2012 International Conference on Life Science and Engineering
IPCBEE vol.45 (2012) © (2012) IACSIT Press, Singapore
DOI: 10.7763/IPCBEE. 2012. V45. 18

The Study of Body Composition and Waist-to-hip Ratio of Women among Different Age Groups

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Abstract. Purpose: To investigate and evaluate the body composition and waist-to-hip ratio (WHR) of women among different age groups. Methods: 60 women aged 30-80 years old were randomly selected and divided into five different age groups: 31- 40 y (12 persons, abbreviated as number), 41-50 y (14), 51-60 y (12), 61-70 y (12) and 71-80 y (10). The subjects' body composition and WHR were measured. Body composition analysis was conducted using the InBody 220 body composition analyzer. Data analysis was conducted using the SPSS statistical software for Windows 12.0. Independent one-way ANOVA was used as the statistical method at a significance level (á) of .05, followed by the Scheffé's method as post hoc. Results: Statistical analyses showed that there were no significant difference in the body mass index (BMI) and body fat mass (BFM) of women among the different age groups. However, significant differences are noted in the WHR, water, protein, and mineral mass of women from different were groups. Conclusions: (1) Water, protein, and mineral mass decreases with age, while body fat mass remains the same or accumulates in the body. (2) Age was found to be proportional to WHR in women. With increasing central adiposity and a declining muscle mass, women start to develop an "apple shaped" body type, increasing the possibility and risks of developing cardiovascular disease.

Keywords: Body composition, Waist-to-hip ratio (WHR), Body mass index (BMI)

1. Introduction

Both obesity among the elderly and its cardiovascular risks have increasingly been a topic of concern in recent times. Many scholars have highlighted several indicators, such as waist girth, BMI, and body fat mass among others, as screening measures of obesity. Waist-to-hip ratio (WHR) is a common non-invasive screening measure of cardiovascular disease. The accumulation of body fat has a large impact on the body. An annual gain of 0.7kg of body fat in adults[1], coupled with deteriorating bodily functions due to aging, would result in a greater adverse effect on the body.

Obese body types include the "apple-shaped" (central adiposity, WHR>1) and the "pear-shaped" (gynoid adiposity) body type. Central obesity is related to the development of metabolic syndrome, hence individuals with central obesity have a greater risk of developing health problems [2]. According to a survey by Ogden [3], up to 68% of post-menopausal women are or are at risk of being overweight or obese. This changes the fat distribution pattern in women towards a more central fat distribution, thus increasing the tendency of a central body shape which would result in central obesity. An increase in visceral fat increases free fatty acids levels in the liver, resulting in greater insulin resistance. Furthermore, lipoprotein levels would increase as well, elevating the risks of developing hyperlipidemia, decreased glucose tolerance, and hypertension. The increase in low-density lipoproteins and fat accumulation in the peritoneal cavity between the abdominal walls and torso, would impair the functioning of the vascular walls and vascular vasoconstriction, as well as platelet aggregation abilities in the body [4], increasing the risk of developing atherosclerosis which would in

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turn lead to the onset of other cardiovascular diseases [5]. It is hence important to note that a central fat distribution is more harmful and dangerous than a gynoid fat distribution (hip and thigh areas). Thus, the type of fat distribution pattern is closely related to the degree of its harmful effects on the body [6].

With aging comes declining hormonal function. The endocrine system is responsible for the secretion of hormones and it controls all cell activities in the body. Therefore, the endocrine system plays a major part in many body functions, including the immune, reproductive, and metabolic system, etc. A hormonal concentration level of any hormones below the normal level would negatively affect the normal function of the body system, causing fatigue, weight gain, sexual dysfunction, and may result in the development of major diseases. Moreover, the change in the body composition of post-menopausal women due to menopause would result in a 1-3% loss of muscle mass every year. In addition, women have a lower muscle mass compared to men and hence, post-monopausal women have a higher possibility and risk of developing sarcopenia and frailty [7, 8], which would further increase their inability to engage in sufficient physical activity to maintain their health and well-being [9]. Besides aging, declining oestrogen levels in post-menopausal women is another major factor responsible for the loss of muscle mass. The decline in oestrogen levels would stop the hormonal mechanism and its function, leading to a decline in basal fat oxidation [10]. Therefore, an appropriate proportion of fat and muscle mass is one important factor in maintaining the health of post-menopausal women.

With the aging population in Taiwan, obesity should not be neglected and how to age sucessfully needs to have more emphasis in today's aging society. To slow down the aging process, hormonal balance and an increased antioxidant capacity is crucial to remove free radicals and maintain optimum cell health. Moreover, with regular exercise and immunity can be enhanced, bringing healthy aging to the Taiwan population, so the purpose of this research was to investigate and evaluate the body composition and waist-to-hip ratio (WHR) of women among the different age groups.

2. Methods

2.1. Subjects

The subjects consists of 60 healthy women from Chiayi, Taiwan. The participants exercise on a regular basis and do not suffer from any major diseases or physical disabilities that will affect their mobility. The 60 participants aged 30-80 years old are selected randomly and divided into five different age groups: 31-40 y (12 persons, abbreviated as number), 41-50 y (14), 51-60 y (12), 61-70 y (12) and 71-80 y (10).

2.2. Body Composition Test

Subjects remove any metallic belongings or metal items before the test. After which, sbujects should stand on the InBody 220 body composition analyzer with bare feet in contact with the metallic sheets on the analyzer, and with both hands relaxed while holding onto a bio impedance electrode each. Subjects should relax and face forward. The analyzer uses the bioelectrical impedance method to perform the body composition analysis.

3. Statistics and Data Analysis

Data analysis was conducted using the SPSS statistical software for Windows 12.0. Independent one-way ANOVA was used as the statistical method at a significance level (á) of .05, followed by the Scheffé's method, as post hoc.

4. Results and Discussion

4.1. Results

From Table 2:

(1)A non-significant difference in the BMI of women across the different age groups can be seen.

(2)A significant difference in the waist-to-hip ratio (WHR) of women across different age groups can be seen, with greater significant differences in all other age groups as compared to the 70-80 years old age group (Scheffé: 31-70 y＞70-80 y).

(3)There is a significant difference in the water weight of women across different age groups, with the exception of the 30-40 years old age group, and a greater significant difference can be seen when compared to the 71-80 years old age group (Scheffé: 41-70 y＞70-80 y).

(4)A significant difference in the protein weight of women across the different age groups can be seen, with greater significant differences in all other age groups as compared to the 70-80 years old age group (Scheffé: 31-70 y＞70-80 y).

(5)A significant difference in the mineral weight of women across the different age groups can be seen, with greater significant differences in all other age groups as compared to the 70-80 years old age group (Scheffé: 31-70 y＞70-80 y).

(6)A non-significant difference in the fat weight of women across different age groups can be seen.

Table 1: Characteristics of women (study population) across different age groups

	Group	Total	Height mean (cm)	Weight mean(kg)	BMI mean(kg/cm^2)
31-40(y)	12	156.50	±6.43	47.85	±25.30	25.03	±4.07
41-50(y)	14	156.28	±4.16	48.05	±17.40	23.38	±3.36
51-60(y)	12	158.17	±4.57	53.82	±15.61	24.28	±2.10
61-70(y)	12	156.67	±4.36	52.73	±16.86	23.88	±2.69
71-80(y)	10	147.00	±7.30	53.41	± 6.69	24.72	±2.78

Table 2: BMI, WHR, Water weight, Protein weight, Mineral weight, Fat weight of women (study population) across different age groups

Project	SV	SS	DF	MS	Fo	*p*-Value
BMI	Interaction	21.74	4	5.44	.57	.687
	Error	526.87	55	9.58		
	Total	548.61	59			
WHR	Interaction	.27	4	.0	8.210	**.000****
	Error	.45	55	.01		
	Total	.73	59			
Water(kg)	Interaction	193.89	4	48.47	4.75	**.002***
	Error	560.77	55	10.20		
	Total	754.66	59			
Protein(kg)	Interaction	15.28	4	3.82	6.86	**.000****
	Error	30.62	55	.56		
	Toral	45.89	59			
Mineral(kg)	Interaction	1.61	4	.40	5.59	**.001***
	Error	3.96	55	.07		
	Total	5.57	59			
Fat (kg)	Interaction	82.33	4	20.58	.76	.552
	Error	1479.12	55	26.89		
	Total	1561.45	59			

$p < .05^{*}$

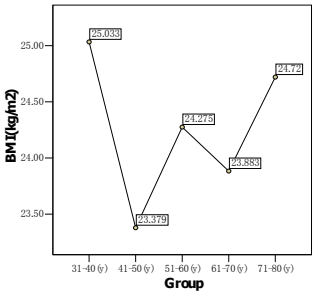

Fig. 3: BMI mean.

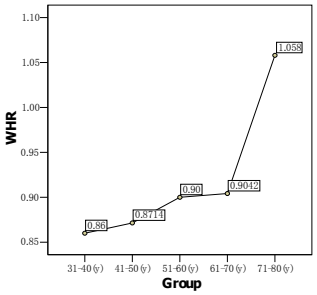

Fig. 4: WHR mean

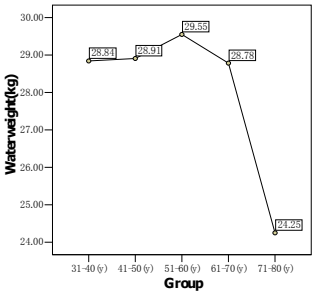

Fig. 5: Water weight mean

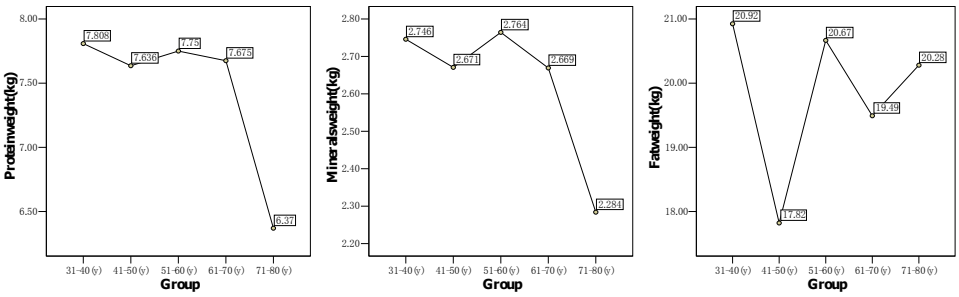

Fig. 6: Protein weight mean. Fig. 7: Mineral weight mean. Fig. 8: Fat weight mean.

These results show that there is no significant difference in the body mass index (BMI) and body fat mass (BFM) of women across the different age groups. However, significant differences are noted in the WHR, water, protein, and mineral mass of women across the different age groups.

4.2. Discussion

With increasing age under a constant body weight, two results can be drawn from the study through two perspectives: (1) An internal change within the body composition, (2) A change in general appearance – the body type of aging adults. (1) Internal change: Under a similar body weight, water, protein, and mineral mass decline with age, with a greater decline in the 70-80 y age group as seen from Fig 5, 6, and 7 above. However, body fat accumulated in the body as the subjects getting old. This could be due to declining hormonal function with age. As the endocrine system is responsible for all cell activities in the body, it plays a major part in numerous body functions, such as the immune, reproductive and metabolic system. A hormonal concentration level of any hormones below the normal level would thus negatively affect the normal functioning of the body system. Growth hormones (GH) could be another factor affecting body composition. The key function of growth hormones is to stimulate protein synthesis and lipolysis. Hence, lower levels of growth hormones would reduce protein mass and encourage fat accumulation in the body. A decrease in hormonal secretion plays a major role in the aging process as according to the glucose caramelization phenomenon under the Genetic Endowment Theories, aging is primarily due to two causes: (a) A decline in hormonal secretion which leads to the deterioration of body organs and its functions, and (b) a decline in antioxidant capacity which results in free radical cell damage, weakening the immune system and therefore, leads to the aging of the body. (2) A change in appearance – body type: Statistical analyses show that there is no significant difference in the body mass index (BMI) of women across the different age groups. However, a significant difference is noted in the waist-to-hip ratio (WHR) of women across the different age groups. Hence, it can be deduced that under a similar body weight, body shape changes with age from a "pear-shaped" to an "apple-shaped" body type. According to a survey by Ogden [3], up to 68% of post-menopausal women are or are at risk of being overweight or obese. This changes the fat distribution pattern in women towards a more central fat distribution, thus increasing the tendency of a central body shape, which would result in central obesity.

5. Conclusion and Recommendation

In conclusion, this study shows that as metabolism decreases with increasing age, body fat accumulates. Therefore, healthy lifestyle habits and regular exercise can be adopted to enhance the quality of life among aging adults, especially among post-menopausal women. It is recommended that further research be conducted on this topic to help improve the health of the aging population.

6. References

[1] A. W. Jackson, J. R. Morrow Jr, D. W. Hill, R. K. Dishman. *Physical activity for health and fitness.* Champaign, II: Human Kinetics Books, 2004.

[2] H. Scharfetter, T. Schlager, R. Stollberger. Assessing abdominal fatness with local bioimpedance analysis: vasics and experimental findings. *International Jouma1 Obestv.* 2001, 25: 502-11.

[3] C. L. Ogden, M. D. Carrol, L. R. Curtin, M. A. McDowell, C. J. Tabak, K. M. Flegal. Prevalence of overweight

and obesity in the United States, 1999-2004. *The Journal of the American Medical Association*. 2006, *295*(13): 1549-1555.

[4] E. Barret-Connor, T. L. Bush. Estrogen and coronary heart disease in women. *The Journal of the American Medical Association*. 1991, *265*(14): 1861-1867.

[5] M. Ledoux, J. Lambe, B. A. Reeder. Correlation between cardiovascular disease risk factors and simple anthrpometric measures. *Canada Medicine Assoation Jouma.*1997, 157(1): 46-53.

[6] R. W. Taylor, D. Keil, E. J. Gold. Body mass index, waist girth, and waist-to-hip ratio as indexes of total and regional adiposity in women: Evaluation using recever operating characteristic curves. *American Journal Clinical Nutrion.*1998, 67: 44-49.

[7] T. J. Doherty. Invited review: Aging and sarcopenia. *Journal of Applied Physiology*. 2003, *95*(4): 1717-1727.

[8] W. S. Shore, and B. J. Delateur. Prevention and treatment of frailty in the postmenopausal women. *Physical Medicine Rehabilitation Clinics of North America*. 2007, 18(3): 609-621.

[9] M. A. Fiatarone-Singh. Exercise and Aging. In M. A. Fiatarone-Singh (Ed.). *Exercise, Nutrition, and the Older Woman; Wellness for Women over Fifty.* London: CRC Press. 2000, pp. 1-36.

[10] J. Calles-Escandon, P. J. Arciero, A. W. Gardner, C. Bauman, E. T. Poehiman. Basal fat oxidation decreases with aging in women. *Journal of Applied Physiology*. 1995, 78(1): 266-271.