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Anthropometric measurements of the elderly

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ABSTRACT

Body composition was assessed in a group of 344 free-living elderly between 60 and 89 years by means of anthropometry. The height, weight and body mass indexes of the elderly were reduced with advancing age in both the males and females. Skinfold thickness measurements also declined with age. Overall, the female elderly had a greater tricep skinfold thickness but smaller mid-arm circumferences, mid-arm muscle circumference and mid-arm muscle area compared to the male.

INTRODUCTION

Anthropometric measurements are now regarded as important indicators of an individual's nutritional status. Malnutrition, either undernutrition or overnutrition gives rise to detrimental alterations of body composition. If the loss of available energy reserve in the malnourished is severe enough, it can result in increased morbidity or mortality. Anthropometry is a convenient and reliable technique whereby changes in the status of nutrition can be evaluated easily. It also provides a means of monitoring the appropriateness of nutritional therapy. The anthropometric measurements most commonly used for assessing nutritional status are height, body weight, mid-arm circumference and triceps skinfold thickness (Blackburn *et al.*, 1977).

Physiologic changes in stature and body composition that accompany aging can be detected by means of nutritional anthropometry. (Mitchell & Lipschitz, 1982). Changes that occur includes height, weight, body composition and lean body mass. Bowman and Rosenberg, (1982) also noted the many changes with age that effect skinfold measurements such as reciprocal changes in lean body mass and body fat, changes in the distribution of body fat and alterations in skinfold thickness, turgor, elasticity and compressibility. A decrease in lean body mass is a characteristic of aging regardless of energy intake (Forbes, 1976).

Anthropometric measurements obtained in the elderly can be compared against a reference standard such as the NHANES

standards which end at the age of 74 (Shuran & Nelson, 1986., McEvoy & James, 1982 and Burr & Phillips, 1984). However it is also necessary to compare the data obtained with a local reference standard for the elderly which is lacking.

The main objective of this study is to assess the anthropometric measurements of the elderly population and to provide some baseline data for the elderly in Malaysia.

METHOD

Antropometric studies were carried out on 344 Malay subjects in three states at the southern Peninsular Malaysia comprising of Johor (n = 117, male = 55 and female = 62), Malacca (n = 97, male = 33 and female = 64) and Negeri Sembilan (n = 130, male = 52 and female = 78). In Johor, two districts were involved which is Muar and Batu Pahat. Two areas were also chosen for Malacca that is Alor Gajah and Air Molek. In Negeri Sembilan however, respondents were taken from four areas; Kuala Pilah, Kampung Teluk in Port Dickson, Kampung Jimah Baru and lastly Kampung Sungai Sekawang. To reach a sampling of the population group, the headman of the village were contacted for permission to conduct the study. The free-living subjects who were all in apparent good health were than invited to participate on a voluntary basis in the community centers , while those who were bedridden were not included in the study. The subjects were mostly involved in agriculture activities like working in padi fields and rubber, oil palm or pineapple plantations

Antropometric measurement were taken on respondents aged 60 to 89 years of age by trained staff. Subjects were then categorizes in three different cohort groups based on age which is 60 to 69 years, 70 to 79 years and 80 to 89 years of age. Weight of respondent were measured with a portable scale in light clothing (without shoes) to the nearest 0.1kg. While the height was measured with a tape to the nearest 0.5 cm. Skinfold thickness measurements were taken at 4 sites (tricep, bicep, subscapula and suprailiac) as recommended by Durnin and Rahaman (1967) using Harpenden skinfold calipers. From the weight and height values the body mass index (Wt/Ht^2) was calculated for each individual. Upper arm circumference was measured using an insertion tape following standard procedures (Burr & Phillips, 1984).

Estimates of muscle size were derived by computation as follows:

Arm muscle circumference (cm) = arm circumference (cm) - (π x triceps skinfold [mm])

$$\text{Arm muscle area} = \frac{Cm^2}{4\pi}$$

where Cm = muscle circumference.

RESULTS

The study showed that the mean anthropometric measurements as seen in table 1 declined with age increases. The mean weight of the elderly (sexes combined) decreased from 54.38 kg at the age of 60 to 69 years to 48.06 kg at age of 80 - 89

Table 1 : Anthropometric Data For Elderly in Southern Peninsular Malaysia Based On Age Specific Group

Measurements	Age 60 to 69 years n=207				Age 70 to 79 years n=103				Age 80 to 89 years n=34			
	M (n=80) x + sd	F (n=127)	Statistical Analysis	Total Mean (n=207)	M (n=44)	F (n=59)	Statistical Analysis	Total Mean (n=103)	M (n=16)	F (n=18)	Satistical Analysis	Total Mean (n=34)
Body weight (kg)	58.66± 11.84	51.69± 10.85	p<0.05	54.38± 11.72	54.14± 10.04	48.36± 10.66	p<0.05	50.83± 10.74	53.46± 12.81	43.26± 12.17	p<0.05	48.06± 13.32
Body height (cm)	159.24± 7.23	147.44± 5.56	p<0.05	152.00± 8.49	157.55± 7.61	146.28± 5.19	p<0.05	151.09± 8.43	155.68± 7.12	144.32± 4.93	p<0.05	149.66± 8.29
Body Mass Index (kg/m^2)	23.24± 4.21	23.70± 4.67	n.s	23.52± 4.49	21.95± 4.07	22.56± 4.54	n.s	22.30± 4.34	21.78± 3.32	21.30± 5.15	n.s	21.52± 4.32
Mid Arm Circumference (cm)	26.64± 4.20	26.29± 3.78	n.s	26.43± 3.94	25.16± 2.68	24.72± 3.44	n.s	24.93± 3.10	25.21± 2.99	21.92± 3.97	p<0.05	23.86± 3.72
Mid Muscle Circumference (cm)	23.41± 3.93	21.17± 2.81	p<0.05	22.06± 3.47	21.95± 2.55	20.67± 2.48	p<0.05	21.26± 2.58	22.19± 2.89	18.93± 2.06	p<0.05	20.86± 3.01
Tricep (mm)	11.05± 5.10	17.34± 7.16	p<0.05	14.91± 7.12	9.95± 5.72	15.04± 6.48	p<0.05	12.87± 6.64	9.63± 2.69	13.57± 7.83	n.s	11.71± 6.23
*Body fat (%)	24.38± 7.70	24.45± 8.13	n.s	24.28± 6.62	22.36± 6.70	24.503± 7.82	p<0.05	23.69± 7.69	24.92± 8.15	22.24± 10.12	n.s	24.29± 9.79

*Calculated from Womerskey & Durnin (1977) prediction equation

Male BF% = 1.340 x BMI - 12.5

Female BF% = 1.37 x BMI - 3.5

years with a greater corresponding decline observed for the female (8.43 kg) compared to the male (5.20 kg).

According to Noppa *et al.*, (1980), body weight of women increases with age till the age of 45 to 50 years after which it decreases with the aging process. Likewise, it is well recognized that height decreases with age. Such a trend was seen in this study whereby the average height of the combined sexes decreased from 152 cm (60 - 69 years) to 149.66 cm (80 to 89 years). Part of this effect is related to loss of stature within individuals, and effect that has been attributed to weakening or imbalance of muscle groups, postural changes, osteoporosis, disk deterioration, and spinal deformities such as kyphosis and scoliosis (Trotter and Gleser, 1951, Dequeker *et al.* 1969, Rossman 1986). A significant overall decrease in height was apparent among the very elderly. This is consistent with what was reported by Rossman's (1986) that is loss of height becomes progressively more severe in the eight and ninth decades.

The body mass index is now widely used as an index of body fatness, and is recommended for this purpose by several advisory committees (Royal College of Physicians, 1983; Simopolous & Van Itallie, 1984). Garrow (1981) proposed a cut-off values for the classification of obesity as BMI $\geq$ 20 kg /m^2 for normal; $\geq$ 25 kg/m^2 for overweight and $\geq$ 30 kg/m^2 for obesity, which are generally accepted.

The average body mass indexe of the elderly of 23.52 kg/m^2, 22.30 kg/m^2 and 21.52 kg/m^2 for age 60 to 69 years, 70 to 79 years and 80 to 89 years respectively were within the normal range. A reduction in the body mass indexe with an increase in age even though it was not significant was also observed. It was reported that with advancing age, lean body mass decreases (Noppa *et. al.*, 1979; Steen, Isaksson & Svanborg, 1979) and the amount of body fat generally increases until age 70 after which it decreases again (Frisancho, 1981; Burr & Phillips, 1984). Thus it seems likely that the relation between body fatness and body mass index changes with advancing age (Deurenberg *et. al.*, 1989). However the average body fat percentage derived from the body mass index in the elderly using the prediction equations of Womersley & Durnin (1977) were 24.28%, 23.69% and 24.29% for ages 60 to 69 years, 70 to 79 years and 80 to 89 years respectively.

Skinfold measurements which are simple to obtain, are less affected by hydration status than weight and are independent of height (Chernoff, 1991). Skinfold measurements have also been shown to correlate with body fat (Durnin & Womersley, 1974). Age and sex-specific percentile distributions for the triceps skinfold thickness, the mid-upper arm circumference, the mid-upper arm muscle circumference and the mid-upper arm muscle area of the elderly are presented in table 2.

The mean triceps skinfold thickness for elderly women between the ages of 60 - 89 years was 16.35 $\pm$ 7.12 mm. Ninety percent of the female elderly between the 5^{th} and 95^{th} percentiles had their skinfold

Table 2 : Trisep Skinfold, Mid Upper Arm Circumference, Mid Upper Arm Muscle Circumference and Mid Upper Arm Muscle Circumference Area By Percentile.

SEX AND AGE GROUP	SAMPLE NUMBER	MEAN ± SD	PERCENTILE						
Trisep Skinfold Thickness (mm)			5th	10th	25th	50th	75th	90th	95th
Women 60-89years	164	16.35 ± 7.12	5.75	6.51	8.66	11.44	15.66	19.44	21.49
60 - 69 years	113	17.34 ± 7.16	7.36	8.91	11.70	15.76	21.03	28.68	31.62
70 - 79 years	43	15.04 ± 6.48	6.14	6.68	9.72	12.02	17.41	19.20	20.70
80 - 89 years	8	13.57 ± 7.83	3.75	3.95	4.55	6.55	8.55	10.45	12.15
Men 60 - 89 years	121	10.54 ± 5.10	5.27	5.82	6.97	8.59	11.83	14.64	16.23
60 - 69 years	72	11.05 ± 5.10	5.35	6.28	7.42	9.28	12.82	16.08	18.62
70 - 79 years	37	9.95 ± 5.72	5.00	5.43	6.33	7.85	12.52	16.30	18.22
80 - 89 years	12	9.63 ± 2.69	5.45	5.75	7.15	8.65	10.15	11.55	11.85
Mid-Upper-Arm Circumference (cm)									
Women 60 - 89 years	164	25.64 ± 3.85	19.60	20.35	21.84	23.78	25.94	27.92	28.87
60 - 69 years	112	26.29 ± 3.77	20.28	21.15	23.38	25.63	29.72	30.85	31.81
70 - 79 years	44	24.72 ± 3.44	19.68	20.65	22.45	24.75	26.15	30.25	31.75
80 - 89 years	8	21.92 ± 3.97	18.85	19.25	19.70	20.95	21.95	22.65	23.05
Men 60 - 89 years	122	26.04 ± 3.73	21.24	22.12	23.80	25.36	26.65	28.36	29.09
60 - 69 years	73	26.64 ± 4.20	20.16	21.62	24.27	26.54	28.22	29.84	30.80
70 - 79 years	38	25.16 ± 2.68	21.25	21.88	23.51	25.38	27.12	29.05	30.00
80 - 89 years	11	25.21 ± 2.99	22.30	22.85	23.62	24.17	24.62	26.20	26.48
Mid-Upper-Arm Muscle Circumference (cm)									
Women 60 - 89 years	164	20.92 ± 2.73	17.14	17.67	18.57	19.82	21.13	22.95	23.63
60 - 69 years	112	21.17 ± 2.81	17.15	18.06	19.30	20.81	22.55	24.61	25.90
70 - 79 years	44	20.67 ± 2.48	17.30	17.82	18.89	20.46	22.50	24.18	24.55
80 - 89 years	8	18.93 ± 2.06	16.98	17.12	17.52	18.18	18.85	20.05	20.45
Men 60 - 89 years	122	22.84 ± 3.51	17.98	19.42	20.83	22.16	23.54	24.98	25.53
60 - 69 years	73	23.41 ± 3.93	17.68	19.42	21.85	23.50	24.58	26.49	27.22
70 - 79 years	38	21.95 ± 2.55	16.95	19.25	20.41	22.05	24.24	24.95	25.60
80 - 89 years	11	22.19 ± 2.89	19.32	19.60	20.24	20.92	21.80	23.50	23.78
Mid-Upper-Arm Muscle Area (cm^2)									
Women 60 - 89 years	164	33.48 ± 0.21	25.22	26.68	29.15	32.5	35.4	38.03	39.45
60 - 69 years	112	34.60 ± 0.18	25.71	26.82	30.92	34.05	42.54	37.99	38.12
70 - 79 years	44	31.84 ± 0.16	25.09	27.40	29.96	35.03	35.06	46.71	50.76
80 - 89 years	8	24.84 ± 0.18	24.87	25.82	26.58	28.42	28.59	29.39	29.46
Men 60 - 89 years	122	41.09 ± 0.57	30.59	32.8	37.19	40.96	42.0	45.03	45.65
60 - 69 years	73	42.74 ± 0.54	27.19	30.74	38.32	44.44	46.61	48.93	48.78
70 - 79 years	38	38.66 ± 0.06	30.84	32.41	36.88	41.81	42.81	45.60	46.93
80 - 89 years	11	39.19 ± 0.37	33.75	35.26	36.38	36.64	36.57	40.57	41.24

measurements less than or equal to 21.49 mm but greater than 5.75 mm. According to Falciglia et. al., (1988), the skinfold measurements of women showed differences that were related to aging whereby the measurements were lowered with age. The mean skinfold of women age 60 to 69 years was 13.3% greater than those age 70 to 79 years whose skinfold thickness in turn was 9.8% greater than those age 80 to 89 years.

Among the men there was a slight lowering of the mean tricep skinfold thickness with age similar to what was observed by Falciglia *et. al.*, (1988) in her Cincinnati Anthropometric survey with the elderly. The mean tricep skinfold thickness of the men between 60 to 89 years was 10.54 ± 5.10 mm. Ninety percent of the men between the 5^{th} and 95^{th} percentiles had their measurements less than or equal to 16.23 mm but greater than 5.27 mm. The mean skinfold thickness (11.05 ± 5.10 mm) of men age 60 - 69 year was 10% greater than those age 70 to 79 years and 3.2% than those 80 to 89 years. Overall the mean tricep skinfold thickness of the oldest group among the men was 12.9% less than the youngest group while among the female, the oldest group was 21.7% less the youngest female elderly.

The differences in the tricep skinfold thickness between male and female elderly were due to the wider range measurement among the female as compared to male. Ninety percent of female had measurements within a range of 15.74 mm as compared to male (10.96 mm). The mean skinfold thickness of female age 60 - 89 years was found to be greater than male of the same age group as well as within each age sub group. Besides that was a noticeable difference in trend with age, whereby the lowering of the mean skinfold thickness from the youngest to oldest female were 21.74% compared to 12.9% reduction in the mean of the elderly male.

Mid upper arm circumference

The mean upper arm circumference for elderly female aged 60 to 89 years was 25.64 ± 3.85 cm. Ninety percent of the female elderly had their measurement as less than or equal to 28.87 cm but greater than 25.64 cm. The mean arm circumference was lowered as age increases. Female elderly age 60 to 69 years had measurement 6.0% greater than those 70 to 79 years which instead was 11.3% greater than those aged 80 to 89 years. Overall the reduction from youngest age to oldest age was 16.6%.

For the elderly male aged 60 to 89 years the mean arm circumference was 26.04 ± 3.73 cm. The mean arm circumference of elderly male exceeded those of elderly female in all age group. Their measurements fell within a range of 7.85 cm which was less than or equal to 29.09 cm but greater than 21.24 cm. The reduction in measurement from youngest to oldest was by 5.4%.

Mid upper arm muscle circumference

The mean arm muscle circumference for the elderly female aged 60 to 89 years was 20.92 ± 2.7 cm, ninety percent of them falls within a

range of 6.49 cm which was less than or equal to 23.63 cm but greater than 17.14 cm. There was a reduction in mean arm muscle circumference as age increase that is 10.58% from the youngest to the oldest.

The measurement for male elderly aged 60 - 89 was 22.84 ± 3.51 cm. With ninety percent of them having lesser than or equal to 25.53 cm but greater than 17.98 cm. The range was within 7.55 which is greater than female. A slight reduction (5.21%) in measurement was observe from the youngest age group to the oldest. However the mean arm muscle circumference for elderly male 60 - 89 years was slightly greater than female elderly of the same group and within sub group.

Mid upper-arm muscle area

The mean arm muscle area of female elderly age 60 to 89 year was 33.48 ± 0.21 cm^2, with 90% of them falls within a range of 14.23 cm^2. That is less than or equal to 39.45 cm^2 but greater than 25.22 cm^2. A reduction (28.2%) in measurement was observed from the oldest elderly female to the youngest.

As for the male elderly the mean was 41.09 ± 0.57 cm^2 with measurements falling within a range of 15.06, which is less than or equal to 45.65 cm2 but greater than 30.59 cm2. A reduction 8.3% in measurement was also observed from the oldest elderly to the youngest.

Overall the mean arm muscle area of male elderly exceeded the female elderly. The measurements for males elderly were distributed over a wider range than those of female. The difference between oldest and youngest group was greater for woman than for men.

CONCLUSION

The anthropometric results indicate a reduction in weight and height as age increases. The average body mass indexe of the elderly for different age group were within the normal range. However a reduction in the body mass indexes with an increase in age was observed even though it was not significant. Looking at the age and sex percentile distributions for triceps skinfold thickness, arm circumference, muscle circumference and arm muscle area of the elderly indicated a trend related to aging. The trend were, the greater the age, the lower the measurement of the four parameters. The decline with age is greater in elderly female than in male. Overall the tricep skinfold thickness among elderly female were larger but smaller arm circumference, arm muscle circumference and arm muscle area compared to male.

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