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AGEING IN STRUCTURAL AND FUNCTIONAL DIMENSIONS AMONG INSTITUTIONALIZED AND NON-INSTITUTIONALIZED SENIOR CITIZENS

ABSTRACT: The present study is aimed to find out and compare the structural and physiological changes with age between institutionalized and non-institutionalized aged males. A total of 188 males ranging in age from 60 to 89 years were studied. A separate group of 30 young adult males (20–25 years) were taken as controls. Eight anthropometric variables (stature, sitting height, weight, triceps skinfold thickness, subscapular skinfold thickness, chest skinfold thickness, upper arm circumference, waist circumference, hip circumference) and four physiological variables (heart rate, blood pressure, forced vital capacity, grip strength) were taken for the present study. Body mass index (BMI) and waist hip ratio (WHR) were computed statistically.

Stature, sitting height, forced vital capacity and average grip strength showed a decline in their mean values with age whereas weight, adiposity level as assessed from skinfold thickness, chest skinfold thickness and circumferences measurements, systolic blood pressure, body mass index and waist/hip ratio showed an increase with advancing age. Significant intragroup differences were found in both institutionalized and non-institutionalized aged males for all the variables. Weight, skinfold thickness at suprailiac and chest sites, upper arm circumference, body mass index, systolic blood pressure and average grip strength showed significant differences between the corresponding age groups of institutionalized and non-institutionalized aged males.

KEY WORDS: Adiposity – Anthropometry – Gerontology – Body fat – Senior citizens

INTRODUCTION

Ageing is a universal phenomenon. It is a complex and multidimensional process. Old age is associated with changes and deterioration in structural and functional status of an individual. An important characteristic of age related changes are their variability. The individuals age at different rate and the different body parts of an individual age with varying rate.

The institutionalization of the senior citizens is a fledgling concept in India. Modernization with the influence of westernization has resulted in breakdown of joint family system in India. This has further resulted in diminishing acceptance of one's elder family member by the younger family members. This transition has led to evolution of old age homes. Institutions here refer to an old age home with residential facility to older people either on pay & stay basis or free accommodation. The homes provide regular medical facility on some fixed days in a week or 24 hours round the clock medical facility. The homes also provide two or three meals per day. Some of the old age homes are also provided with recreation facilities like TV, radio indoor games (carrom), library facility. People in old age homes chat with their peers for most of the time and have relatively lower level of physical activity than their counterparts staying with families. The influence of institutionalization on the ageing phenomenon

has been studied from psychological point of view by many researchers; however, the literature about the biological perspectives of ageing phenomenon in institutionalized elderly people is scanty. Besides, studies of institutionalized aged people are few in India, and their comparative accounts with non-institutionalized aged people (staying within family set-up) are still fewer.

The present study is an effort to fill the gap. The aim of the present research work is to find changes in structural and functional parameters of body and their interplay in influencing the phenomenon of ageing among institutionalized and non-institutionalized aged people.

MATERIAL AND METHOD

A total of 218 individuals volunteered to take part in the study, including a control group of adult males (CM). Both the test groups (institutionalized as well as non-institutionalized older persons) were divided into five groups, viz 60+, 65+, 70+, 75+ and 80+ years. The data was collected from Delhi metropolis. Institutions were the old age homes with regular medical services. All inmates in the institutions (old age homes) were staying over there from more than a year.

The institutionalized aged males (IAM), non-institutionalized aged males (NIAM) and control males (CM) belonged to middle class socio-economic group. The subjects consumed rice-based mixed diet and a majority of them were vegetarians. The differences in lifestyle between IAM and NIAM groups were quite apparent in their daily routine, habitual physical activities, anxiety levels and level of responsibilities.

The data obtained from the institutionalized category was the limiting factor for the present study with regard to sample size and composition. The data from various institutions was found to be heterogeneous, so in order to maintain the uniformity of the total sample, efforts were made to collect a comparable heterogeneous sample for the non-institutionalized aged males. The sample was heterogeneous with respect to caste group. Total sample included subjects from one caste group, namely Punjabis, for both the groups under study, i.e. institutionalized and non-institutionalized males. Similarly, utmost care has been taken to select the control group of comparable caste composition. The reproducibility of the measurements was checked by measuring 30 subjects on two consecutive days. An interview was taken to gather personal information and to conduct various tests and measurements. The age was recorded according to the date of birth certificate and as being verbally told to the investigator. Age in the latter case was aided by a recollection of any significant socio-cultural event, and comparison with birth cohorts and family members to ascertain an approximately correct age. Normal and healthy subjects were included in the present study. The subjects were explained the aims and the method used prior to conduct the study.

All the subjects were measured before noon i.e. prior to their lunch. The anthropometric measurements were taken with prior calibrated instruments using standardized techniques (Weiner, Lourie 1981). The instruments were calibrated and the zero error was checked regularly. The forced vital capacity of the lungs represents the maximum range of inspiratory and expiratory mechanisms of an individual and is viewed as volume of air forced out by him with a maximum expiratory effect using Microplus Spirometer. Three readings were recorded and the best of three was noted down. For FVC, clothing worn by the subjects was loosened and the subject was instructed to breathe in maximally, to close the lips firmly over the mouthpiece and to blow out as hard and as fast as possible. The manoeuvre was demonstrated to the subjects individually and repeatedly as and when needed.

Body mass index (BMI) was computed as weight in kilograms divided by height squared (height was measured in meters). Waist hip ratio (WHR) was computed as the ratio of waist circumference to hip circumference. The analysis was performed with the SPSS statistical computing package on an IBM compatible computer.

RESULTS

The mean values with standard deviation (SD) and t-test values to compare different age groups with the control group for all the anthropometric variables have been presented in *Table 1*. The stature and sitting height showed a decline after the sixth decade of life in both the test groups (i.e. institutionalized aged males and non-institutionalized aged males). The weight showed a highest mean value in the 7th decade of life, followed by a decline in non-institutionalized aged males, whereas in institutionalized aged males the highest value for weight was found in the 65+ age group. The mean value of weight was found to be higher in both the test groups when compared with control males individually.

Triceps skinfold thickness and subscapular skinfold thickness showed an irregular change with age in both the test group (NIAM and NAM). However, both the skinfold thicknesses showed higher values in institutionalized as well as in non-institutionalized aged males when compared with the young adult males individually.

Upper arm circumference and waist circumference displayed an increase till 70 years of age, after which it showed a decline in NIAM, whereas in IAM an irregular change was observed. Waist hip ratio (WHR) showed an increase till 70 years of age, thereafter it plateaus in NIAM unlike IAM. The waist circumference, hip circumference and waist/hip ratio exhibited higher values among males of both the test groups when compared to the control males individually. BMI showed an increase till 75 years of age in both the groups of subjects, followed by a decline in later years in NIAM group only. Non-institutionalized males showed higher values of BMI than control males.

TABLE 1. Mean, SD and t-test values among non-institutionalized males (NIAM, control group males (CM) and institutionalized males (IAM) for anthropometric variables.

Stature (ST)	**Non-institutionalized aged males**					**CM**	**Institutionalized aged males**				
Age group	60+	65+	70+	75+	80+	20+	60+	65+	70+	75+	80+
No.	29	30	30	26	11	30	16	12	15	11	8
Mean	161.68	162.05	161.67	159.22	159.06	163.77	165.1	166.32	163.79	163.23	161.79
SD	5.31	5.79	6.15	5.88	5.97	7.03	5.25	5.58	6.2	6.55	13.53
t-value	1.67***	1.17***	0.13	2.03***	1.82***	–	0.40**	1.03***	0	0.22	0.57***
Sitting height (SHT)											
Mean	82.07	83.08	83.26	81.17	81.16	84.95	79.88	85.19	82.03	83.36	78.2
SD	4.06	3.34	5.75	3.95	1.44	3.49	5.46	2.74	4.04	4.74	8.2
t-value	2.96***	2.45***	0.88***	2.10***	2.33***	–	2.77***	0.19	2.51***	1.17***	3.54***
Weight (WT)											
Mean	57.5	58.3	59.21	58.55	54.3	53.08	54	71.4	58	62.64	47.69
SD	11.05	12.12	13.96	17.27	11.63	5.89	14.49	4.87	14.46	12.38	11.05
t-value	2.39***	2.27***	1.32***	2.32***	0.2	–	0.25	8.35***	1.62***	3.35***	1.88***
Triceps skinfold thickness (TSF)											
Mean	9.85	10.08	11.72	10.71	9.04	6.96	8.08	13.42	9.25	9.89	6.68
SD	4.7	5.77	5.84	6.26	7.09	3.35	3.25	4.91	4.26	3.25	2.3
t-value	2.86***	2.90***	2.30***	3.36***	0.24	–	0.69***	4.68***	1.49***	2.50***	0.22
Subscapular skinfold thickness (SCSF)											
Mean	12.29	13.25	14.58	15.29	11.6	9.24	13.28	19.94	10.27	14.56	9.73
SD	5.63	7.07	6.94	9.38	8.12	4.78	6.79	3.01	4.68	5.78	4.76
t-value	2.48***	2.58***	1.97***	3.93***	0	–	1.65***	6.62***	0.68***	2.98***	0.25
Upper arm circumference (UAC)											
Mean	25.29	25.44	25.9	25.3	24.8	24.45	22.74	27.88	25.77	26.76	21.63
SD	3.44	3.54	3.37	3.5	4.15	2.05	2.5	1.53	3.72	2.73	3
t-value	2.83***	1.39***	0.64***	1.82***	0.36*	–	1.61***	4.54***	1.54***	2.92***	3.13***
Waist circumference (WTCR)											
Mean	82.79	82.8	85.24	84.31	81.04	72.36	83.02	92.77	82.73	87.9	75.13
SD	8.34	10.89	10.77	12.33	10.2	5.24	14.54	3.74	10.09	9.03	10.25
t-value	5.40***	6.07***	4.02***	5.02***	2.61***	–	3.12***	11.3***	4.56***	6.55***	1.06***
Hip circumference (HPCR)											
Mean	90.54	91.46	92.18	93.38	89.82	85.59	89.06	99.05	91.72	94.97	86.29
SD	6.99	7.58	8.55	12.5	8.47	4.34	9.86	1.87	8.83	8.33	7.54
t-value	3.92***	3.64***	2.97***	3.46***	0.37*	–	1.34***	9.45***	3.14***	4.71***	0.34*

* p<0.05 ** p<0.01 *** p<0.001

The mean values with the SD and t-test values for the physiological and computed variables have been displayed in *Table 2*. Heart rate showed lower values among males of both the test groups (IAM and NIAM) as compared to males of the control group. Blood pressure (both systolic and diastolic) showed a continuous decline from the 7th decade onwards in both the test groups. The blood pressure showed higher values in non-institutionalized aged males as compared to institutionalized aged males in all the corresponding age groups. Forced vital capacity (FVC) displayed a decrease in its value after the 6th decade in NIAM only. FVC exhibited lower values for all the age groups of both the test groups when compared with the control group males individually. Average grip strength

TABLE 2. Mean, SD and t-test values among non-institutionalized males (NIAM), control group males (CM) and institutionalized males (IAM) for physiological and computed variables.

	Non-institutionalized males					CM	Institutionalized males				
Heart rate (HR)	60+	65+	70+	75+	80+	20+	60+	65+	70+	75+	80+
Mean	80.33	76.13	74.77	79.45	67.6	79.73	75.2	75.8	76.8	77.82	61.25
SD	12.94	12.96	11.17	12.3	10.33	10.62	4.6	10.35	11.56	8.22	11.61
t-value	0.70***	0.55***	1.36***	1.74***	0.58***	–	0.93***	1.02***	0.84***	0.54***	4.29***
Systolic blood pressure (SBP)											
Mean	132.53	130.6	137.46	140.55	137.2	121.33	129.6	128	126.8	131.64	118.75
SD	17.24	21.61	19.44	13.68	8.79	8.65	13.07	14.05	24.34	14.5	21.22
t-value	3.16***	3.16***	2.60***	1.91***	2.33***	–	1.84***	1.79***	1.10***	2.79***	0.33
Diastolic blood pressure (DBP)											
Mean	93	86.27	84.15	92.55	89.2	87.73	82.4	78.4	74.93	79.82	76
SD	11.6	12.93	11.8	7.54	8.07	7.62	10.71	9.03	11.51	12.11	12.69
t-value	2.14***	1.95***	0.18	1.98***	1.38***	–	1.36***	3.20***	4.46***	2.49***	3.33***
Forced vital capacity (FVC)											
Mean	1.56	1.68	1.55	1.53	1.26	2.4	1.66	2.05	1.68	1.53	1.87
SD	0.73	0.61	0.45	0.54	0.83	0.58	0.84	0.3	0.57	0.59	0.74
t-value	3.24***	5.49***	4.29***	4.32***	3.09***	–	2.47***	1.81***	3.97***	4.22***	2.18***
Average grip strength (GSA)											
Mean	24.4	24.05	21.98	20.73	21.2	38.57	24.3	25.35	19.07	22.18	16.81
SD	5.1	5.65	5.96	4.85	3.87	4.87	3.11	4.53	6.28	5.84	8.55
t-value	6.51***	11.2***	10.6***	7.49***	8.52***	–	6.29***	7.55***	11.4***	9.05***	9.47***
Body mass index (BMI)											
Mean	21.96	22.14	22.48	22.97	21.66	19.82	19.6	25.86	21.58	23.36	17.98
SD	3.93	4.1	4.38	6.37	5.77	2.15	4.27	2.11	5.09	3.4	2.3
t-value	3.24***	3.13***	1.96***	2.52***	0.46**	–	0.17	7.73***	1.63***	3.96***	2.13***
Waist hip ratio (WHR)											
Mean	0.91	0.9	0.92	0.9	0.9	0.85	0.93	0.94	0.9	0.93	0.87
SD	0.06	0.06	0.04	0.06	0.03	0.04	0.08	0.04	0.05	0.05	0.08
t-value	4.94***	5.66***	3.61***	4.63***	3.88***	–	3.68***	6.43***	4.12***	5.39***	1.19***

* $p<0.05$ ** $p<0.01$ *** $p<0.001$

(GSA) decreased after the 5th decade in both the test groups and it showed lower values among males of both the test groups when compared with the control group males individually. Statistically significant differences were observed for all the anthropometric and physiological variables with age for most of the groups of NIAM and IAM.

The diastolic blood pressure showed significantly higher values in NIAM as compared to IAM between all the corresponding age groups. Institutionalized aged males showed higher forced vital capacity than non-institutionalized aged males, though the differences were statistically non-significant.

ANOVA test revealed that sitting height, weight, chest skinfold thickness, upper arm circumference and body mass index showed significant differences ($p<0.05$) for most of the age groups, whereas non-significant differences were found for institutions and interaction term, age/institution. Systolic blood pressure and suprailiac skinfold thickness showed significant differences ($p<0.05$) for age as well as for interaction of age/institution. On the other hand, forced vital capacity and average grip strength showed significant differences for the age groups and institution. Rest of the variables showed non-significant differences between different age groups, between elderly staying in the institutions and in families and for interaction age/institution.

DISCUSSION

A decline in stature with advancing age is found, though non-significant. Other researchers (Khosla, Lowe 1968, Cline *et al.* 1989, Brahmam 1994, Nirmala, Reddy 1997,

Joyce, Kapoor 1995) also observed a decline in stature with age. The cartilage discs between vertebrae degenerate with age, causing the vertebrae to come close together, thus resulting in a decline in stature (Aiken 1995). Loss of stature can also be attributed to weakening or imbalance of muscle groups, postural changes, osteoporosis, disk deterioration and spinal deformities as kyphosis and scoliosis (Cline *et al.* 1989). The sitting height significantly declined among IAM with advancing age, which is in corroboration with the earlier studies (Parízková, Eiselt 1980). The decline in stature is mainly due to the decline in sitting height rather than long bones, which remain unchanged in length with advancing age.

A significant increase in weight is observed till the 7th decade of life in both the test groups. An increase in weight with advancing age is reported by Nirmala, Reddy (1997). A marked decrease in physical activity level with unchanged caloric input could be responsible for this increase in weight. A decline in weight was reported after 70 years of age in NIAM like IAM. A similar decline after 70 years was reported by Brahmam (1994) and Tyagi, Kapoor (1999). The triceps skinfold thickness showed higher values in non-institutionalized aged males as compared to institutionalized aged males in all the age groups. Subscapular skinfold thickness changed significantly in IAM. An increase in upper arm circumference till 70 years of age was followed by a decline. Sidhu *et al*. (1975), Parízková, Eiselt (1980), Campbell, Borrie (1988) found an increase in upper arm circumference till mid age, followed by a decline in later years. BMI showed a decline after the 7th decade of life. An increasing trend in mean BMI until about 50 years, followed by a decline, indicates a non-linear nature of age effects (Reddy 1998).

An age-related decline was found in the heart rate among NIAM. A similar decline in heart rate and pulse rate was found by Tyagi and Kapoor (1999). Systolic blood pressure showed an increase after the 6th decade and most of the age changes in diastolic blood pressure were found to be statistically significant. An increase in systolic as well as diastolic blood pressure was observed by Mukherjee *et al.* (1988) and Kapoor, Saxsena (1994). Significant changes in diastolic blood pressure between corresponding age groups of NIAM and IAM indicate a strong influence of environment on this variable. The diastolic blood pressure was reported to be more age sensitive than systolic blood pressure by Majumdar *et al.* (1990). A non-linear relationship of blood pressure with age was reported in the present study, which was also reported by Joyce and Kapoor (1995). Nirmala, Reddy (1997) and Tungdim *et al.* (2002) reported that both systolic blood pressure and diastolic blood pressure increase with age.

The forced vital capacity declined after 70 years of age. Lazer *et al.* (1984) found a gradual and steady decline in most of the lung functions and capacities, i.e. forced vital capacity, forced expiratory volume, etc. Telang and Bhagwat (1941) reported a value of 2.95 liters as vital capacity in males aged 18–29 years. The decline in FVC with age might be due to impairment of pulmonary elasticity and decreased mobility of the chest cage (Mittman *et al.* 1965). Kaltreider *et al*. (1938) studied the degenerative changes in lungs and found that respiratory muscles and spine were probably the most important factor that limits the maximum inspiration, thereby reducing vital capacity. Kapoor and Tandon (2003), however, found a general decrease in respiratory efficiency with advancing age in a high altitude population, but the rate of decline was relatively less in elderly females with rigorous physical activity level. Average grip strength showed lower values among males of both the test groups (i.e. IAM and NIAM) when compared to the control males individually. The decrease in average grip strength with advancing age was found to be significant in most of the groups of IAM, but non-significant in NIAM age groups. A decline in grip strength with advancing age was reported by Kapoor, Kapoor (2000), Kapoor, Tandon (2003). The decrease in grip strength is indicative of lesser degree of muscles weakening and muscular degeneration among NIAM as compared to IAM subjects, which is quite suggestive of relatively more muscular activity among elderly staying alone or with families.

The finding that the waist/hip ratio (WHR) – a measure of abdominal fat distribution – increases with age, is supported by the findings of Satwanti *et al.* (1980) and Tyagi, Kapoor (1999). A slower decline in lung capacity and cardio-vascular functions was found among institutionalized males as compared to non-institutionalized males, which may be attributed to a relatively higher smoking level in the latter group.

Significantly higher values for weight, subscapular skinfold thickness, upper arm circumference, waist circumference, hip circumference and BMI in some of the age groups of IAM when compared to NIAM indicate a physically less active routine of the people staying in the old age homes. In our day-to-day life, it is common to see our elders sharing as much physical work as any other member in the household. In the households sometimes, they undertake the entire workload. In the old age homes however, almost all the routine chores are done for the elderly inmates.

The higher values for heart rate, systolic blood pressure and diastolic blood pressure in NIAM for most of the corresponding age groups, witness a relatively higher level of anxiety and stress among NIAM, which is not the case in IAM. Diastolic blood pressure showed significant differences in all the corresponding age groups of institutionalized age males and non-institutionalized aged males, reflecting it to be a highly environmentally controlled variable.

CONCLUSION

Structural and functional status on any individual is affected with advancing age. All the measurements for most of the

age groups of IAM and NIAM showed significantly different values as compared to the control group. Stature, sitting height, forced vital capacity and average grip strength showed significant decline in their mean values with advancing age. Ageing seems to be associated with decline in cardio-vascular fitness, muscular strength and changes in fat redistribution in favour of central obesity. Significant differences between corresponding age groups of institutionalized and non-institutionalized aged males indicated an influence of environment on the ageing phenomenon. In the light of the above results it can be inferred that the institutionalization of elderly has a positive impact on their cardio-vascular and respiratory fitness. Institutionalized senior citizens showed a significant and relatively slow pace of changes associated with ageing, as compared to the non-institutionalized ones.

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