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Preventable Risk Factors for Beginning of Metabolic Syndrome and Comorbidities among Women

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Abstract

Age related changes in basic health parameters, cardio respiratory functions and clinical parameters contribute to the risk of comorbidity including metabolic syndrome in women. The paper aims to understand the risk factors responsible or beginning of metabolic syndrome and related morbidities among adult women with age. A cross sectional study was carried out among the 121 women of age 25 to 65 years. The data on cardio respiratory, anthropometric and clinical variables was collected after taking the prior informed and signed written consent from each participant. SPSS version 26.0 was used for the data analysis Age related changes in adiposity, blood pressure, lung functions and clinical parameters were obtained. The present findings indicate beginning of metabolic diseases risk and CVD risk among women of more than 45 years. This cross-sectional study of women can help researchers or health educators to identify the risk factors of metabolic syndrome and comorbidity in middle aged women. An early awareness and management of such risk with life style modification may go long way for better quality of life among women.

Keywords: Age; Hypertension; Metabolic Syndrome; Co-Morbidity; Women

Abbreviations: BMI: Body Mass Index; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; PR: Pulse Rate, FER: Forced Expiratory Ratio; Hb: Haemoglobin; HDL: High Density Lipoprotein; FBS: Fasting Blood Sugar

Introduction

Ageing is a lifelong process. It starts from conception to adulthood to maturity and as we enter into aging process our body functions become slow or fast which leads to other health problems and increase the comorbidity in elder persons. The life expectancy has increased dramatically during the past century. The burden of comorbidity and poor health outcomes in the aging population especially among women in developing countries is simultaneously increasing. The populations of both developing and developed nations are heading towards a more sedentary lifestyle. According to the WHO, 1.5 billion adults over 20 years of age are overweight and 0.5 billion are obese and women are more prone to physiological and structural changes in their life time [1]. According to WHO (2007), the number of women who are in their 60s and above will increase from about 336 million in 2000 to just over 1 billion in 2050. Women outnumber men in older age groups and this imbalance increases with

age. Worldwide, there are 123 women for every 100 men aged 60 years and over where, highest proportions of older women are in developed countries and the majority live in developing countries (WHO 2007).

Menarche and menopause are the two factors which trigger women body to change accompanying endocrine changes [2]. The age at menarche is the age at which menstruation begins. The term menopause refers to the end of the menstruation but the associated endocrine changes may take place over a longer period. It is accompanied by various structural, physiological and psychological changes, which usually takes place between the ages of 45 to 55 years [3]. Undernourished women get their menopause as much as four years earlier. They undergo hormonal changes caused by menopause and post-menopausal women are more susceptible to osteoporosis and cardiovascular diseases [4]. A study of population-based cohort from the Framingham Heart Study reports that in middle-aged and older subjects, at any given level of SBP > or = 120 mmHg, the risk of coronary heart diseases rose with discordantly lower DBP, suggesting that the wider pulse pressure was driving the risk for Coronary heart diseases [5]. Increased blood pressure with age is attributed to structural changes in the arteries and many studies validated the fact that increased blood pressure is a risk factor for the cardio vascular diseases [6]. Changes in cardiac function include a reduction in the heart rate and mean heart rate in an adult is about 70-78 beats per minute under resting conditions. Bell [3] reported that systolic blood pressure and to a lesser extent diastolic pressure, rises with age, though there are populations in which this rise does not occur.

Reduced elasticity of the lungs results in increased functional residual capacity and closing volume, reduced vital capacity and forced expiratory volume [3]. Increased pulse rate during the flush in women is a consequence of menopause. Menopause increases cardiometabolic risk factors due to the significant decline in the estrogen levels and the testosterone predominance. Consequently, post menopause appears to be associated with higher incidence of metabolic syndrome and cardiovascular diseases [7]. The structural changes are obesity; increased BMI, decline in stature and increased body circumferences etc. and physiological changes are increased blood pressure, poor cardiac output, poor capacity of lungs and declined bone density etc.

It has been found that the age-related increase in fat content occurs first in the peripheral and later in the axial skeletal region. A statistically significant correlation was established between the fat fraction and the age in lumbar vertebral body, ilium and intertrochanteric region of the femur. The mean fat fraction of post-menopausal females was significantly higher than that of pre-menopausal females in these sites [8]. The menopausal symptoms and changes worsened the quality of life [9]. "Most important physiological changes associated with ageing are: a decrease in the static elastic recoil of the lung, a decrease in compliance of the chest wall, and a decrease in the strength of respiratory muscles. [10]. The structure of lungs, their elasticity and muscles changes which make human respiratory functions get slow with time. A central body fat distribution is associated with age, sex, and sex hormones [11]. The present paper aims to understand the association of anthropometric, clinical and cardio-respiratory variables with the age in women.

Methodology

A cross sectional study was carried out among the women of age group 25 to 65 year. The sample size of 121 women under this age group has been divided into two sub- groups. The first group consists of women below 45 years of age and the other group included women above 45 years of age. The data on cardio respiratory, anthropometric and clinical variables was collected at the departmental laboratory after taking the well informed and written consent from each participant during March 2019 to February 2020. The research protocol was approved by the Department ethical committee.

The anthropometric data includes height, weight, waist and hip circumference. The height was taken using anthropometric rod and weight by weighing machine as per the recommendation of Weiner and Lourie (1989). Waist and hip circumferences were taken with the help of flexible steel tape. The biochemical data: haemoglobin (Hb), total cholesterol, high density cholesterol (HDL) and fasting blood sugar (FBS) were taken by extracting 1ml blood from each participant. Cardio- respiratory data includes systolic blood pressure (SBP), diastolic blood pressure (DBP), pulse rate (PR) and forced expiratory ratio (FER). Lung function was collected with the use of portable micro spirometer. Systolic and diastolic blood pressure was measured on the right hand using the auscultatory method with a standardized calibrated mercury column-type sphygmomanometer after 10–15 minutes resting in sitting position Two measurements were done for all women at five-minute intervals and the average of the 2 measurements was calculated. Pulse rate (PR) was measured with the help of stop watch. The BMI and fat % were computed. For analyzing the data, the variables were categorized as displayed in Table 1.

BMI	<24.9	Normal	World Health Organization (2004)
	≥25.0	over wt.& obese	
SBP	<120mmHg	Normal	(JNC VIII,2014)
	≥120mmHg	Hypertensive	
DBP	<80 mmHg	Normal	
	≥80mmHg	Hypertensive	
Total Cholesterol	<200	Desirable	ATP III (2001)
	200 & above	High	
HDL	<40	Low	
	≥40	Normal/High	
Fat%	<30	normal	(Durnin & Wormsely, 1978).
	≥30	At Risk	
FER	≥80	Normal	(Shavers,1982)
	< 80	Risk	
Hb	≥12	normal	(WHO,2011)
	<12	at Risk	
FBS	<100 mg/dl	normal	(ADA,2014)
	≥100mg/dl	prediabetic/diabetic	

Table 1: Guidelines followed for different variables.

All blood specimens were drawn at 8.30 a.m. after a 12-hour fast. Samples were centrifuged within 1 hour of sample collection and the sera frozen immediately at -20°C. Fasting blood sugar level, HDL and Total cholesterol were determined enzymatically using bichromate analyser (RMD). Mean, Standard deviation, t-test, correlation and chi square were calculated with the help of SPSS version 26.0.

Results

Mean, standard deviation and t- value of the anthropometric variables for all the participants is displayed as table 2. The mean value of height decrease with the age. The other variables like weight, waist circumference and hip circumference were found to be showing higher mean values among women above 45 year age group with statistically significant differences for waist and hip circumference.

S.No.	Variables	Women ≤ 45 years Mean ± SD	Women > 45 years Mean ± SD	t-value
1	Height(cm)	155.82 ±5.15	154.19±5.19	1.69
2	Weight(kg)	61.769 ±12.3	65.81 ±12.41	1.77
3	Waist circumference(cm)	78.22 ±9.66	83.86 ±10.07	3.08**
4	Hip Circumference(cm)	98.54 ±9.52	103.97 ±10.86	2.85***

p<0.01*p<0.001

Table-2: Distribution of basic parameters among women.

Table 3 presents the mean, standard deviation and t-values of adiposity indices and cardio-respiratory variables among the women. The adiposity determining variables like BMI and fat% are increasing with age. The mean and standard deviation of BMI and fat% values were higher among women above 45 years of age group with statistically significant differences. The cardio respiratory functions showed declining trend with age. The SBP and DBP mean values were higher among women above 45 years of age group showing the increased blood pressure with the increased age with statistically significant differences. The PR mean value increased with age while FER mean value is decreased. However declined cardiorespiratory functions with increased age were statistically non- significant.

S.No.	Variables	Women ≤ 45 years Mean ± SD	Women > 45 years Mean ± SD	t-value
1.	Fat%	36.55±6.67	39.79 ±7.42	2.41*
2.	BMI (kg/m^2)	25.42±4.79	27.7±5.15	2.47**
3.	SBP (mmHg)	112.77±15.63	123.7±14.84	3.94***
4.	DBP (mmHg)	75.31±10.74	79.6 ±11.45	2.08*
5.	PR(b/min)	76.46±10.82	77.72 ±8.08	0.73
6.	FER	84.41±10.57	82.09 ±13.13	1.01

Table-3: Distribution of adiposity indices and cardio-respiratory variables among women.

Table 4 present the mean, standard deviation and t-values of clinical variables among women of two age groups. Hb, total cholesterol, blood sugar and HDL were found to be higher in women above 45 years of age with only significant differences for total cholesterol.

S.No.	Variables	Women ≤ 45 years Mean ± SD	Women > 45 years Mean ± SD	t-value
1.	Hb(g/dL)	10.29 ±1.69	12.8 ±18.41	0.96
2.	Total Cholesterol(mg/dL)	158.47 ±39.64	179.49 ±40.59	2.56**
3.	FBS (mg/dl)	100.92±23.90	110.99±35.47	1.85
4.	HDL (mg/dL)	47.56 ±11.18	56.26 ± 50.27	1.06

**p<0.01

Table-4: Distribution of clinical variables among women.

Association of all the categorized variables with the age is displayed as table 5. As per the SBP women of age group below 45 years, 41.3% women were normal and 17.4% were hypertensive whereas among above 45 years group, 18.2% were normal and 23.1% were hypertensive with significant differences. As per the DBP among below 45-years of age group women, 35.5% were normal and 23.1% were hypertensive whereas among above 45 years of age group, 19.8% were normal and 21.5% were hypertensive.

S.NO.	Variables	Categories	Women ≤ 45 years N (%)	Women > 45 years N (%)	Total N (%)	Chi-square	Correlation coeff. with age r
1	SBP (mmHg)	Normal	50(41.3)	22(18.2)	72(59.5)	8.50**	0.32**
		Hypertensive	21(17.4)	28(23.1)	49(40.5)		
		Total	71(58.7)	50(41.3)	121(100)		
2	DBP (mmHg)	Normal	43(35.5)	24(19.8)	67(55.4)	1.87	0.12
		Hypertensive	28(23.1)	26(21.5)	54(44.6)		
		Total	71(58.7)	50(41.3)	121(100)		
3	FER	Normal	14(12.1)	14(12.1)	28(24.1)	1.65	-0.22*
		At Risk	56(48.3)	32(27.6)	88(75.9)		
		Total	70(60.3)	46(39.7)	116(100)		
4	Hb(g/dL)	Normal	63(52.1)	43(35.5)	106(87.6)	0.2	0.02
		Low	8(6.6)	7(5.8)	15(12.4)		
		Total	71(58.7)	50(41.3)	121(100)		
5	Total Cholesterol(mg/dL)	Desirable	51(50)	27(26.5)	78(76.5)	1.84	0.23*
		High	12(11.8)	12(11.8)	24(23.5)		
		Total	63(61.8)	39(38.2)	102(100)		

6	HDL (mg/dL)	Low	13(13)	9(9)	22(22)	0.04	0.1
		Normal/high	48(48)	30(30)	78(78)		
		Total	61(61)	39(39)	100(100)		
7	BMI(kg/m^2)	Normal	28(23.1)	12(9.9)	40(33.1)	3.16	0.27**
		Overweight/ Obese	43(35.5)	38(31.4)	81(66.9)		
		Total	71(58.7)	50(41.3)	121(100)		
8	Fat%	Normal	4(3.4)	2 (1.7)	6(5.1)	0.16	0.27**
		At Risk	65(55.6)	46 (39.3)	111(94.9)		
		Total	69 (59)	48 (41)	117(100)		
9	FBS	Normal	44 (37)	19 (16)	63(52.9)	7.73*	0.16
		Prediabetes /Diabetes	25 (21.0)	31(26.1)	56 (47.1)		
		Total	69(58)	50(42)	119(100)		

*p<0.05 **p<0.01

Table 5: Chi square and correlation coefficient with age for all the variables.

The FER data shows that among women below 45 years of age group, 12.1% were normal and 48.3% were at risk and among above 45 years, 12.1% were normal and 27.6% were at risk. As per the Hb among below 45 years of age group, 52.1% were normal and 6.6% had low Hb whereas among above 45 years women, 35.5% were normal and 5.8% had low Hb. Taking total cholesterol into consideration, among above 45 years age group, 26.5 % had desirable level. However among below 45, 50% had desirable Total cholesterol level. With reference to HDL, 13% women who belonged to below 45 years age group had low HDL and 48% were having high HDL whereas in their younger counterpart, only 9% had low and 30% had high HDL.

As per the BMI, among above 45 years of age group, 9.9% were normal weight, 31.4% were overweight/obese and among below 45 years age group, 23.1% were normal while 35.5% were overweight/ obese. With reference to the fat%, among below 45 years age group, 3.4% were normal and 55.6% were at risk and among above 45 age group, 1.7% were normal and 39.3% were at risk. As per the FBS, 26.1% women in > 45 years age belonged to prediabetic / Diabetic category. In the younger age group, 21% were in the prediabetic / diabetic category with statistically significant difference with their elderly counterparts. FER showed negative correlation with age and the differences were found to be statistically significant. All the other variables were positively correlated with age with statistically significant differences for fat%, BMI, SBP, FER and total cholesterol.

Discussion

The declined height with advancing age in the present participants, and as also well documented in other studies [12-15] is not only a result of aging process but also a birth cohort effect [16]. Weight, BMI, waist and hip circumferences were found to increase with age in the present study and a large portion of this increase is driven by gain in body weight. However, the increase observed is larger than those predicted from increases in BMI alone, and increases in WC are seen with aging in the absence of weight gain [17]. Studies have shown that the waist circumference alone can be a good predictor for all-cause mortality than BMI. A significant increase in waist circumference among women above 45 years than their younger counterparts indicate a risk of morbidity in women after 45 years of age Overweight and obesity are rising and are at peak later in life. Within the 14-year study period (1994–96 to 2008–10) the distributions of BMI and WC have changed such that younger people entering adult life are already obese, and more older people have adverse body composition. The continuing rise of WC into older age groups is evidence of continued body fat accumulation and/or redistribution of fat into older age, a major emerging public health concern. Menopausal transition is associated with increase in abdominal adiposity, independent of the effect of age and total body adiposity as pattern of hormone secretion changes and gradually causes more fat accumulation in visceral tissues of abdomen [18].

Increased BMI and fat% are clearly indicating the higher level of adiposity among elder women as compared to their younger counterparts in the present study. Svendsen [11] also reported significant higher total-body fat%, abdominal fat%, abdominal to total-body fat tissue ratio and lower LTM (Lean Tissue Mass) among post- menopausal than premenopausal women. According to them FTM (Fat tissue mass) and fat distribution were positively associated and LTM correlated with age. They suggested that estrogen deficiency in the perimenopausal years increases FTM and decreases LTM. Yoneshiro [19] reported that the decreased brown adipose tissue activity may be associated with accumulation of body fat with age.

Blood pressure and PR also showed increased mean value with an advancing age [20,21]. Kannel and Gordon [22] clearly established that high blood pressure is a significant risk factor for stroke, coronary artery disease and congestive heart failure. Moreover, cardiovascular disease was a more frequent cause of death and morbidity in the hypertensive elderly more than 65 years of age than in the younger people [23]. Age-associated blood vessel stiffening and diastolic dysfunction contribute to changes in pulmonary artery pressure and increased pulmonary artery systolic pressure is associated with increased all-cause mortality, independent of both age and the presence of clinically-evident cardiopulmonary disease [24].

In the present study, FER showed declining trend with increased age. A decline in lung function like forced expiratory volume in one second (FEV1) and forced vital capacity (FVC) were reported after the age 20 years in earlier studies as well [10,25,26,15]. Boss [23] has reported negative association between change in weight and FEV1. In the present study as well an increase in weight with poor cardio respiratory functions were reported among women who belonged to above 45 years age group with significant differences. It has been reported that weight reduction may significantly slow lung function decline [27].

All the clinical variables, Hb, Total cholesterol, HDL and FBS were found to be increasing with age with significant differences in case of total cholesterol for the both the category of women. The 45 years above women were more diabetic or prediabetic than their younger counterpart. Yates and Laing [28] also showed age-related rises in FPG (Fasting plasma glucose) and haemoglobin but steady decline in pancreatic β cell function. Association between HDL-C and myocardial infarction also persisted for low levels of total cholesterol in both men and women. HDL-C is inversely related to the development of myocardial infarction, particularly in women [29].

Our results are clearly showing the higher adiposity and comorbid factors like hypertension, poor lung functions, higher cholesterol and blood glucose levels among women above 45 years as compared to their younger counterparts. Pelclova [30] found the association of physical activity and body composition variables in middle aged and older women. It has been said that moderate amount of physical activity can reduce the risk of cardiovascular diseases and improve the body composition.

Conclusion

In the present study, significant increase in waist circumference, hip circumference, Fat%, BMI, blood pressure and Total cholesterol were reported with the advancing age. These age-related changes indicates hypertension, poor cardio respiratory functions, high adiposity which all pose risk of CVD and mortality. In the present study participants i.e. women above 45 years of age were reported to have pre metabolic syndrome with higher central obesity, hypertension and higher fasting blood glucose level as compared to their younger counterparts. Statistically significant variations were observed for metabolic syndrome viz higher central obesity, hypertension and higher fasting blood glucose level. According to WHO (2003), the cardiovascular diseases risk is known to increase with age, hypertension and central obesity [31-33]. The present study finding indicates beginning of metabolic diseases risk and CVD risk among women of more than 45 years. Women may take care of these health aspects from early age to manage them appropriately which helps to avoid chronic health condition and live healthy ageing phase. Therefore an early awareness and management of such risk with life style modification including regular physical activity may go long way for management of the health risk well in time. Policy makers may consider the health challenges among midlife women while planning and implementing any programmes for this section of population. .

Limitation of the study: Our study results are quite indicative of a future health problem if corrective measures are not taking in younger years but these findings may be well established with a bigger sample size.

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