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Assessment of Nutritional Status and Disease Prevalence among Elderly Population in Elderly Homes in Kandy

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ABSTRACT. *A study was conducted to assess the nutritional status and the prevalence of non-communicable diseases among elderly people in elderly homes in Kandy. A population of 105 elderly people (>65 years), representing 7 elderly homes in Kandy was examined using the Mini Nutritional Assessment (MNA) tool and an additional questionnaire. Skinfold thickness was measured using the Harpenden caliper and body fat was measured using a digital Fat Analyzer. According to the MNA tool 59.1% were at risk of being malnourished, 3.8% weres malnourished and 37.1% were normal. Based on BMI classification, 16.2% was under-weight, 55.2% was normal and 28.6% was over-weight. According to waist-to-hip ratio, 51.4% had a lower risk, 32.4% a moderate risk and 16.2% a higher risk for health problems while 41.9% of the population had hypertension, 13.3% had diabetes and 19.0% had airway obstructive disorders. Furthermore, 31.4% of the population was less active and 67.6% was moderately active. The daily mean energy intake (1945.6 kcal) of subjects was higher than the calculated energy requirement (1490.1 kcal). Among the variables studied BMI had a strong positive correlation with body fat mass ($r=0.901$, $p<0.0001$) and skin fold thickness (biceps $r=0.594$, $p=0.000$; triceps $r=0.538$, $p<0.0001$). Waist circumference also had a positive correlation with skinfold thickness (biceps, $r=0.521$, $p<0.0001$; triceps, $r=0.337$, $p<0.01$) and fat mass($r=0.645$, $p<0.0001$). Waist-to-hip ratio showed a positive correlation ($r=0.322$, $p<0.05$) with biceps skinfold thickness. With waist-to- hip ratio >0.95, the prevalence of non-communicable diseases was clearly high. Further studies are needed using data from other regions in the country to verify the above findings.*

INTRODUCTION

There was an estimated 605 million elderly population in the world in 2002 and among them nearly 400 million were living in low-income countries. By 2025, these statistics were expected to reach more than 1.2 billion, with about 840 million living in low-income countries (WHO, 2002). The achievement and maintenance of good nutritional status among the elderly population are critical for their health, functioning and quality of life (Food & Nutrition Board, 2000).

An insufficient food intake with associated imbalances of essential nutrients and energy from food can increase the vulnerability of the elderly to adverse health outcomes. These include low immune response (Lesourd *et al*., 1998), longer periods of hospitalization and increased chances of hospital readmission (Chima *et al*., 1997), impairment in physical and cognitive functions (Galanos *et al*., 1994), premature institutionalization (Herndon, 1995) and

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mortality (McCormack, 1997). Many of the diseases suffered by the elderly are due to dietary factors, some of which have been operating since infancy. These factors are then confounded by changes that naturally occur with the ageing process.

The availability, preparation and consumption of an appropriate quantity and quality of food are direct interfering factors of food intake, which in turn may be negatively influenced by many other factors such as multiple medications (Ausman and Russell, 1999), burden of diseases (Payette *et al*., 1995), social isolation (Melnik *et al*., 1994), oral health problems (Ritchie *et al*., 1997), depression and life stresses (Payette *et al*., 1995) and chemosensory dysfunction (Rolls, 1999). However, many of these studies were limited to evaluate the adequacy of nutrient intakes among the elderly. In most studies, the nutrient inadequacy was based on nutrient intakes from a single 24-h dietary recall (Bianchetti *et al*., 1990).

The Mini Nutritional Assessment **(**MNA) tool, which is a validated, reliable and easy to use nutritional assessment technique, was used in the present study. This tool was developed to assess nutritional status as part of the standard evaluation of elderly persons aged 65 years and older. Anthropometric assessments, general assessments, dietary assessments and subjective assessments are used through the MNA to assess the nutritional status of elderly people. According to MNA tool, a total score below 17 (out of 30) is considered malnourished, a score between 17- 23.5 is at-risk of malnutrition and a score above 23.5 is considered normal (Guigoz *et al*., 1994). Furthermore, several anthropometric indicators are available to measure the nutritional status of adults, such as body mass index, waist circumference, waist-to-hip ratio and skinfold thickness. Among these, it is important to find out indicators which are more suitable for measuring nutritional status of the elderly population.

The objectives of the present study were to assess the nutritional status and the non-communicable disease prevalence of the elderly people living in elderly homes in Kandy, Sri Lanka and to investigate relationships among different anthropometric and health parameters of the elderly people.

MATERIALS AND METHODS

Human subjects

The study included 105 adults (68 females and 37 males) aged over 65 years, from 7 elderly homes in the Kandy district, Sri Lanka. The data collection was carried out from 8th to 15th February 2009.

Equipment and tools

Standardized MNA tool, provided by Nestle HealthCare Nutrition, Sri Lanka was used to assess the overall nutritional status. Since the MNA tool uses a combination of different types of assessments, it gives accurate results compared to those obtained only by anthropometric assessment alone.

Holtain skinfold caliper (PE025, U.K.) was used to get the skinfold thickness of the subjects and the body fat percentage was assessed using the digital fat mass analyzer (Omron, HBF-306, Japan). Health records provided by the doctors were used to get the prevalence of non-communicable diseases among the study population.

An additional questionnaire was used to collect information regarding food intake, availability of non-communicable diseases and the level of activity. The NutriSurvey 2007 nutrition software was used to calculate the energy and the macronutrients in the diet using food composition data of locally available foods.

Measurement of weight and height

Weight was measured using a digital weighing scale. Three consecutive readings were taken for each subject and the average weight was recorded to the nearest 100 g. A portable stadiometer, which could read to the nearest 0.1 cm was used to measure the height of the subjects.

Measurement of mid upper-arm, calf-, waist- and hip circumferences

A non-stretchable measuring tape was used to measure the circumferences of mid upper-arm, calf, waist- and hip. Mid upper-arm circumference was taken from the non-dominant arm when the forearm was hanging relaxed at the side. The circumference of the widest point of calf was measured as the calf circumference. Waist and hip circumferences were measured when the subject was standing erect with abdominal muscles relaxed, arms at sides and heels together. The waist circumference was taken at the horizontal plane mid-way between the lowest rib margin and the iliac crest when the chest is exhaled. The widest point of the hip was used to measure the hip circumference. Each measurement of circumferences were taken as three consecutive readings and average was used as the final reading.

Measurement of skinfold thickness

The subject was advised to hang arm loosely and to position the palm interiorly. The triceps skinfold thickness was taken at the mid-point along the posterior midline of the upper arm and the biceps skinfold thickness was taken along the long axis of anterior midline. Three readings were taken from each site and average values were used as triceps and biceps skinfold thickness.

Measurement of fat percentage

Data fed (height, weight, age, sex) digital fat mass analyzer was used to get the body fat percentage when the subject was standing straight and holding the arms of the fat analyzer with stretched elbows.

Filling the MNA tool and questionnaire

Individual subjects were interviewed in the presence of the warden of each elderly home and their health records were observed before filling the MNA tool. Additional information was collected by direct observation of subjects.

Classification of activity levels

The study subjects were divided into three categories as bed-ridden, moderately active and less active based on their observed behaviour as suggested by Varsha (2003). The subjects who were full-time on bed were considered as bed-ridden while those who were most of the time active and moved as usual were categorized as moderately active. Less active category included those who were on bed most of the time but could get up and move out when necessary.

Measurement of dietary intake and energy requirement

All meals provided on one particular day were measured using standard unit sizes and the measurement was repeated three days for each of the seven elderly homes. The average energy content was calculated by analyzing the diet using food composition data of locally available foods with the help of NutriSurvey 2007 nutrition software.

The total energy requirement was calculated using the basal energy expenditure (BEE), activity factor and the thermic effect of food. The BEE was estimated using the Harris-Benedict equations given below.

BEE female = 655.1 + {9.56 × weight (kg)}+ {1.85 × height (cm)} – {4.67 × age (y)}
BEE male = 66.47 + {13.75 × weight (kg)}+ {5.00 × height (cm)} – {6.77 × age (y)}

Activity factors used were 1.2 for less active and 1.3 for moderately active elders (Varsha, 2003).

Data and statistical analysis

MNA score and different activity levels, and anthropometric measurements and disease prevalence, were compared using Chi-square tests.

The correlation of fat mass and the skinfold thickness with BMI, waist circumference and waist-to-hip ratio was assessed using Pearson's correlation method with the help of Minitab statistical software.

RESULTS AND DISCUSSION

Sample characteristics

The study sample consisted of 105 adults living in elderly homes in Kandy, Sri Lanka with a female:male distribution of 64.8%:35.2%. The mean age ± SD of the subjects was 75 ± 7.6 years and the mean BMI was 23.0 ± 4.3. Other anthropometric data and body fat percentage of the study subjects are given in Table 1.

Table 1. Characteristics of the study subjects (n= 105)

Characteristic	Mean ± SD
Age (years)	75.0 ± 7.6
Weight (kg)	49.8 ± 10.2
Height (cm	148.7 ± 8.7
Body mass index (kg m^{-2})	23.0 ± 4.3
Waist circumference (cm)	83.7 ± 11.8
Hip circumference (cm)	89.9 ± 10.2
Waist-to-hip ratio	0.93 ± 0.09
Skinfold thickness	
Biceps (mm)	5.5 ± 2.6
Triceps (mm)	10.7 ± 3.8
Fat mass (%)	36.1 ± 6.6

Overall nutritional status based on MNA tool and BMI classification

The nutritional status of the population based on the MNA tool is given in Table 2. Accordingly, the prevalence of the risk of being malnourished was 15.5 times of prevalence of actually malnourished in the elderly population. One third of the adult population under study was found to be normal.

Table 2. Nutritional status of the study population based on MNA tool (n=105)

Nutritional status	Number of Subjects	Percentage
Malnourished	4	3.8
Risk of being malnourished	62	59.1
Normal	39	37.1

Table shows the nutritional status of subjects based on WHO recommended BMI values. Accordingly, 28.6% of elderly subjects were over-weight while the prevalence of under-weight was only 16.2 %.

Table 3. Nutritional status of the study population based on BMI (n=105)

Nutritional status	No. of Subjects	Percentage
Under-weight (<18.5)	17	16.2
Normal (18.5-24.9)	58	55.2
Out of normal		
18.5-22.9	43	74.1
23.0-24.9	15	25.9
Over-weight (≥25.0)	30	28.6
Out of overweight		
Pre-obese (25.0-29.9)	25	83.3
Obese (≥30.0)	5	16.7

Majority of the sample identified as under-weight in the BMI based classification falls into the group of risk of being malnourished in the MNA tool. It appears that the BMI based classification over-estimated the normal percentage compared to the MNA tool. The MNA tool considers a variety of factors of individual subjects but BMI based classification considers only the weight and height. Hence, the accuracy of results of the MNA tool is higher compared to those of BMI based classification (Kabir *et al.*, 2007).

Health risk based on waist-to-hip ratio

Waist-to-hip ratio is associated with number of health hazards including cardiovascular disease and type 2 diabetes mellitus. Based on the cut-off values recommended by the National Institute of Health, US Department of Health and Human Services, majority of females had higher risk (66.2%) while males had lower risk (51.4%). for adverse health outcomes (Table 4). Prevalence rate of high risk of getting adverse health outcomes is four times higher among females compared to males.

Table 4. Health risk of elderly subjects based on waist-to-hip ratio

Gender	Waist-to-hip ratio	No.	%
Female(68)	≤0.80 (Low risk)	12	17.6
	0.81-0.85 (Moderate risk)	11	16.2
	>0.85 (High risk)	45	66.2
Male (37)	≤0.95 (low risk)	19	51.4
	0.96-1.00 (Moderate risk)	12	32.4
	>1.00 (High risk)	6	16.2

MNA score for different activity levels

Based on the classification of activity levels, 71 subjects in the study (67.6%) were moderately active while 33 subjects (31.4%) were less active. There was only one (1%) bed-ridden subject who was not included in the study.

Moderately active adults showed a mean MNA score of 22.5, while less active adults had a mean score of 20.7 out of 30.0 and the difference was not statistically significant ($p>0.05$). The mean energy requirement for moderately active and less active adults was 1503.8 kcal and 1425.8 kcal, respectively.

The mean energy requirement of the study population was 1490.1 kcal per day. In estimating the daily energy intake of the incumbents of the elderly homes, random observations were made on their diets received throughout the day. It was revealed that each person usually eats the entire portion of food provided to him/her. On that assumption the mean energy intake was calculated to be 1945.6 kcal per day, which was higher than the mean requirement. Surprisingly, despite the high mean energy intake of the subjects, the risk of being malnourished was higher. Perhaps there could be other factors affecting absorption and utilization of different energy sources in the elderly population. The contribution from carbohydrate, protein and fat in their diet was 53.2%, 10.5% and 36.3%, respectively. There was slightly higher contribution from fat to the total energy intake when compared to the recommended levels of a balanced diet.

Prevalence of non-communicable diseases among the elderly population

Hypertension was the most common non-communicable disease among both male and female elderly populations (Table 5). The prevalence of diabetes mellitus was high among females whereas airway obstructive disorders remained at a higher level for both males and females. It has been reported that restriction and distortion of the chest cage can reduce pulmonary vital capacity and maximal breathing capacity extensively (Culhan *et al*., 1994). The prevalence of cancer was very low and only one female was found to have a cancer. Higher prevalence of non communicable diseases like hypertension, diabetes and airway obstructive disorders were observed when the waist-to-hip ratio was greater than 0.95 (Fig. 1).

Relationship among anthropometric variables

The relationship among different anthropometric variables is shown in Table 6. The strongest positive correlation ($r= 0.901$) was observed between BMI and fat mass while there were

significant correlations between BMI and skinfold thickness, and BMI and waist circumference.

Table 5. Prevalence of non-communicable diseases among the elderly population

Disease	Female (n=68)		Male (n=37)		Total (n=105)	
	No.	%	No.	%	No.	%
Diabetes	12	17.6	2	5.4	14	13.3
Hypertension	30	44.1	14	37.8	44	41.9
AOD	10	14.7	10	27.0	20	19.0
Other	06	8.8	0	0	06	5.7
Total	58	85.3	26	70.3	84	80.0

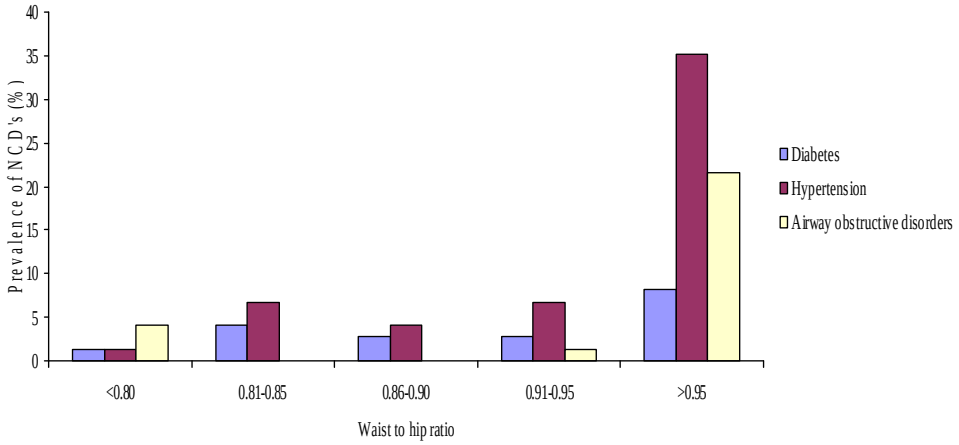

Fig. 1. Distribution of non-communicable diseases based on waist-to-hip ratio

Table 6. Correlation coefficients of relationships among anthropometric variables

Parameter	Correlation coefficient	p-value
Body mass index and fat mass	0.901	< 0.0001
Body mass index and biceps skinfold thickness	0.594	< 0.0001
Body mass index and triceps skinfold thickness	0.538	< 0.0001
Waist circumference and fat mass	0.645	< 0.0001
Waist circumference and biceps skinfold thickness	0.521	< 0.0001
Waist circumference and triceps skinfold thickness	0.337	< 0.01
Waist-to-hip ratio and fat mass	-0.223	0.150
Waist-to-hip ratio and biceps skinfold thickness	0.322	< 0.05
Waist-to-hip ratio and triceps skinfold thickness	0.094	0.466

The relationship of waist circumference and biceps skinfold thickness is stronger than waist circumference and triceps skinfold thickness. However, the errors associated with measuring skinfold thickness may reduce the correlation strength of waist circumference and skinfold thickness. Notably, the correlation between waist circumference and body fat mass is stronger than waist circumference and skinfold thickness. Nevertheless, there was no positive

correlation between waist-to-hip ratio and the body fat mass although a slight positive correlation was observed between waist-to-hip ratio and biceps skinfold thickness.

CONCLUSIONS

A considerably higher proportion (59%) of elderly people living in elderly homes in Kandy was at risk of being malnourished. The prevalence of hypertension, diabetes mellitus and airway obstructive disorders among the population was 41.9%, 13.3% and 19.1% respectively. Of the anthropometric and other variables measured, positive correlations were observed between BMI and body fat, BMI and skinfold thickness, waist circumference and body fat mass, waist circumference and skinfold thickness and waist-to-hip ratio and biceps skinfold thickness. The strongest correlation (r=0.901) was observed between BMI and body fat mass indicating that BMI could represent the body fat in the elderly better than other anthropometric measurements.

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