of

1. Office of the Provincial Director of Health Services, Maligawatte, Colombo
2. Faculty of Dental Science, University of Peradeniya, Peradeniya
Correspondence : lilanie@pdn.ac.lk

Medicine, University of Colombo. Those living in business premises, prisons, hostels and religious institutions as well as those who were physically and mentally challenged were excluded. Also written informed consent was obtained from all participants.

The formula for estimating a population proportion with absolute precision was used to calculate the sample size.For the purpose of calculating the sample size, the prevalence of underweight in 55-65 year olds in the Western Province (20%) reported in a previous study was considered (10).Accordingly, the minimum sample size required for the present study using a prevalence estimate of 20% at a 95% confidence level and accepting a sample error of 5% was 246. Since it was decided to use the cluster sampling method to select the sample, it was necessary to make allowance for the design effect which was considered as 1.5. After making adjustments for the design effect and non-responses (10%), the sample size required was 406. However 452, $\geqslant$ 60 year old subjects were included in the main study which exceeded the minimum sample size (406) required for this part of the study. Therefore that sample of 452 was adopted for the present study as well.

Cluster sampling technique- a method of probability sampling was used to select the sample and when this technique is used it is necessary to include at least 30 clusters to obtain valid data (11). As the study population is large and distributed over a wide geographical area, it was decided to select the subjects from 60 clusters to ensure validity and also the same number of subjects from each cluster.

Administration of health services in the Colombo district is carried out by the Ministry of Health and the Colombo Municipal Council (CMC). The regions under the purview of these two authorities are further divided into Public Health Inspector areas (PHI). Based on the population proportions of the two regions, it was decided to select 17 of the 60 clusters from the CMC area and 43 from the rest of the district. A PHI area was considered as a cluster. The probability proportionate to size technique (PPS) was used to identify the required number of clusters from each of the two regions and 7 subjects per age group (452/60) were selected from each identified cluster. By using the PPS technique and selecting the equal number of subjects per cluster, each individual in the population would have the same probability of being selected to the sample (12). The households from a selected cluster were identified by the method recommended by the World Health Organization for cluster surveys (13). The individuals who satisfied the inclusion criteria were chosen by visiting the selected households in each cluster.

Data were collected by means of a pre-tested interviewer administered questionnaire and a physical examination. The questionnaire was intended to obtain information on socio-demographic data and the medical history (diagnosed as diabetics and having hypertension). Administration of the questionnaire were done by the first author while a trained research assistant took the height and weight measurements for estimating the body mass index (BMI) of the subjects. An electronic weighing scale was used to measure the weight of the subjects. The scale was calibrated with a weight of 10 kg before a measurement was made. The measurement was made to the nearest 0.1 kg. Standing body height without footwear was measured to the nearest 0.5cm using a height measuring board. To check for accuracy, a second measurement was made for both height and weight.

SPSS 13.0 software (SPSS Inc., Chicago, Il, USA) was used for data analysis.The BMI was classified based on the proposed World Health Organization cut-off values for Asians; normal (18.5-22.99 kg/m^2), under weight (<18.5 kg/m^2), over weight ($\geqslant$ 23-24.99 kg/m^2), obese ($\geqslant$ 25 kg/m^2) (14). Chi square test was used to determine the associations between categorical variables. The differences in BMI between two groups were determined using the t-test. Variables associated with BMI at P<0.06 level in the bivariate analysis were then used in a multnomial logistic regression analysis to determine the independent associations between the dependent and explanatory variables. Age was added to the model as a continuous variable.

Results

Of the 452 subjects, height and weight measurements were obtained only from 437 subjects giving a response rate was 97%. The mean age of the sample was 67.6 ± 6.4 years and there was a preponderance of females (52%). The mean BMI of the sample was 21.75 ± 3.88 kg/m^2.

Table 1: BMI according to age group and sex

Age group (years)	BMI	
	Mean	SD
60-70 (143)	21.75	3.53
>70 (66)	19.59	3.16
Total male (209)	21.07	3.55
60-70 (155)	22.70	4.00
>70 (73)	21.70	4.15
Total female (228)	22.38	4.06
Total sample	21.75	3.88

Table 1 shows the BMI according to age and sex. The mean BMI of males and females were 21.07 ± 3.55 kg/m^2 and 22.38 ± 4.06 kg/m^{2}respectively. The BMI was significantly higher in females compared to males and in the 60-70 year old group than in the >70 year old group. Also in males, the 60-70 year old group had a significantly higher BMI than the >70 year old group. According to the BMI cut-offs used in this study, 46% of the sample was normal weight while 20, 16 and 18% were under weight, over weight and obese respectively. Age, sex, ethnicity and the level of education were significantly associated with the BMI in the bivariate analysis (Table 2). The results of the mutinomal logistic regression analysis for BMI are shown in Table 3. Age was independently associated with being overweight and obese. With a unit increase in age, the odds of being overweight and obese relative to being normal weight decreased by 6% and 5% respectively (0.94-1.00=-0.06; 0.95-1.00=-0.05). The odds of being obese relative to being normal weight was 58% (0.42-1.00=0.58) lower in males compared to women. Also the odds of being obese relative to being normal weight was lower in the Sinhalese (OR=0.14; 95% CI= 0.03-0.79) and the Tamils (OR=0.14; 95% CI= 0.02-0.84) compared to the Moors.

Table 2: Associations between some variables and nutritional status as assessed by the BMI

Variable	Underweight N=87		Normal N=203		Overweight N=69		Obese N=78	
	N	%	N	%	N	%	N	%
Sex								
Male (209)	46	22.0	109	52.2	28	13.4	26	12.4
Female (228)	41	18.0	94	41.2	41	18.0	52	22.8
			p=0.002					
Agegroup(years)								
⩾60 70 (298)	46	15.4	13	45.3	55	18.5	62	20.8
>70 (139)	41	29.5	68	48.9	14	10.1	16	11.5
			p<0.001					
Ethnicity								
Sinhala (352)	75	21.3	164	46.6	54	15.3	59	16.8
Tamil (73)	9	12.3	37	50.7	13	17.8	14	19.2
Moor (12)	3	25.0	2	16.7	2	16.7	5	41.7
			p=0.014*					
Marital status								
Married (284)	59	20.8	128	45.1	49	17.3	48	16.9
Single/divorced/ Widowed (153)	28	18.3	75	49.0	20	13.1	30	19.6
			p=0.54					
Education (years)								
⩽ 5 (130)	35	26.9	59	45.4	13	10.0	23	17.7
>5 (307)	52	0.9	144	46.9	56	18.2	55	17.9
			p=0.03					
Smoking status								
Current (40)	7	17.5	27	67.5	3	7.5	3	7 .5
Ever (93)	23	24.7	44	47.3	12	12.9	14	15.1
Never (304)	57	18.8	132	43.4	54	17.8	61	20.1
			p=0.052					
Diabetes								
Yes (128)	26	20.3	55	43.0	23	18.0	24	18.7
No (309)	61	19.7	148	47.9	46	14.9	54	17.5
			p=0.77					
Hypertension								
Yes (150)	31	20.6	70	46.7	22	14.7	27	18.0
No (287)	56	19.5	133	46.3	47	16.4	51	17.8
			p=0.96					
Total (437)	87	19.9	203	46.5	69	15.8	78	17.8

Table 3: Multinomial logistic regression for nutritional status (n=437)

Variable	Underweight			Overweight			Obese		
	OR	95% CI	p value	OR	95% CI	p value	OR	95% CI	p value
Age				0.94	0.89-0.98	0.02	0.95	0.90- 0.98	0.03
Sex									
Male							0.42	0.19-0.91	0.02
Female							1.00		
Ethnicity									
Sinhala							0.14	0.03-0.79	0.02
Tamil	0.12	0.17-0.87	0.03				0.14	0.02-0.84	0.03
Moor	1.00						1.00		

Reference category: normal weight

Only significant associations are shown in the table

Discussion

In the present study the BMI was categorized according to the cut-off values proposed for populations in Asian and Pacific countries by the Western Pacific Regional Office of the World Health Organization (14). According to this classification a BMI of 23.0-24.9 kg/$m^2$is considered as overweight while a BMI >25kg/$m^2$is defined as being obese. In fact the findings of the study by Wen et al (15) supports the use of these cut-offs to define over weight and obesity in Asian populations.

The prevalence of underweight as measured by the BMI was 20% and lower than the prevalence rates reported for elderly populations from other developing countries of Asia. Jenkins et al (16) have reported that 30% of older Filipinos were underweight while 50% of the elderly living in rural Bangladesh was found to be underweight (17). However the prevalence of underweight among this sample of the elderly was much higher than what has been reported for similar groups from the developed countries of Asia such as Singapore (7%) (6). When gender specific prevalence of underweight was considered it was observed that 22% of males and 18% of females of the present study were underweight. In contrast the prevalence of underweight among Indian male and female elderly was much higher than these figures. Shukla et al (9) in their study on urban Indian adults found that 24-36% and 24-48% of males and females aged 65years and above were underweight. In a recent study it has been reported that 11% of healthy elderly Pakistani men are underweight (18).With respect to the prevalence of overweight and obesity, strict comparisons across Asian studies are not possible due the differences in BMI cut-offs that have been used to define these two entities. According to the BMI cutoffs used in this study, 13 and 12% of the males were overweight and obese respectively while the figures for the females were 18 and 23% respectively. In a recent study conducted in Sri Lanka where the BMI cut-off of 23-27.49 kg/$m^2$was used to define overweight and a BMI of $\geqslant$ 27.5 kg/$m^2$was considered as being obese, 14-21% and 1-8% of elderly men were found to be overweight and obese respectively. With respect to elderly women, 23% was overweight while 5-9% was obese (8).Shukla et al (9) used a BMI cut-off of $\geqslant$ 25.0-29.99 to define overweight and accordingly the prevalence of overweight was 6-11% and 8-19% in elderly Indian males and females respectively.

The present study also attempted at determining the socio-demographic factors associated with the BMI. The prevalence of overweight/obesity decreased with age while the prevalence of underweight increased (Table 2). A similar pattern has been reported for an elderly Italian population (19). Moreover both overweight and obesity were independently associated with age and as age increased the likelihood of being overweight and obese decreased. Similar findings have been reported in other elderly populations as well (6). Ageing is associated with a progressive decrease in appetite and food intake (20) which as a result may lead to a decrease in body weight. Therefore it is possible that the tendency for being overweight/obese particularly in the elderly reduces with increasing age. Also females were more likely to be obese than males and is in agreement with the findings from other studies (6, 21). There are two explanations for the observed association between gender and BMI. Firstly females typically have more body fat than males. Secondly,it has been shown that older women are overall more sedentary and less active than older men (22). Ethnicity was associated with being underweight and well as being obese and

conforms to the findings of other studies (6).

Studies have shown that the level of education is associated with the BMI in the elderly (4). Although the level of education was associated with the BMI in the bivariate analysis it lost its significance in the multivariate analysis indicating the confounding effects of other variables on the level of education –BMI relationship.Diabetes and hypertension are two weight associated conditions and therefore it was considered important to assess the effect of these conditions on the BMI in this sample. However the results revealed that neither diabetes nor hypertension was associated with BMI categories. In contrast Kvamme et al (4)found that diabetes and ischemic heart disease were associated with BMI in the elderly. It was also evident from the results that diabetes and hypertension were prevalent at all four BMI categories but a majority of subjects with these conditions were of normal weight. On the other hand Bays et al (23) having analyzed data from two national surveys conducted in the US found that over 75% of patients with either diabetes or hypertension was overweight/obese and less than 1% of subjects with these conditions were underweight.

Socio-economic status is an important determinant of nutritional status. As it was not possible to obtain accurate information about the social-economic status of the sample, association between socio-economic status and BMI was not determined and is therefore is a limitation of the present study.

In conclusion, it is evident from the BMI distribution that a double burden of malnutrition; a high prevalence of both underweight and overweight/obesity exists in this sample of the elderly and therefore highlights the need for public health intervention programmes to improve the nutritional status of this group. Furthermore as this study assessed the associations between a few variables and the BMI, it is recommended that further studies be conducted to identify other determinants particularly the effect of physical activity on the BMI in the elderly from Sri Lanka.

References

1. United Nations Organization. World Population Ageing: 1950-2050. Department of Economic and Social Affairs, Population Division, United Nations: New York 2001
2. Brownie S.Why areelderly at risk of nutritional deficiency? International Journal of Nursing Practice2006;12:110-118.
3. Shetty P. Measures of nutritional status from anthropometric survey data. Available at **http://www.fao.org/docrep/005/y4249e/y4249e0b.htm** accessed on 26th March 20102.
4. Kvamme JM, Wilsgaard T, Florholmen J, Jacobsen BK. Body mass index and disease burden in elderly men and women: the TromsØ study. European Journal of Epidemiology2010;25:183-193.
5. AhnS, Sharkey JR, Smith ML, Ory MG, Phillips CD. Variations in body mass index among older Americans: the roles of social and lifestyle factors. Journal of Aging and Health 2010;23:347-366 dol: 10.1177/0898264310382657.
6. Østbye T, Malhotra R, Chan A. Variations in and correlates of body mass status of older Singaporean men and women: results from a national survey. Asia-Pacific Journal of Public Health 2011doi: 10.1177/1010539510393726.
7. World Bank (2008) Demographic trends, the profile of old people and emerging issues. Available at **www.sitesources.worldbank.org/INTSRILANKA/Resources/LKAgingChap1.PDF/** accessed on 26th March 2012.
8. Katulanda P, Jayawarena MA, Sheriff MH, Constantine GR, Mattews DR. Prevalence of overweight and obesity in Sri Lankan adults. Obesity Reviews2010;11: 751-756.
9. Shukla HC, Gupta PC, Mehta HC, Hebert JR. Descriptive epidemiology of body mass index of an urban adult population. Journal of Epidemiology and Community Health 2002;56:876-880.
10. Wijewardene K, Mohideen MR, Mendis S, Fernnando DS, Kulathilaka T, Weerasekara D.*et al.* Prevalence of hypertension, diabetes and obesity: baseline findings of a population based survey in four provinces in Sri Lanka. Ceylon Medical Journal2005;50:62-70
11. Kirkwood, B.R. and Sterne, JAC. *Essential Medical Statistics.* 2nd ed. London: Blackwell Publishing Company;2004.
12. Benette S, Woods T, Liyanage WM, Smith DC. A Simplified general method for cluster sample surveys of health in developing countries. World Health Stat Q 1991;44:98-106.
13. World Health Organization.*Immunization coverage cluster survey- Reference manual.* Geneva: World Health Organization; 2005
14. World Health Organization, Western Pacific Region, International Association for the Study of Obesity, International Obesity Task Force. *The Asia-Pacific Perspective: Redefining Obesity and Its Treatment.* Sydney: Health Communications; 2000.
15. Wen CP, Cheng TYD, Tsai SP, Chan HT, Hsu HL, Hsu CC.*et al.* Are Asians at greater mortality risks for being overweight than Caucasians? Redefining obesity for Asians. Public Health Nutrition2008;12:497-506
16. Jenkins KR, Johnson NE, Ofstedal MB. Patterns and association of body weight among older adults in two Asian societies. Journal of Cross- Cultural Gerontology2007;22: 83-99.
17. Kabir ZN, Ferdous T, Cederholm T. Mini Nutritional Assessment of rural elderly people in Bangladesh: the impact of demographic, socio-economic and health factors. Public Health Nutrition2006;9: 968-974.
18. Alam I, Larbi A, Pawelec G, Paracha P. Relationship between anthropometric variables and nutrient intake in apparently healthy male elderly individuals: a study from Pakistan. Nutrition Journal 2011;10:111

19. Perissinotto E, Pisent C, Sergi G, Grigoletto F, Enzi G. Anthropometric measurements in the elderly:age and gender difference. British Journal of Nutrition2002;87:177-186.
20. Akimoto S, Miyasaka K. Age-associated changes ofapetite-regulating peptides. Geriatric & Gerontology International2010 Suppl 1:S 107-119.
21. Carter AO, Hambleton IR, Broome HL, Fraser HS, Hennis AJ. Prevalence and risk factors associated with obesity in the elderly in Barbados. Journal of Aging and Health 2006;18:240-258.
22. Lee Y-S. Gender difference in physical activity and walking among older adults. Journal of Women &Aging 2005;17:55-70.
23. Bays HE, Chapman RH, Grandy S, SHEILD Investigators. The relationship of body mass index to diabetes, hypertension and dyslipideamia: comparison of data from two national surveys. International Journal of Clinical Practice2007;61:737-747.