Age related changes in weight, height and body mass index of Brahmin females: A rural-urban comparison

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INTRODUCTION

Human aging is often defined as a process of change that occurs in an individual during the course of time following maturity. This process finds its reflection in age related changes that takes place in various systems of a person including the skeleton [1]. Anthropometric evaluation is an essential feature of geriatric nutritional evaluation for determining malnutrition, being overweight, obesity, muscular loss, fat mass gain, and adipose tissue redistribution. Anthropometric indicators are used to evaluate the prognosis of chronic and acute diseases and to guide medical intervention in the elderly [2].

In India, women above the age of 50 years constitute more than 54 million and their number is expected to exceed 130 million by 2015 [3]. With the growing aged population, well being and quality of life of elderly persons is of utmost importance at both the individual and the societal levels. Unfortunately there is still a paucity of studies that include older people. So the present research has been conducted to have a baseline information on the age related changes in weight, height and body mass index and to gauge the prevalence of underweight and overweight of rural and urban Brahmin females.

MATERIAL AND METHODS

The present cross-sectional study was conducted on a sample of 870 healthy Brahmin females (rural= 450, urban= 420), ranging in age from 40 to 70 years. Data were collected in two phases from the year 1999 to 2001 from the rural and the urban areas of district RoopNagar (Punjab, India). Each subject was contacted individually at her residence and was interviewed regarding her educational status, place of birth, parity and occupation etc. Care was taken to include only normal and healthy individuals, who are not suffering from any chronic disease or physical deformity. The subjects were selected at random.

Both the rural and the urban subjects belong to one endogamous group that is Brahmins of district RoopNagar (Punjab, India). These two sub-groups of Brahmin population have same broad genetic constitution but are exposed to different environment settings. Earlier Brahmins were Priest class but now they are engaged in trade, commerce, government, and private jobs. Some of the families residing in rural area were also engaged in agriculture. Some of the most commonly occurring Gotras are Bhardwaj, Bhargava, Bhanot, Dubey, Gaur, Joshi, Kalia, Khausal, Mishra, Pandey and Vashisht. Both the groups of Brahmin females were believers of Hindu traditions, and worship all Hindu Gods and goddesses.

The data were arranged in six age groups, each of five years duration except the first age group, which is of six years.
duration for both the rural and urban Brahmin females. Age in years had been obtained from the date of birth, which most of the urban females could recall. Whereas in most of the rural females and some elderly urban females age had to be ascertained by association with some important events like age at marriage, age of the first child, any important festival etc. With this cross-questioning, it was possible to ascertain nearly the correct age of the subject. Weight and height were measured according to standardized procedures as recommended by Weiner and Lourie [4]. Body mass index was calculated as weight in kg divided by height in meter squared (m$^2$). WHO [5] defined cutoffs were used to classify all the subjects in to five groups: Grade 2 underweight (16.00 - 16.99 kg/m$^2$), Grade 1 underweight (17.00-18.49 kg/m$^2$), Normal range (18.50 -24.99 kg/m$^2$), Grade 1 overweight (25.00-29.99 kg/m$^2$) and Grade 2 overweight (> 30.00 kg/m$^2$).

RESULTS
Table 1 presents mean and standard deviation values of weight in rural and urban Brahmin females. Weight of rural Brahmin females at age group 40-45 is 59.64 kg and this progressively increases to peak mean value of 60.25 kg upto the age group 46-50, whereafter a trend of decline in the mean values sets in, which continues upto 70 years. Urban Brahmin females show a trend of increase in weight from the age group 40-45 (59.24 kg) to age group 51-55 (61.57 kg), thereafter, the mean values decrease with the advancing age. Urban females have been found to be heavier than their rural counterparts at all age groups except for 40-45 years and 46-50 years. However, statistically significant differences have been emerged from the age group 56-60 to 66-70.

Figure 1
Table 1: Descriptive statistics for weight (kg) according to age in rural and urban Brahmin females

Table 2 shows mean and standard deviation values of height in rural and urban Brahmin females. In rural Brahmin females mean value of height at age group 40-45 is 154.32 cm, whereafter a regular decrease has been noticed at all successive periods under study, till it reaches 149.39 cm at age group 66-70. Urban females also show similar pattern except for some minor fluctuations at age group 51-55, where mean value increases to 156.19 cm, followed by a decline in the later years. Urban females are taller than the rural females at all ages, but reveal statistically significant differences only in the age groups 46-50 and 51-55.

Figure 2
Table 2: Descriptive statistics for height (cm) according to age in rural and urban Brahmin females

Table 3 explains mean and standard deviation values of body mass index in rural and urban Brahmin females. This index starting from an initial average value of 25.01 kg/m$^2$ in rural and 24.20 kg/m$^2$ in urban females reaches finally to 22.50 kg/m$^2$ and 24.69 kg/m$^2$ in rural and urban Brahmin females respectively. Rural females exhibit slightly higher mean values for body mass index as compared to urban females up till 55 years, whereafter urban females take the lead and demonstrate statistically significant differences between age group 61-65 and 66-70 as is evident from the t-values.

Figure 3
Table 3: Descriptive statistics for body mass index (kg/m$^2$) according to age in rural and urban Brahmin females

DISCUSSION
In the current cross-sectional study both the groups of
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Brahmin females shows a decline in the mean values of weight with advancing age. Rural females register 15.69% decline in body weight, whereas among urban females only 4.6% decline has been noticed from the initial age group till the last age group. Rural and urban Brahmin females of the present study gain weight up to age group 46-50 and 51-55 years respectively, followed by a decline till the last age group. A net loss of 9.36 kg and 2.73 kg recorded in rural and urban females respectively in the entire age range under study. Banian females [6] showed a decline in the mean values of weight after 50 years and reported a net loss of 9.92 kg. Jat Sikh females demonstrated a decline in this parameter after the age of 65 years, showing a net loss of 7.55 kg [7].

Sidhu & Sidhu [7] reported that Sikh and Hindu Harijan females gain weight till 50 years followed by a decrease in weight with a net loss of 5.01 kg and 6.09 kg respectively during the entire period studied. Rural and urban Kunbi females of Maharashtra [8] gain up to 50 years, where after, show a decrement in weight and witness a total loss of 6.37 kg and 3.28 kg respectively. Bagga [9] observed both Maharashtrian Brahmins and migrant (punjabi and sindhi) women show a decrement of weight after 60 years, reporting a net decrease of 14.47 kg and 24.04 kg respectively from 40-49 years to 80 +. Hunter et.al. [10] recorded that weight continued to increase among urban Australian females up to 55-59 years, whereafter, a gradual decline is witnessed, registering a loss of 5.9 kg from 40-44 years to 65-69 years. A perusal of these studies exhibit a decline in the mean values of weight with age, although magnitude and age of onset of decline show variability among different populations.

Like weight, urban Brahmin females are found to be taller than their rural counterparts. Both the groups of present study show a decreasing trend in the mean values of height with advancing age, but the magnitude of decline is higher in rural (9.93 cm) than the urban subjects (5.06 cm). The precise time of this decline remains uncertain and is variable in previous studies. Present study reveals that a decrease in stature begins in 4th decade in rural and in the middle of 5th decade in urban Brahmin females.

Rural and urban Brahmin females of present study have been compared with the rural and urban Jat Sikh females [11], Sikh and Hindu Harijan [7] and Banian females [6] (table 4). Rural and urban Brahmin females are lighter than their rural and urban Jat Sikh counterparts at all ages and show statistically significant differences at most of the age groups. Both the groups of Brahmin females of present study are considerably heavier than the Hindu and Sikh Harijan females at all ages as is evident from the highly significant t-values observed at all ages (table 5). Rural as well as urban Brahmin females are also found to be significantly heavier than Banian females at almost all age groups.

Figure 4

Table 4: Age group wise comparison of weight of rural and urban Brahmin females of the present study with Sikh Harijan, Hindu Harijan, Banian, rural Jat Sikh and urban Jat Sikh females

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Rural Brahmin Females</th>
<th>Urban Brahmin Females</th>
<th>Sikh Harijan Females</th>
<th>Hindu Harijan Females</th>
<th>Banian Females</th>
<th>Rural Jat Sikh Females</th>
<th>Urban Jat Sikh Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>35-40</td>
<td>59.82 ± 3.33</td>
<td>59.82 ± 3.91</td>
<td>59.82 ± 3.91</td>
<td>59.82 ± 3.91</td>
<td>59.82 ± 3.91</td>
<td>61.56 ± 3.34</td>
<td>61.56 ± 3.34</td>
</tr>
<tr>
<td>41-45</td>
<td>59.82 ± 3.91</td>
<td>59.82 ± 3.91</td>
<td>59.82 ± 3.91</td>
<td>59.82 ± 3.91</td>
<td>59.82 ± 3.91</td>
<td>61.56 ± 3.34</td>
<td>61.56 ± 3.34</td>
</tr>
<tr>
<td>46-50</td>
<td>59.82 ± 3.91</td>
<td>59.82 ± 3.91</td>
<td>59.82 ± 3.91</td>
<td>59.82 ± 3.91</td>
<td>59.82 ± 3.91</td>
<td>61.56 ± 3.34</td>
<td>61.56 ± 3.34</td>
</tr>
</tbody>
</table>

Table 5: t-values showing age group wise differences in the rural and urban Brahmin females of the present study with Sikh Harijan, Hindu Harijan, Banian, rural Jat Sikh and urban Jat Sikh females

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Rural Brahmin Females vs Sikh Harijan Females</th>
<th>Urban Brahmin Females vs Sikh Harijan Females</th>
<th>Rural Brahmin Females vs Hindu Harijan Females</th>
<th>Urban Brahmin Females vs Hindu Harijan Females</th>
<th>Rural Brahmin Females vs Banian Females</th>
<th>Urban Brahmin Females vs Banian Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>35-40</td>
<td>0.000084</td>
<td>0.000084</td>
<td>0.000084</td>
<td>0.000084</td>
<td>0.000084</td>
<td>0.000084</td>
</tr>
<tr>
<td>41-45</td>
<td>0.000084</td>
<td>0.000084</td>
<td>0.000084</td>
<td>0.000084</td>
<td>0.000084</td>
<td>0.000084</td>
</tr>
<tr>
<td>46-50</td>
<td>0.000084</td>
<td>0.000084</td>
<td>0.000084</td>
<td>0.000084</td>
<td>0.000084</td>
<td>0.000084</td>
</tr>
</tbody>
</table>

Like weight, urban Brahmin females are found to be taller than their rural counterparts. Both the groups of present study show a decreasing trend in the mean values of height with advancing age, but the magnitude of decline is higher in rural (9.93 cm) than the urban subjects (5.06 cm). The precise time of this decline remains uncertain and is variable in previous studies. Present study reveals that a decrease in stature begins in 4th decade in rural and in the middle of 5th decade in urban Brahmin females.

Borkan et.al. [6] and Cline et.al. [13] observed that slight changes in height from 20 years to 60 years are too small to be measurable in a single individual and are within the range of daily individual height variations, but are significantly different from zero. Singal & Sidhu [6] studied Jat Sikh and Banian females and found that decline in height started after the age of 50 years and 40 years respectively. Hussain [8] reported that among rural and urban Kunbi women decline in height began after the third and fourth decade of life respectively. Bagga [9] observed this decline in stature after 4th decade in Maharashtrian women as well as in migrant group (sindhi & punjabi). Singal et.al., [6] showed decrement in height of rural and urban Jat Sikh females after 6th decade of life. Hunter et.al., [10] found that among urban Australian females decrement of stature started at 5th decade.
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of life. It is well recognized that a perceptible decrease in height takes place after maturity [14,15,16,17]. Part of this effect is related to loss of stature within individuals, an 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 [17,18,19]. The amount of apparent decrease in height with age is not only a result of the ageing process, but also a birth cohort effect [18].

To study the population difference mean height of the rural and urban Brahmin females has been compared with the existing data on Indian studies (table 6). Brahmin females of current study when compared with Bania females [12] exhibit higher mean values for height at all age levels. However rural Brahmin females reveal statistically significant differences from 40 to 60 years, but in urban females t-values exhibit highly significant results all through the age range under consideration. Rural and urban Brahmin females have been found to be considerably shorter at all ages than their rural and urban Jat Sikh counterparts [11] as is evident from the statistically significant results at almost all ages (table 7).

Figure 6

Table 6: Age group wise comparison of height of rural and urban Brahmin females of the present study with Bania, rural Jat Sikh and urban Jat Sikh females

<table>
<thead>
<tr>
<th>Age Group (in years)</th>
<th>Rural Brahmin Females</th>
<th>Urban Brahmin Females</th>
<th>Bania Females</th>
<th>Rural Jat Sikh Females</th>
<th>Urban Jat Sikh Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>40-45</td>
<td>154.32±4.88</td>
<td>153.67±5.06</td>
<td>151.92±5.39</td>
<td>163.55±1.11</td>
<td>161.52±3.02</td>
</tr>
<tr>
<td>46-50</td>
<td>154.25±4.87</td>
<td>155.82±6.99</td>
<td>153.28±5.89</td>
<td>163.62±1.12</td>
<td>161.38±3.37</td>
</tr>
<tr>
<td>51-55</td>
<td>154.17±4.54</td>
<td>156.32±6.66</td>
<td>153.42±5.70</td>
<td>163.76±0.87</td>
<td>162.49±2.16</td>
</tr>
<tr>
<td>56-60</td>
<td>152.65±7.13</td>
<td>153.09±5.59</td>
<td>149.82±3.38</td>
<td>164.00±1.37</td>
<td>162.52±3.54</td>
</tr>
<tr>
<td>61-65</td>
<td>150.61±5.64</td>
<td>152.97±4.68</td>
<td>149.04±4.42</td>
<td>163.49±1.13</td>
<td>162.37±1.94</td>
</tr>
<tr>
<td>66-70</td>
<td>148.39±5.37</td>
<td>151.64±6.61</td>
<td>147.86±5.34</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Body mass index is a proxy measure for obesity and is the most commonly studied marker of it. Present study reveals that the overall body mass index of urban Brahmin females is higher than their rural counterparts (24.70±3.97 vs 24.06±4.11 p<0.05). Our findings are in accordance with the results of a previous study [20] showing a large prevalence of low body mass index in rural area and high body mass index in urban area of the Congo, a Central African country. Uma et al., [21] also demonstrated higher body mass index of urban females as compared to rural females (22.77±4.99 vs 22.18±3.71 p<0.05). A similar trend has been showed by various cross-sectional studies [22, 23, 24].

Rural and urban Brahmin females have been classified in their normal, underweight and overweight categories depending upon the WHO [5] criteria of body mass index (table 8). Rural subjects has 48.88% of the subjects in the normal range of body mass index, 6.88% in Grade I underweight and 4.88% in Grade II underweight. Only 29.55% of rural subjects can be designated Grade I overweight and 9.77% as Grade II overweight. The urban Brahmin females, on the other hand has 52.88% of the subjects in normal range, 1.42% in Grade I underweight and only 0.23% in Grade II underweight. 40.23% of the urban females can be designated as Grade I overweight and 5.35% as Grade II overweight. As is evident from the table 8 that overall prevalence of underweight is higher among rural subjects (11.76%) , whereas overall prevalence of overweight is higher among urban females (45.58%). This may be attributed to their dietary habits, enhanced physical activity resulting in more energy expenditure besides hormonal changes among rural females.
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Figure 8
Table 8: Distribution of rural and urban Brahmin females according to WHO classification of body mass index

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Rural (%)</th>
<th>Rural (Grade I–II overweight)</th>
<th>Urban (%)</th>
<th>Urban (Grade I–II overweight)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-45</td>
<td>30 (20.9)</td>
<td>22 (15.0)</td>
<td>40 (28.6)</td>
<td>33 (24.2)</td>
</tr>
<tr>
<td>45-59</td>
<td>20 (14.3)</td>
<td>15 (11.1)</td>
<td>30 (21.4)</td>
<td>26 (19.2)</td>
</tr>
<tr>
<td>51-59</td>
<td>10 (0.7)</td>
<td>8 (0.6)</td>
<td>20 (14.3)</td>
<td>18 (13.5)</td>
</tr>
<tr>
<td>59-69</td>
<td>5 (0.4)</td>
<td>4 (0.3)</td>
<td>10 (0.7)</td>
<td>9 (0.7)</td>
</tr>
<tr>
<td>0-45</td>
<td>15 (10.6)</td>
<td>11 (8.3)</td>
<td>25 (18.1)</td>
<td>20 (15.1)</td>
</tr>
<tr>
<td>45-59</td>
<td>10 (0.7)</td>
<td>8 (0.6)</td>
<td>20 (14.3)</td>
<td>18 (13.5)</td>
</tr>
<tr>
<td>51-59</td>
<td>5 (0.4)</td>
<td>4 (0.3)</td>
<td>10 (0.7)</td>
<td>9 (0.7)</td>
</tr>
<tr>
<td>59-69</td>
<td>2 (0.1)</td>
<td>2 (0.1)</td>
<td>4 (0.3)</td>
<td>3 (0.2)</td>
</tr>
</tbody>
</table>

It is clear from the above discussion that rural Brahmin females show a thinner body frame as compared to urban females. Both the weight and height demonstrate a decline with advancing age, but the onset and magnitude of decrement differ in different population. Sinclair [13] stated that the decrease in stature is the result of changes which occur, predominantly in the vertebral column. The changes in the vertebrae, and in all trabecular bones in particular, are related to bone rarefaction or osteoporosis, a feature of the normal ageing. Hence understanding these changes in the elderly population is helpful to promote their general well being and health status.

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