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Association of BMI, W/H Ratio, A/H Ratio with Age at Natural Menopause, Type 2 Diabetes, Hypertension and Thyroid Status in South Part of Bangladesh

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Abstract **Original Research Article**

Introduction: Menopause is a natural occurrence in a women's life, which occurs at the end of their reproductive capability. Proper monitoring of early menopausal signs can let the women have a better understanding of their future and plan accordingly. Any association with non-medical factors in regards to menopausal age can help women make appropriate decisions without needing to go through unnecessary tests. ***Aim of the study:*** The aim of the study was to observe possible association between BMI, waist-hip ratio, abdomen-hip ratio, age at natural menopause, type 2 diabetes, hypertension and thyroid disorders. ***Methods:*** This was a cross-sectional study conducted at various government and renounced private hospitals of Chittagong district, Bangladesh, during the period from July 2023 to July 2024. A total of 1000 cases of post-menopausal women were interviewed for this study following primary inclusion criteria. Among them, some patients had withdrawn from the study for various reasons, and the final sample size was determined to be 743 following the inclusion and exclusion criteria. Informed verbal consent was obtained from each of the participants. Data collection was done using a structured questionnaire, and collected data was analyzed using the SPSS v26. ***Result:*** Among the participants, 41.32% were aged between 41-50 years and 1.08% of the participants were over 70 years of age. 49.39% had lived a sedentary lifestyle, and 52.09% were illiterate. 30.96A% of the participants were overweight, and 0.81% were morbidly obese. 46.30% had waist-to-hip ratio between 0.90-0.99, and 53.03% had abdomen-to-waist ratio of 0.90-0.99. 70.93% had reached menopause between the ages of 40-49 years, and 49.80% had diabetes. history of diabetes had a significant negative correlation with WH ratio (<0.001), while history of hyperthyroidism had a significant positive association with BMI (<0.001) and WH ratio (0.029). ***Conclusion:*** The present study concluded that age of menopause was natural for majority of Bangladeshi population, and was significantly influenced only by hyperthyroidism, while BMI had been significantly associated with history of hypertension and wait-to-hip ratio. History of diabetes mellitus also had significant relation with both waist-to-hip ratio and history of hypertension. Hypertension had significant relations with most factors of the present study, excluding abdomen-to-hip ratio, hypothyroidism and hyperthyroidism. Both abdomen-to-hip ratio and hypothyroidism had no significant relation with any of the factors of present study.

Keywords: Menopause, Body-Mass-Index, Hypertension, Circumference, Thyroid, Diabetes.

INTRODUCTION

Menopause occurs when your periods cease owing to decreased hormone levels. This often occurs between the ages of 45 and 55. It can occasionally happen naturally earlier. Or for medical reasons like as removing the ovaries (oophorectomy) or uterus (hysterectomy), cancer therapies such as chemotherapy, or a hereditary cause [1]. As medical technology has

advanced, human lifetime has increased dramatically, and any woman who lives long enough will experience menopause [2, 3]. It is a normal condition that middle-aged women encounter, but the changes caused by menopause can be extremely severe, disrupting their daily lives. The physiology and clinical manifestations of this menopausal transition are not fully known; nevertheless, certain symptoms, such as hot flashes, do begin in the perimenopause. Menopause marks the end of a woman's reproductive life and, as such, can have a substantial psychological and social influence [4]. As a result, understanding the time of menopause is a crucial determinant in the prevalence, morbidity, and mortality associated with numerous metabolic illnesses such as diabetes [5]. Epidemiology studies have indicated that menopause beginning at 45 years of age is related with an increased risk of CVD and overall mortality [6, 7]. Some research have been conducted in order to understand more about the variables that might cause menopause to occur early in women. Early menopause may have a substantial impact on a woman's and her family's lifestyle. Some studies have linked the body-mass-index, or BMI, to the onset of menopause at a young age [8-10]. BMI has also been linked to cardiovascular disease and hypertension in both male and female populations [11-14]. A person's BMI can have an effect on their physical shape, waist to hip (WH) ratio, and abdomen hip (AH) ratio. The weight-to-height ratio is the most important component in determining a patient's BMI. BMI is calculated by dividing a person's weight in kilograms by their height in meters squared [15]. The circumference of the abdomen and hip or the waist and hip can be utilized to successfully detect overweight and obesity in individuals [16,17]. At the same time, these measures can be utilized as predictors of cardiovascular disease, sometimes outperforming BMI [17]. In a 2015 Greek research, waist circumference, waist-to-hip ratio, and abdomen-to-hip ratio were utilized to diagnose abdominal obesity in a large percentage of abdominal obesity patients [18]. Obesity identification is critical since it can have a substantial influence on diabetes, hypertension, thyroid issues, and other conditions. When these disorders are combined with menopause in women, the effect might be considerably more severe. Simply depending on BMI to diagnose obesity is frequently insufficient, since WH ratio and AH ratio can become stronger predictors of obesity than BMI. Despite the fact that several research have been undertaken to investigate probable links between BMI and natural age of menopause, or WH ratio and diabetes, clear answers are lacking. The current study was carried out to investigate the relationship between parameters such as BMI, WH ratio, AH ratio, age at natural menopause, type 2 diabetes, hypertension, and thyroid problems.

OBJECTIVE

General Objective

- To observe association between BMI with age at natural menopause, type-2 diabetes, hypertension and thyroid status.
- To observe association between waist-to-hip ratio with age at natural menopause, type-2 diabetes, hypertension and thyroid status.
- To observe association between abdomen-to-hip ratio with age at natural menopause, type-2 diabetes, hypertension and thyroid status.

METHODS

This was a cross-sectional study conducted at various government and renounced private hospitals of Chittagong district, Bangladesh, during the period from July 2023 to July 2024. A total of 1000 cases of post-menopausal women were admitted in the study following primary inclusion criteria. Among them, some patients had withdrawn from the study for various reasons, and the final sample size was determined to be 743 following the inclusion and exclusion criteria. Informed written consent was obtained from each of the participants, and ethical approval was obtained from the ethical review committee of the study hospital. Data collection was done using a pre-made questionnaire sheet, and collected data was analyzed using the SPSS v26.

Inclusion Criteria

- Participants having natural menopause
- Only female participants
- Both early and premature age of menopause
- Patients who had given consent to participate in the study.

Exclusion Criteria

- Patients receiving chemotherapy
- Patients having surgery of the ovaries or uterus
- Unable to answer the criteria question.
- Exclude those affected with other chronic diseases etc.

RESULTS

Table 1: Social characteristics distribution of the participants (n=743)

Characteristics	Frequency	Percent
Age		
≤40	24	3.23%
41-50	307	41.32%
51-60	292	39.30%
61-70	112	15.07%
>70	8	1.08%

Characteristics	Frequency	Percent
Lifestyle		
Sedentary	367	49.39%
Physical labor	376	50.61%
Educational Status		
Illiterate	387	52.09%
under 5	234	31.49%
5-8	110	14.80%
more than 8	12	1.62%

Among the participants, 41.32% were aged between 41-50 years, 39.30% were between the age of 51-60 years, and only 1.08% of the participants were over 70 years of age. In regards to lifestyle, 50.61% had an active lifestyle with physical labor, and 49.39% had sedentary lifestyle. Over half (52.09%) of the participants were illiterate, while only 1.62% of the participants had received education after class 8.

Table 2: BMI Distribution of the participants (n=743)

BMI	Frequency	Percent
Underweight	71	9.56%
Normal	390	52.49%
Overweight	230	30.96%
Obese	45	6.06%
Morbidly Obese	6	0.81%

Among the participants, 52.49% were of normal weight, 30.96% of the participants were overweight, while 6.06% of the participants were obese and 0.81% were morbidly obese.

Table 3: Distribution of the participants by Waist-to-Hip ratio and Abdomen-to-Hip ratio (n=743)

Range	Frequency	Percent
Waist Hip ratio		
0.70-0.79	36	4.85%
0.80-0.89	259	34.86%
0.90-0.99	344	46.30%
1.00-1.09	86	11.57%
≥1.10	4	0.54%
Abdomen Hip Ratio		
0.70-0.79	21	2.83%
0.80-0.89	185	24.90%
0.90-0.99	394	53.03%
1.00-1.09	99	13.32%
≥1.10	28	3.77%

Among the total 743 participants, waist-to-hip ratio was between 0.90-0.99 for 46.30% of the participants, while it was between 1.00-1.09 for 11.57% of the participants, while 0.54% of participants had 1.10 or higher WH ratio. In regards to abdomen-to-hip ratio, 53.03% had ratio between 0.90-0.99, 2.83% had an AH ratio of between 0.70-0.79 and 3.77% had an AH ratio of 1.10 or higher.

Table 4: Distribution of participants by maternal factors (n=743)

Range	Frequency	Percent
Number of Full-term pregnancies		
0	4	0.54%
1-3	296	39.84%
4-6	383	51.55%
7-9	52	7.00%
>9	8	1.08%
Number of miscarriages		
0	433	58.28%
1-2	284	38.22%
3-4	24	3.23%

Range	Frequency	Percent
>4	2	0.27%
Age at menopause		
30-39	48	6.46%
40-49	527	70.93%
50-59	168	22.61%

In regards to full term pregnancy, 0.54% of the participants had no record of full-term pregnancy, while over half (51.55%) had between 4-6 full term pregnancies. 1.08% of the participants had over 9 full term pregnancies during their lifetime. Almost 6/10 (58.28%) had no miscarriages, while 38.22% had 1-2 miscarriages, and 0.27% of the participants had over 4 miscarriages. Age at menopause was between 40-49 years for majority (70.93%) of the participants, while 6.46% had menopause between the ages of 30-39 years.

Table 5: Distribution of participants by associated risk factors (n=743)

Associated risk factors	Frequency	Percent
Smoking	36	4.85%
No exercise	641	86.27%
Diabetes	370	49.80%

Among associated risk factors, smoking was present in 4.85% of participants, 49.80% had no diabetes, and 86.27% of the participants had no history of regular exercise.

Table 6: Distribution of participants by duration of diabetes (n=743)

Duration of diabetes in months	Frequency	Percent
0	373	50.20%
1-3	94	12.65%
3-6	178	23.96%
7-12	112	15.07%
13-24	32	4.31%
>24	12	1.62%

Among the participants, 50.20% had no diabetes, while 12.65% had diabetes for 1-3 months, 23.96% of the participants had diabetes for 3-6 months, 15.07% had diabetes for 7-12 months, and 1.62% had diabetes for over 2 years.

Table 7: Distribution of participants by clinical findings (n=743)

Clinical Findings	Frequency	Percent
H/O taking ovulation inducing drugs	46	6.19%
H/O Gestational DM	54	7.27%
Hyperthyroidism	48	6.46%
Hypothyroidism	39	5.25%
H/O hypertension	250	33.65%

Among the participants, 33.65% had a history of hypertension, 7.27% had a history of gestational diabetes mellitus, 6.46% had hyperthyroidism, 5.25% had hypothyroidism, and 6.19% had a history of taking ovulation inducing drugs.

Table 8: Distribution of the participants by duration of hypertension (n=743)

Duration of Hypertension	Frequency	Percent
0	493	66.35%
1-3	109	14.67%
3-6	136	18.30%
7-12	52	7.00%
13-24	7	0.94%
>24	8	1.08%

Among the participants, 66.35% had no hypertension, while 18.30% had hypertension for 3-6 months, 0.94% had hypertension between 13-24 months, and 1.08% had hypertension for over 2 years.

Table 9: Pearson's correlation between BMI, W/H ratio, A/H ratio with age at menopause, type 2 diabetes, hypertension and thyroid status (n=743)

Variables		BMI	waist hip ratio	abdomen hip ratio	age at menopause	history of diabetes	hyperthyoidism	hypothyroidism	h/o hypertension
BMI	Pearson Correlation	1	.621**	0.045	-0.058	-0.010	-0.005	0.019	.167**
	Sig. (2-tailed)		**<0.001**	0.225	0.114	0.777	0.884	0.605	**<0.001**
Waist-Hip ratio	Pearson Correlation	.621**	1	0.021	0.004	-.142**	0.054	0.055	.081*
	Sig. (2-tailed)	**<0.001**		0.579	0.908	**<0.001**	0.144	0.138	**0.029**
Abdomen-Hip ratio	Pearson Correlation	0.045	0.021	1	-0.014	-0.041	-0.008	-0.008	-0.025
	Sig. (2-tailed)	0.225	0.579		0.711	0.274	0.830	0.826	0.503
Age at menopause	Pearson Correlation	-0.058	0.004	-0.014	1	0.052	.088*	0.021	.099**
	Sig. (2-tailed)	0.114	0.908	0.711		0.160	**0.016**	0.575	**0.007**
History of diabetes	Pearson Correlation	-0.010	-.142**	-0.041	0.052	1	0.067	0.019	.083*
	Sig. (2-tailed)	0.777	**<0.001**	0.274	0.160		0.069	0.604	**0.024**
Hyperthyroidism	Pearson Correlation	-0.005	0.054	-0.008	.088*	0.067	1	-0.062	0.045
	Sig. (2-tailed)	0.884	0.144	0.830	**0.016**	0.069		0.092	0.225
Hypothyroidism	Pearson Correlation	0.019	0.055	-0.008	0.021	0.019	-0.062	1	-0.014
	Sig. (2-tailed)	0.605	0.138	0.826	0.575	0.604	0.092		0.696
H/O Hypertension	Pearson Correlation	.167**	.081*	-0.025	.099**	.083*	0.045	-0.014	1
	Sig. (2-tailed)	**<0.001**	**0.029**	0.503	**0.007**	**0.024**	0.225	0.696	

**Correlation is significant at the 0.01 level (2-tailed)

*Correlation is significant at the 0.05 level (2-tailed)

Among the present study participants, the age of menopause had no significant association between BMI, WH ratio or AH ratio. On the other hand, history of diabetes had a significant negative correlation with WH ratio (<0.001), while history of hyperthyroidism had a significant positive association with BMI (<0.001) and WH ratio (0.029)

DISCUSSION

The present study was conducted with the aim of understanding any possible correlation between a women's BMI, waist-to-hip ratio and abdomen-to-hip ratio with their age of natural menopause, diabetes, hypertension and thyroid disorders. Menopause is a normal occurrence among women where their monthly period ends, marking the end of their reproductive age. It typically occurs between the ages of 40-50 years [19]. Early onset of menopause can cause physical and social challenges for a women, and the present study was conducted to observe is some non-clinical factors can be used to detect early menopausal signs among women. The present study was conducted with records collected from a total of 743 cases, among whom majority had been between the age of 41-50 years, with 49.39% leading a sedentary lifestyle. This was understandable considering the age of the participants and the social structure of our country, where very few women can have jobs, and this has been changing only recently. Another reason for 50.61% leading lifestyle with physical labor was the low literacy among participants, as it is an important factor in the job market. According to the BMI distribution of the participants, over half the participants had been of normal BMI range, while 30.96% had been obese, and 6 patients had been morbidly obese. This was similar to another Bangladeshi study where majority of women had been of normal BMI, but the age of the participants were from higher age range compared to our study [20]. 34.86% of the participants had waist-to-hip ratio of between 0.80-0.89, while another 46.30% had WH ratio between 0.90-0.99. This was accurate for the Bangladeshi population as supported by the findings of Begum *et al.,* where it was observed that mean ratio among Bangladeshi women was between 0.80-0.89 range, while the ratio among European women were significantly lower [21]. Abdomen hip ratio was between 0.90-0.99 for over half the participants, and was 1.10 or higher for 3.77% of participants. WH ratio and AH ratio can be influenced by factors such as reproductive status, lifestyle, dietary habits etc., and as such can be used for predictors of natural menopause age, risk of cardiovascular diseases etc. [22, 23]. Among the present study participants, over half (51.55%) had 4-6 full-term pregnancies, while 1.08% had over 9 full-term pregnancies. This high number of full-term pregnancies among population was understandable considering their age. Among the participants, 58.28% had no record of miscarriage, while 0.27% had over 4 miscarriages. 38.22% of the participants had 1-2 miscarriages. A low rate of miscarriage can be an indicator for adequate health care available for the population, but the present study had much higher miscarriage rates compared to global rates

[24, 25]. Majority (70.93%) of the participants had reached menopause at the natural age range of 40-49 years, while 6.46% of the participants had an early menopause between 30-39 years of age. The remaining 22.61% of the participants had reached menopause by 50-59 years of age. This distribution of early and late menopause was similar to the findings of multiple Bangladeshi studies [26, 27]. Among the participants, 86.27% had no regular exercise, while 49.80% had diabetes and 4.85% had been smokers. The incidence of diabetes among post-menopausal women was much higher in our study compared to other global findings, but this may have been influenced by our selection criteria [28, 29]. Among the total participants, 12.65% had diabetes for 1-3 months, 23.96% of the participants had diabetes for 3-6 months, 15.07% had diabetes for 7-12 months, and only 1.62% had diabetes for over 2 years. Clinical findings of the participants showed that 33.65% had a history of hypertension, 7.27% had a history of gestational diabetes mellitus, 6.46% had hyperthyroidism, 5.25% had hypothyroidism, and 6.19% had a history of taking ovulation inducing drugs. The incidence of thyroid disorder in our study was much lower compared to other global studies [30, 31]. Most of the participant did not have hypertension, while 18.30% had hypertension for 3-6 months. Only 1.08% of the participants had hypertension for over 2 years. Pearson's correlation showed that patient BMI had a significant positive correlation with WH ratio ($P<0.001$) and history of hypertension ($P<0.001$), WH ratio had a significant negative correlation with history of diabetes ($P<0.001$) and a positive correlation with history of hypertension ($P=0.029$). Abdomen-hip ratio of the participants had no positive or negative correlation with any other factors, while age of menopause only had one positive significant correlation with hyperthyroidism ($P=0.016$). History of diabetes also had significant positive correlation with history of hypertension ($P=0.024$).

Limitations of The Study

The study was conducted in a single hospital with a small sample size. So, the results may not represent the whole community.

CONCLUSION

The present study concluded that age of menopause was natural for majority of Bangladeshi population, and was significantly influenced only by hyperthyroidism, while BMI had been significantly associated with history of hypertension and wait-to-hip ratio. History of diabetes mellitus also had significant relation with both waist-to-hip ratio and history of hypertension. Hypertension had significant relations with most factors of the present study, excluding abdomen-to-hip ratio, hypothyroidism and hyperthyroidism. Both abdomen-to-hip ratio and hypothyroidism had no significant relation with any of the factors of present study.

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