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The Associations between Body Shape Index and Dyslipidemia and Diabetes in Cardiovascular Patients

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ABSTRACT

Background: Due to the importance of identifying and preventing non-communicable diseases, especially obesity and overweight, this study was performed to investigate the relationship between A Body Shape Index (ABSI) and dyslipidemia.

Objectives: This study was performed to investigate the relationship between A Body Shape Index (ABSI) and dyslipidemia.

Methods: This cross-sectional study was conducted on 300 patients. Eligible individuals were selected using convenience sampling. The participants' height and waist circumference were measured. The results of these measurements as well as other demographic information, reason for referral, blood sugar, Low Density Lipoprotein (LDL), High Density Lipoprotein (HDL), Triglyceride (TG), and cholesterol levels, and blood pressure were recorded in a checklist that was designed based on the research objectives. The obtained data were then entered into the SPSS 11 software and analyzed using independent sample t-test and Pearson's correlation coefficient at the 0.05 significance level.

Results: This study was conducted on 300 patients with the mean age of 41.6 ± 7.17 years. The means of body mass index and ABSI were 27.10 ± 4.40 kg/m^2 and 0.082 ± 0.006, respectively. The mean of ABSI was significantly higher in the patients who had high TG levels as well as sugar levels higher than 100 mg/dL compared to those with low TG and blood sugar levels ($P = 0.03$ and $P = 0.02$, respectively). However, this parameter was significantly lower in the patients with low HDL levels compared to those with high HDL levels ($P = 0.02$). ABSI was significantly correlated to fasting blood sugar ($r = 0.15$, $P = 0.008$) and TG ($r = 0.12$, $P = 0.02$).

Conclusion: The study results indicated that ABSI was correlated to the serum levels of TG and fasting blood sugar. Additionally, the mean of ABSI was higher among the patients with diabetes compared to the others.

1. Introduction

Obesity, which is a major cause of some types of cancer, leads to several problems such as type II diabetes and cardiovascular diseases (1). In Iran, the concurrent frequencies of overweight and obesity have been calculated as 42.8% and 57% among males and females, respectively. The frequencies of overweight and obesity among males and females have been expected to reach 54% and 74%, respectively in future (2).

Due to the importance of obesity and overweight, it is vital to have an accurate criterion for the assessment and diagnosis of obesity. Researchers have proposed numerous methods for measuring body fat including various Para clinical and experimental methods such as Bioimpedance Analysis (BIA), Dual Energy X-ray Absorptiometry (DEXA), Computed Tomography (CT), and Magnetic Resonance Imaging (MRI). These techniques mostly rely on expensive equipment that are not always available (3-5). On the other hand, simple measurement of skin compression is highly time-consuming and demands experienced technicians (6), which is not favored by daily medical care clinics and population-based studies. According to the World Health

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Organization (WHO), Body Mass Index (BMI) that is measured based on body weight and height is linked to hypertension, while Waist Circumference (WC) is related to dyslipidemia and diabetes mellitus (7-9). Furthermore, there are reliable data suggesting that BMI can lead to the misdiagnosis of body fat (10, 11). Yet, there is evidence on the usefulness of this index for the body mass fat rather than the total body fat, which has been found to be associated with metabolic disorders and health risk factors (12, 13). According to WHO, BMI is not suitable for the assessment of body fat in populations with different ethnicities (6). It is also worth mentioning that highly athletic individuals may have high BMIs with no excessive body fat (weight gain is caused by the muscle mass) as well as no metabolic abnormalities (14).

Recently, Krakauer et al. introduced a simple index for body composition called the body shape index (ABSI). This index is calculated using both BMI and WC and is seemingly a more reliable index for the measurement of mortality and body composition (15). Some previous studies analyzed the relationship between this index and the mortality risk (15). The results demonstrated that diabetes mellitus, cardiovascular diseases, and hypertension could be more accurately predicted by ABSI than by BMI in Iranian and Chinese adolescent populations (16-19). Although the reason for this difference was unknown, it might have been caused by the differences in fat distribution among different ethnicities (20). Moreover, several studies have reported that the validity of this index was equal to the validity of other experimental measurements (21). Furthermore, some researchers have shown a positive relationship between ABSI and body fat, but a negative relationship between free body fat and ABSI (22). Therefore, it could be concluded that this index was positively related to abdominal fat in patients with type II diabetes (23).

2. Objectives

Considering what was mentioned above as well as the importance of the identification of the risk factors of non-contagious diseases, especially obesity and overweight, and the early prevention of these diseases, the present study aims to explore the relationship between ABSI and dyslipidemia in the patients referred to the cardiovascular clinic of Birjand in 2018.

3. Patients and Methods

This descriptive-analytical study was approved by the Ethics Committee of Birjand University of Medical Sciences (code: IR.BUMS.REC.1397.153). The study was conducted on 300 patients who were referred to the outpatient cardiovascular clinic of Valiasr Hospital in Birjand in 2018. The patients were selected using convenience sampling.

The study data were collected using a checklist that was designed based on the research objectives. After obtaining the informed consent forms from the patients, a stretchable band with 0.1 cm graduation was used to measure their height and WC. Additionally, a digital Seca 703 height scale made in Germany (with gram graduation) was used to calculate their weight and BMI. The results of these measurements as well as other demographic information, reason for referral, blood sugar, Low Density Lipoprotein (LDL), High Density Lipoprotein (HDL), Triglyceride (TG), and cholesterol levels, and blood pressure were recorded in a checklist for each patient. The following formula was used to calculate ABSI:

$$ABSI = WC\,(m)/[BMI^{2/3} \times height\,(m)^{1/2}]$$

It should be noted that the patients who needed drugs for lipid profile control received medications.

According to the definition of dyslipidemia, this condition occurs when TG is greater than or equal to 250 mg/dL, cholesterol level is greater than or equal to 200 mg/dL, LDL level is greater than or equal to 130 mg/dL, or HDL level is lower than 35 mg/dL in males and 45 mg/dL in females (6).

The obtained data were entered into the SPSS software, version 11. Considering the normality of data distribution based on the Kolmogorov-Smirnov test, independent t-test was utilized to compare the study groups regarding the mean of ABSI. Besides, Pearson's coefficient was employed to determine the correlation between ABSI and other study variables at the 0.05 significance level.

4. Results

The present study was conducted on 300 patients with the mean age of 41.6 $\pm$ 7.14 years. Among the patients, 183 (61%) were male. Additionally, 46.3% of the patients had cholesterol levels higher than 200 mg/dL and 12% had TG levels > 250 mg/dL. Moreover, 4.3%, 17.7%, and 78% of the patients had diabetes mellitus, pre-diabetes, and normal blood sugar levels, respectively. Furthermore, 8.3% of the patients had systolic blood pressures higher than 140 mmHg, while 12.7% had diastolic blood pressures above 90 mmHg (Table 1). The means of the anthropometric indices, fasting blood sugar, serum lipids, and blood pressure have been presented in Table 2.

The findings showed that the mean of ABSI was significantly higher in the patients with hypertriglyceridemia and normal HDL levels compared to those with TG < 250 mg/dL (P = 0.03) and low HDL levels (P = 0.02). Accordingly, the mean ABSI was significantly higher in the patients with blood sugar levels higher than 100 mg/dL compared to those with blood sugar levels lower than 100 mg/dl. However, no significant difference was observed in the mean of ABSI on the basis of cholesterol level, LDL level, and systolic and diastolic blood pressure (Table 3). Overall, ABSI was mostly correlated to fasting blood sugar (r = 0.15, P = 0.008) and TG (r = 0.12, P = 0.02).

5. Discussion

The present study aimed to determine the relationship between ABSI and dyslipidemia among 300 patients who were referred to the cardiovascular clinic of Birjand University of Medical Sciences.

The findings showed a significant difference in the mean of ABSI concerning TG, fasting blood sugar, and HDL levels. Accordingly, higher levels of TG, fasting blood sugar, and HDL resulted in a significant increase in the mean of ABSI. However, no statistically significant results were obtained in terms of hypercholesterolemia and LDL level. In addition, the results revealed that ABSI was highly correlated to

Table 1. Demographic and Clinical Characteristics of the Participants

Characteristics		N (%)
Sex	Male	183 (61)
	Female	117 (39)
Age group (years)	< 30	12 (4)
	30 - 40	137 (45.7)
	40 - 50	106 (35.3)
	> 50	45 (15)
Risk factor history	Diabetes	13 (4.3)
	Pre-diabetes	53 (17.7)
	Systolic blood pressure > 140 mmHg	25 (8.3)
	Diastolic blood pressure > 90 mmHg	38 (12.7)
	Cholesterol > 200 mg/dL	139 (46.3)
	TG > 250 mg/dL	36 (12)
	LDL > 130 mg/dL	139 (46.3)
	Low HDL	135 (45)

Abbreviations: TG, triglyceride; HDL, high-density lipoprotein; LDL, low-density lipoprotein.

Table 2. The Participants' Clinical and Laboratory Characteristics

Characteristics	Mean ± SD	95% CI for Mean
Waist (cm)	95.59 ± 10.17	94.43 - 96.75
Weight (kg)	75.48± 12.49	74.06 - 76.90
Height (cm)	167.53 ± 9.78	66.40 - 168.64
BMI (kg/m^2)	26.91 ± 4.02	26.45 - 27.36
ABSI	0.082 ± 0.004	0.082 - 0.083
TG (mg/dL)	162.20 ± 92.59	151.68 - 172.72
Cholesterol (mg/dL)	197.12 ± 41.07	192.45 - 201.78
HDL (mg/dL)	41.00 ± 7.38	40.16 - 41.84
LDL (mg/dL)	117.34 ± 84.73	113.89 - 121.78
FBS (mg/dL)	94.55 ± 19.46	92.32 - 96.76
SBP (mmHg)	120.30 ± 12.68	118.85 - 121.74
DBP (mmHg)	78.36 ± 7.10	77.55 - 79.17

Abbreviations: BMI, body mass index; ABSI, a body shape index; TG, triglyceride; HDL, high-density lipoprotein; LDL, low-density lipoprotein; FBS, fasting blood sugar; SBP, systolic blood pressure; DBP, diastolic blood pressure.

Table 3. Comparison of ABSI according to the Participants' Characteristics

Risk Factors		ABSI Mean ± SD	P-value*
Triglyceride	< 250 (mg/dL)	0.082 ± 0.004	0.03
	> 250 (mg/dL)	0.084 ± 0.003	
Cholesterol	< 200 (mg/dL)	0.082 ± 0.0044	0.95
	> 200 (mg/dL)	0.082 ± 0.0046	
LDL	< 130 (mg/dL)	0.082 ± 0.004	0.14
	> 130 (mg/dL)	0.083 ± 0.0045	
HDL	Normal	0.083 ± 0.003	0.02
	Low	0.081 ± 0.005	
Fasting blood sugar	< 100 (mg/dL)	0.082 ± 0.004	0.02
	> 100 (mg/dL)	0.083 ± 0.004	
Systolic blood pressure	< 140 (mmHg)	0.082 ± 0.004	0.73
	> 140 (mmHg)	0.082 ± 0.003	
Diastolic blood pressure	< 90 (mmHg)	0.082 ± 0.0045	0.79
	> 90 (mmHg)	0.082 ± 0.0042	

Abbreviations: HDL, high-density lipoprotein; LDL, low-density lipoprotein. *Independent sample t-test, significance level = 0.05.

the serum levels of fasting blood sugar and TG. Since the introduction of the ABSI by Krakauer et al. (15), various studies have been conducted on this index, which have shown conflicting results. In a 2015 study conducted by Malara et al. on 114 unemployed male students who had no specific plans to take part in physical activities, BMI was significantly correlated to the TG level. However, ABSI had a relationship with serum insulin and LDL levels, while it showed no correlations with the serum levels of HDL, cholesterol, and TG (6). Fujita et al. conducted another study in Japan in 2015 to analyze BMI, WC, and ABSI for the prediction of diabetes mellitus, blood pressure, and dyslipidemia. The results revealed that an increase in these indices was accompanied by an increase in the risk of diabetes and dyslipidemia. However, no significant relationship was observed between ABSI and hypertension. The results also indicated that ABSI performed more poorly than WC and BMI in the prediction of the risk of blood pressure and diabetes mellitus in a study it is declare that high BMI was the most common risk factor among all of the studied risk factors including HTN, DM, low HDL, high LDL, high TG, and high total cholesterol (24-26). Mameli et al. also carried out a research in Italy in 2018 to determine the relationship between ABSI and cardiovascular risk factors in overweight children. The results of the regression analysis showed that ABSI had a positive correlation with the total cholesterol, TG, and LDL levels, but a negative correlation with HDL level (27, 28). Moreover, Bozorgmanesh et al. conducted a study on 8248 patients aged more than 30 years in 2014 to explore the predictive role of ABSI in the onset of cardiovascular complications. They reported that an increase in the mean of ABSI led to a decrease in the HDL level. However, no significant results were obtained regarding the total cholesterol level (29, 30). Tian et al. also performed a study on 8126 Chinese adults aged 18-85 years in China in 2016 and disclosed that an increase in ABSI did not elevate the risk of dyslipidemia. In other words, there was no significant correlation between ABSI and dyslipidemia. They also reported that the mentioned index was not a good parameter for the prediction of the likelihood of cardiovascular diseases (29). On the contrary, Wang et al. (2018) studied 11247 Chinese residents of rural areas aged over 35 years and came to the conclusion that ABSI was the best criterion for estimating the development of cardiovascular diseases among males (30, 31). The difference between the results of the above-mentioned studies could be attributed to the study populations. Besides, Wang et al. did not mention the risk factors of cardiovascular diseases separately. Review of the literature also revealed differences among the results of various studies including the present one. These differences could be explained by various factors including age, gender (29), mobility, demographic information of the study population (15), and even the research method. For instance, Krakauer et al. stated that the ability of ABSI to predict mortality depended on ethnicity. According to the results, this index had a lower predictive power for Latinos compared to Caucasians and African-Americans. Thus, they emphasized the need for additional cohort studies on other ethnic groups to clarify the predictive power of ABSI (15). It is worth noting that the increased mean levels of TG and fasting blood sugar in the patients could be attributed to immobility. It has been suggested in various studies that weight gain, especially increased fat mass, exacerbates the peripheral insulin resistance and carbohydrate metabolism disorders (32). However, ABSI reflects the body fat mass and its growth is expected to affect blood sugar, as stated earlier. Furthermore, although the mean level of HDL was expected to fall with a higher ABSI, it increased unlike the results of the aforementioned studies. A more detailed analysis of this finding requires further research and analysis of the determining parameters, especially medications and activity levels. The results of various studies have indicated that nicotinic acid compounds and cholesterol ester transferring protein inhibitors increased HDL levels in patients with lipid disorders. However, this increase did not lower the risk of cardiovascular diseases. This finding was attributed to HDL activity. Additionally, it was stated that an increase in HDL level did not necessarily lead to the better performance of this lipoprotein. These could explain the differences between the results of different studies, but more detailed assessments call for further research.

5.1. Conclusion

The present study results showed no significant correlation between ABSI and systolic and diastolic blood pressures. Consistently, most previous studies have demonstrated no significant relationship between blood pressure and ABSI. As an instance, Fujita et al. reported that ABSI was not linked to hypertension. They also disclosed that ABSI was a weaker criterion for the prediction of the likelihood of hypertension compared to WC and BMI (24, 25). Moreover, Tian et al. reported that a higher ABSI did not increase the risk of hypertension. They also found no significant correlation between blood pressure and ABSI (29).

The current study findings indicated that the mean ABSI was significantly higher in the patients with blood sugar levels above 100 mg/dL compared to those with blood sugar levels lower than 100 mg/dL. In addition, ABSI had a positive correlation with fasting blood sugar level. In the research carried out by Fujita et al., higher ABSI elevated the risk of diabetes mellitus (24, 25). In another study performed by Bertoli et al. on 6081 Caucasians in 2017, ABSI was significantly associated with a higher fasting blood sugar level (3). These results were in line with those of the present study, indicating the relationship between ABSI and diabetes mellitus and serum level of blood sugar. Up to now, many studies have demonstrated that weight gain, especially increased fat mass, was linked to an increase in peripheral insulin resistance and carbohydrate metabolism disorders (32). Nonetheless, ABSI is a parameter that reflects the body fat mass. Therefore, an increase in ABSI is expected to affect the blood sugar level. In Framingham's study, blood glucose increased following a rise in body weight, which represented a carbohydrate metabolism disorder (4, 33).

One of the limitations of this study was the patients' lack of cooperation. The results of this study demonstrated a relationship between larger ABSI and increased likelihood of diabetes mellitus and higher serum glucose levels, which occur because of increased insulin resistance and carbohydrate metabolism disorder. Further studies are recommended to be conducted on different populations in different age ranges. Further standardized studies are also suggested to be performed on confounding factors as well as the possible predictability of cardiovascular diseases by ABSI. Future studies are also recommended to investigate the relationship between the other risk factors of cardiovascular diseases and ABSI and other anthropometric indices.

5.2. Ethical Considerations

The study design and protocols were approved by the Ethics Committee of the Birjand University of Medical Sciences (ID: *IR.BUMS.REC.1397.153*).

5.3. Informed Consents

Informed consent were obtained from all the patients before beginning the study.

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Authors' Contribution

Study concept and design: T.K. and B.B.; analysis and interpretation of data: B.B.; drafting of the manuscript: T.K.

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References

1. Camici M, Galetta F, Capri A. Obesity and increased risk for atherosclerosis and cancer. Int Med. 2014.
2. Kelly T, Yang W, Chen C-S, Reynolds K, He J. Global burden of obesity in 2005 and projections to 2030. International journal of obesity. 2008;32(9):1431-7.
3. Neamat-Allah J, Wald D, Hüsing A, Teucher B, Wendt A, Delorme S, et al. Validation of anthropometric indices of adiposity against whole-body magnetic resonance imaging–a study within the German European Prospective Investigation into Cancer and Nutrition (EPIC) cohorts. PloS one. 2014;9(3):e91586.
4. Camhi SM, Bray GA, Bouchard C, Greenway FL, Johnson WD, Newton RL, et al. The relationship of waist circumference and BMI to visceral, subcutaneous, and total body fat: sex and race differences. Obesity. 2011;19(2):402-8.
5. Sun G, French CR, Martin GR, Younghusband B, Green RC, Xie Y-g, et al. Comparison of multifrequency bioelectrical impedance analysis with dual-energy X-ray absorptiometry for assessment of percentage body fat in a large, healthy population. The American journal of clinical nutrition. 2005;81(1):74-8.
6. Malara M, Kęska A, Tkaczyk J, Lutosławska G. Body shape index versus body mass index as correlates of health risk in young healthy sedentary men. Journal of translational medicine. 2015;13(1):75.
7. Feng R-N, Zhao C, Wang C, Niu Y-C, Li K, Guo F-C, et al. BMI is strongly associated with hypertension, and waist circumference is strongly associated with type 2 diabetes and dyslipidemia, in northern Chinese adults. Journal of epidemiology. 2012;22(4):317-23.
8. Flint AJ, Rexrode KM, Hu FB, Glynn RJ, Caspard H, Manson JE, et al. Body mass index, waist circumference, and risk of coronary heart disease: a prospective study among men and women. Obesity research & clinical practice. 2010;4(3):e171-e81.
9. Feller S, Boeing H, Pischon T. Body mass index, waist circumference, and the risk of type 2 diabetes mellitus: implications for routine clinical practice. Deutsches Ärzteblatt international. 2010;107(26):470.
10. Shah NR, Braverman ER. Measuring adiposity in patients: the utility of body mass index (BMI), percent body fat, and leptin. PloS one. 2012;7(4):e33308.
11. Heo M, Faith MS, Pietrobelli A, Heymsfield SB. Percentage of body fat cutoffs by sex, age, and race-ethnicity in the US adult population from NHANES 1999–2004. The American journal of clinical nutrition. 2012;95(3):594-602.
12. Yun C-H, Bezerra HG, Wu T-H, Yang F-S, Liu C-C, Wu Y-J, et al. The normal limits, subclinical significance, related metabolic derangements and distinct biological effects of body site-specific adiposity in relatively healthy population. PloS one. 2013;8(4):e61997.
13. De Larochellière E, Côté J, Gilbert G, Bibeau K, Ross M-K, Dion-Roy V, et al. Visceral/epicardial adiposity in nonobese and apparently healthy young adults: association with the cardiometabolic profile. Atherosclerosis. 2014;234(1):23-9.
14. Tremmel M, Gerdtham U-G, Nilsson PM, Saha S. Economic burden of obesity: a systematic literature review. International journal of environmental research and public health. 2017;14(4):435.
15. Krakauer NY, Krakauer JC. A new body shape index predicts mortality hazard independently of body mass index. PloS one. 2012;7(7):e39504.
16. Haghighatdoost F, Sarrafzadegan N, Mohammadifard N, Asgary S, Boshtam M, Azadbakht L. Assessing body shape index as a risk predictor for cardiovascular diseases and metabolic syndrome among Iranian adults. Nutrition. 2014;30(6):636-44.
17. Cheung YB. "A Body Shape Index" in middle-age and older Indonesian population: scaling exponents and association with incident hypertension. PLoS One. 2014;9(1):e85421.
18. He S, Chen X. Could the new body shape index predict the new onset of diabetes mellitus in the Chinese population? PLoS One. 2013;8(1):e50573.
19. Duncan MJ, Mota J, Vale S, Santos MP, Ribeiro JC. Associations between body mass index, waist circumference and body shape index with resting blood pressure in Portuguese adolescents. Annals of Human Biology. 2013;40(2):163-7.
20. Who EC. Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet (London, England). 2004;363(9403):157.
21. Dhana K, Ikram MA, Hofman A, Franco OH, Kavousi M. Anthropometric measures in cardiovascular disease prediction: comparison of laboratory-based versus non-laboratory-based model. Heart. 2015;101(5):377-83.
22. Dhana K, Koolhas C, Schoufour J, Rivadeneira F, Hofman A, Kavousi M, et al. Association of anthropometric measures with fat and fat-free mass in the elderly: The Rotterdam study. Maturitas. 2016;88:96-100.
23. Bouchi R, Asakawa M, Ohara N, Nakano Y, Takeuchi T, Murakami M, et al. Indirect measure of visceral adiposity 'A Body Shape Index'(ABSI) is associated with arterial stiffness in patients with type 2 diabetes. BMJ Open Diabetes Research and Care. 2016;4(1).
24. Despres J-P, Moorjani S, Lupien PJ, Tremblay A, Nadeau A, Bouchard C. Regional distribution of body fat, plasma lipoproteins, and cardiovascular disease. Arteriosclerosis: An Official Journal of the American Heart Association, Inc. 1990;10(4):497-511.
25. Fujita M, Sato Y, Nagashima K, Takahashi S, Hata A. Predictive power of a body shape index for development of diabetes, hypertension, and dyslipidemia in Japanese adults: a retrospective cohort study. PLoS One. 2015;10(6):e0128972.
26. Zibaeenejad F, Mohammadi SS, Sayadi M, Safari F, Zibaeenezhad MJ. Ten-year atherosclerosis cardiovascular disease (ASCVD) risk score and its components among an Iranian population: a cohort-based cross-sectional study. BMC Cardiovascular Disorders. 2022;22(1).
27. Janghorbani M, Amini M, Willett WC, Gouya MM, Delavari A, Alikhani S, et al. First nationwide survey of prevalence of overweight, underweight, and abdominal obesity in Iranian adults. Obesity. 2007;15(11):2797-808.
28. Mameli C, Krakauer NY, Krakauer JC, Bosetti A, Ferrari CM, Moiana N, et al. The association between a body shape index and cardiovascular risk in overweight and obese children and adolescents. PLoS One. 2018;13(1):e0190426.
29. Tian S, Zhang X, Xu Y, Dong H. Feasibility of body roundness index for identifying a clustering of cardiometabolic abnormalities compared to BMI, waist circumference and other anthropometric indices: the China Health and Nutrition Survey, 2008 to 2009. Medicine. 2016;95(34).
30. Shahrani M, Pilehvarian AA, Kheyri S, Asgari A, Farokhi E, Parvin N, et al. Effects of Kelussia odoratissima Mozaffarian (KOM) extract on blood lipid in Balb/c mice. Journal of Shahrekord Uuniversity of Medical Sciences. 2009;10.
31. Wang F, Chen Y, Chang Y, Sun G, Sun Y. New anthropometric indices or old ones: which perform better in estimating cardiovascular risks in Chinese adults. BMC cardiovascular disorders. 2018;18(1):14.
32. Pouladi S, Bagherpour Borazjani A, Motamed N, Amini A, Rahbar A, Vahedparast H, et al. A Survey on the effect of psyllium on serum levels of triglycerid and lipoproteins. ISMJ. 2009;11(2):139-46.
33. Wilson PW, D'Agostino RB, Sullivan L, Parise H, Kannel WB. Overweight and obesity as determinants of cardiovascular risk: the Framingham experience. Archives of internal medicine. 2002;162(16):1867-72.