

Determinants of Central Adiposity among Iranian Population

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Article information	Abstract
Article history: Received: 6 Dec 2010 Accepted: 5 Jan 2011 Available online: 30 Oct 2012 ZJRMS 2013; 15(3): 7-13 Keywords: Central obesity Dietary determinants Iran Thalidomide *Corresponding author at: Department of Nutrition, Food Security Research Center, School of Nutrition and Food Science, Isfahan University of Medical Sciences, Isfahan, Iran. E-mail: azadbakht@hlth.mui.ac.ir	Background: Central obesity is one of the major public health problems. Recent studies have indicated that body fat distribution would be important in general health. Materials and Methods: The present study is a review of several studies which discuss the contributing factors of abdominal obesity, particularly in Iran. This study reviews 34 cross-sectional and interventional studies, which have been conducted during 1995-2012 and issued in English language. PubMed search engine and the related keywords were used to search the papers. Results: Breakfast skipping and also the sleep duration as well as the quality of diet are also associated with central adiposity. Dietary diversity score among Iranians can be related to abdominal adiposity. Fastfood consumption can increase the risk of central adiposity among young Iranian population. Red meat intake and food source of trans fat can increase the risk of central adiposity. Low quality diet with low amount of nutrients can increase the risk of central adiposity. Conclusion: Some behaviours such as sleep duration and eating breakfast can be associated with central adiposity among Iranians. Diet quality and dietary diversity score is also associated with this problem among Iranians. Copyright © 2013 Zahedan University of Medical Sciences. All rights reserved.

Introduction

At the present time, obesity has turned into a major public health problem, which is related to the risk of most chronic diseases. Meanwhile, most researchers recommended that instead of solely paying attention to obesity, attention should be paid to the pattern of fat distribution in body [1]. They believe that abdominal obesity is a better indicator for other chronic diseases such as metabolic syndrome, type II diabetes, cardiovascular diseases as well as mortality [2-4]. Waist circumference (WC) and waist to hip ratio (WHR) are two major indicators for estimation of abdominal obesity. Most researchers use the WHO criteria or Adult Treatment Panel III to estimate the abdominal obesity. The waist circumferences more than 102cm for men and more than 88cm for women are considered as abdominal obesity. The prevalence of abdominal obesity is increasing at an alarming rate worldwide [5].

A population-based study in individuals over 15 years in 28 province of Iran indicated that 43.3 percent of women, 9.7 percent of men, 28.5 percent of the city dwellers, and 23 percent of the rural residents are centrally obese [6]. In Tehran, the capital and the most industrialized city of Iran, 67 percent of women and 33 percent of men older than 20 are suffering from abdominal obesity [7]. Regarding the gender differences on abdominal fat accumulation in Iran indicated 6 % increase in men and 9 percent in women in the central obesity during 1998-2002 [8]. The mean of waist circumference and waist to hip

ratio of the Iranian women are greater than American women [9]. Comparing the prevalence of abdominal obesity in US during 1999-2000 and 2007-2008 also indicates its ever-increasing trend, as it increased from 37.8 to 43.7 percent in men and 55.8 to 61.8 percent in women [10]. The prevalence of this problem in Omani and Indian women is 65 and 55 percent, respectively [11-12].

Although the genetic factors involve in obesity, it seems that the environmental factors can also aggravate this problem. Several contributing factors such as socioeconomic status, gender differences, marriage, physical activity, education, and dietary factors are reported in different societies [11-13]. Concerning dietary determinants of obesity, different investigations have mentioned dietary pattern, dietary groups, foods and nutrients. Since abdominal obesity is a risk factor for most chronic diseases, identification of its underlying factors seems to be of great importance. Therefore, in this paper, we discuss the dietary and non-dietary determinants of abdominal obesity, particularly in Iran.

Materials and Methods

In the current study, the papers were selected using PubMed search engine and different keywords including determinants and abdominal obesity (185 papers), diet and abdominal obesity (1,209 papers), dietary and

abdominal obesity (1427 papers), and nondietary and abdominal obesity (813 paper). These studies were conducted during 1995-2012 especially in Iran. With respect to the extent of the gathered papers, in order to limit the items found by the search engine, some more elaborated keywords were used which are as follows: whole grain, dairy products, glycemic load, glycemic index, hydrogenated oil, olive oil, fiber, fruit, vegetable together with abdominal obesity, central obesity, abdominal adiposity, central adiposity, body composition and fat distribution. Finally, with respect to the special objectives of this paper and to offer a better conclusion, many papers which are less related to the title of the paper were put aside and 53 papers, which are published in English language during 1997-2010 were studied.

Non-dietary determinants of Abdominal Obesity

Ageing is one of the inevitable and imminent factors of abdominal obesity. Abdominal obesity so-called "menopause abdomen", which occurs after menopause period in women, is attributed to the hormonal changes during this period. Due to high co-linearity between obesity and central obesity, most of their contributing factors are similar. Therefore life-style related factors should be paid sufficient attention. Reduction of physical activity during this period is also considered as a risk factor of obesity and abdominal obesity.

Physical inactivity is one of the risk factors of central obesity in Iran and all over the world [11, 14]. The ability of increased daily physical activity in minimizing age-related increases in abdominal obesity is also mentioned recently [15]. Depression is also related to central fat accumulation. In Tehran, housekeepers are at greater risk of abdominal obesity [13]. Doing housework during the day and lack of independent income are of the factors of depression which leads to central fat accumulation. In addition, availability of food at home may also be one of the effective factors of obesity in women. Socioeconomic status in Tehran and other countries are related to abdominal obesity [13, 14, 16].

The findings of Tehranian adults study [13] are similar to the findings of other studies in this concern [11, 12, 16]. In Iran smokers have greater probability of being centrally obese [13]. A prospective study in US has indicated that weight gaining of smokers in waist is more and in hip is less than what have been predicted. Therefore, the waist to hip ratio increases [17]. Being menopause and marriage are also involved in central fat accumulation, due to the role of sex hormones. Married Iranian women have more odds of central obesity than single ones [13], which may be due to weight gaining after each pregnancy and breastfeeding. The waist to hip ratio in Tehranian women who have more children is greater, which can better indicate the role of pregnancy and breastfeeding in increasing abdominal obesity. A recent study in north of Iran, indicates similar factors [14]. With respect to its findings, the factors involving abdominal obesity include low physical activity, low level of education, family history of obesity, marriage at an early age, and ageing. Since Iran is a multi-racial country, paying attention to the findings of different studies in

various regions of Iran are useful for the correct judgment. Table 1 shows the odds ratios of risk of abdominal obesity among different groups of life-style related factors in Tehranian population.

Dietary Determinants of Abdominal Obesity

With respect to the dietary determinants of abdominal obesity, three levels including dietary patterns, dietary groups, foods and nutrients can be considered.

A- Food Patterns and Abdominal Obesity

Dietary pattern reflects dietary behavior of people. Therefore, they can provide further detailed information about the dietary reason of obesity. Due to of co-linearity of foods and nutrients intake, a multiple approach such as dietary pattern can eliminate the concerns on the confounding factors in addition to foods and nutrients interactions. As a special type of obesity, so-called "Middle Eastern Pattern", prevails in Iran, the study of relationship between the dietary patterns and different forms of obesity in Iran are of paramount importance. This kind of obesity makes Iranian people prone to risk of obesity-related diseases. The predominant characteristic of this pattern of obesity is central fat accumulation and enlarged waist circumference (WC), particularly among women.

Limitted information is available about the relationship between dietary patterns and obesity among Iranian people. Using factor analysis, the three major dietary patterns, so-called western, healthy, and Iranian dietary pattern, were identified among Tehranian women [18]. It is suggested that subjects in the highest quintile of healthy pattern were less likely to be generally and centrally obese, whereas those in the lowest quintile of the western pattern had greater odds for both general and central obesity (Table 2).

Although the Iranian dietary pattern is not associated with obesity, those in the third quintile had higher odds of being centrally obese [18]. These findings are consistent with the results of other studies both in the developing and developed countries. Generally, it seems that the nutritional transition in developing countries helps emergence of the western dietary patterns, which are responsible for the high risk of obesity in these countries. So far, no other valid study has been conducted on the relationship of dietary patterns and obesity in Iran and some prospective studies should be carried out in this country in order to confirm the present findings.

B- Food Groups, Foods intake and Abdominal Obesity

Foods and food groups are also related to the prevalence of overweight and obesity in Iran. A cross-sectional study in Tehran indicates that dairy products are inversely associated with Body Mass Index (BMI) as well as prevalence of obesity. Investigators have reported that the chance of obesity in those who are at the highest quartile of the dairy diet is lower than those who are at the lowest quartile (in men: OR=0.73; CI95%=0.4-0.83, in women: OR=0.69; CI95%=0.34-0.8) [19]. Another study suggests the reverse association of dairy consumption and abdominal obesity. In this study, the mean of waist circumference decrease across quartile of dairy products. [20]. Another study, in Tehranian adults, indicates that the

risk of obesity and abdominal obesity was higher in women who were at the first quartile of dairy intake [7].

Obese individuals were divided into two groups in a clinical trial. Both groups were given the same weight-loss diet (500 kcal/day). The only difference was that the subjects in the first group consumed 400-500 mg/d of calcium and the second group consumed 1100 mg/d calcium from yoghurt. In the end, fat loss in subjects who consumed yoghurt was much higher than the first group. (Yoghurt group: -4.43 ± 0.47 , control group: -2.75 ± 0.73 , and $p < 0.005$), whereas the loss of muscle tissue reduced by 31 percent in this group. Losing body fat in the second group, which consumed yoghurt, increased by 81 percent as compared with the control group ($p < 0.001$) that indicated much further decrease of waist circumference (3.99 ± 0.48 cm against 0.58 ± 0.48 cm and $p < 0.001$) [21]. It is shown that, subjects in the lowest quintile of fruit intake were less likely to be obese compared with those in the highest quintile (43% vs. 23%, $p < 0.05$) and had lower values of waist circumference (98 ± 10 vs. 86 ± 11 , $p < 0.01$). This was also the case for vegetable intake [22]. It seems that whole and refined grain consumption in Iran are also related to the risk of obesity. In a cross-sectional study among 827 Iranian adults between 18-74 aged, a significantly decreasing trend was observed for the risk of having hypertriglyceridemic waist phenotype across quartile of whole-grain intake (odds ratios among quartiles: 1.00, 0.95, 0.90, 0.78, respectively, p for trend = 0.02). Higher consumption of refined grains was associated with higher odds of having hypertriglyceridemic waist phenotype (1.00, 1.38, 1.65, 2.1, p for trend = 0.01). However, no significant association was seen with general obesity ($\text{BMI} \geq 30 \text{ kg/m}^2$) [23].

A recent review article has shown that more consumption of whole grains (3 servings in a day) was related to less BMI and abdominal obesity [24]. Another study carried out by McKeown et al, reported that whole and refined grains affect differently on body fat mass, as whole grains consumption follows the decrease of visceral and subcutaneous fat accumulation, whereas refined grains consumption follows fat accumulation in these areas [25]. We recently suggested that there is a significant association between potato consumption and obesity and central obesity in Isfahanian adults [26]. It was also demonstrated that the low glycemic index and low energy density diet can prevent abdominal obesity [27]. We also found that the highest versus lowest quartiles of dietary energy density was associated with greater values of BMI and WC [28].

In fact, whole grain consumption follows lower glycemic index and consequently lower insulin secretion. High levels of insulin lead to fat accumulation, particularly in abdominal areas. Therefore, by low glycemic index diet and the decrease of insulin level, abdominal obesity will be reduced. Limited data are available that indicate the association of food groups and abdominal obesity. A cross-sectional study among Tehranian women showed that red meat intake was not associated with abdominal obesity, while it was related to metabolic syndrome [29].

More prospective studies are required to confirm the findings regarding red meat intake and abdominal obesity.

Regarding dietary determinants of abdominal obesity, the total fat consumption can better predicts visceral fat accumulation [30]. Another study on Tehranian women showed that those in the highest quintile of hydrogenated vegetable oil had the highest waist circumference and waist to hip ratio compared with those in the lowest quintile [31]. The hydrogenated vegetable oils are highly consumed in Iran [32], as they are the main source of dietary fat in Iran [33]. More than 75 percent of the whole vegetable oils, which are consumed in Iran, are hydrogenated vegetable oils. The trans-fatty acids content of hydrogenated vegetable oils in home consumptions in Iran is 23-36%, which reaches 50 percent in industrial food [32].

Indeed, 4.2 % of the whole energy consumed by Iranians is trans-fatty acids which is about twice more than the amount consumed in developed countries [32]. Trans-fatty acids intake is associated with abdominal obesity and insulin resistance [34] as it is stated that trans-fatty acids contain non-saturation system and lengthen fatty acids [35]. Reports have also shown the harmful effects of trans-fatty acids intake on lipid profile through body weight increase. Insulin resistance may follow obesity and diabetes [36]. Although hydrogenated vegetable oils and trans-fatty acids intakes are positively associated with abdominal obesity, inverse association of olive oil intake has been reported in many studies [37-40].

These studies indicate that olive oil consumption and Mono Unsaturated Fatty Acids (MUFA) which is the major fatty acid of olive oil, prevents abdominal obesity through stimulating fat accumulation in peripheral areas and inhibiting central fat accumulation, while consuming saturated fatty acids leads to central fat accumulation in [41]. The reason of such difference between the saturated fatty acids and MUFA are attributed to the structure difference of these two fatty acid, as MUFA tends more to oxidize and tends less to reserve in body than the saturated fatty acids [37, 38]. The difference is automatically attributed to more stimulating effect of MUFA on PPAR- α and up-regulation of Uncoupling Proteins genes [42].

C- Nutrients Diet and Abdominal Obesity

Concerning the association of nutrient intakes and central obesity, findings of Tehranian adults demonstrated that vitamin C, calcium and fat intake was related to central fat accumulation. Vitamin C, as well as calcium, reduce fat absorption and may reduce abdominal obesity. Calcium can prevent fat and fatty acids absorption. It can also affect agouti production which is a gene that expressed in human adipocytes that stimulates calcium flow into cells and by its effects on lipolysis and lipogenesis causes fat precipitation in adipocytes. Agouti increases fatty acid synthetase and inhibits [43]. High amount of refined carbohydrate intake and simple sugar is positively associated with abdominal obesity [31]. Table 4 shows the risk of abdominal obesity in different groups of calcium and vitamin C intake among Tehranian adults.

Fiber intake also is negatively associated with fat mass ($p<0.001$), percentage of body fat ($p<0.001$), BMI ($p<0.01$) and waist circumference ($p<0.05$) among 18-24 year old students [44].

BMI (26.8 versus 25.8) ($p=0.08$) and body fat percentage (43% versus 39.4%) ($p<0.02$) decrease across quartiles of whole grain intake among old persons, such result has also been observed across quartile of fiber intake from grains, However total fiber intake is not associated with BMI [45].

D-dietary behavior and central obesity

Dietary behavioral determinants of central obesity have not received sufficient attention, however we recently assessed this understudied determinants of central obesity and found that there was a higher proportion of breakfast skipper in the third tertile of the BMI and waist circumference in Isfahanian female youth young female ($p<0.05$). In addition lower breakfast consumption was significantly associated with higher values of dietary energy density [46]. As discussed earlier, we found that highest versus lowest quartile of dietary energy density was associated with greater values of BMI and WC [28]. Among dietary behaviors we considered in young female, fast food consumption was high among this population [47], we have recently demonstrated that BMI and WC increase across the tertiles of fast food intake [48]. Furthermore, the result of the recent investigation showed that Iranian fast foods contains high percentage of trans fat [49]. As we mentioned previously, TFAs intakes are positively associated with central obesity [34]. Regarding the association of sleep deprivation and central obesity, our findings revealed that short sleepers were more likely to be centrally obese and had a higher prevalence of overweight and obesity [50].

Application in other aspects of health and diseases

Central obesity is positively associated with the insulin resistance and it seems that insulin disturbance is the major cause of this kind of obesity. Abdominal obesity is one of the components of metabolic syndrome and those with abdominal obesity are at risk of type II diabetes and cardiovascular diseases [5]. The abdominal obesity may be related to the increase of inflammation and of oxidative stress biomarkers, which are the new risk factors for cardiovascular diseases. Therefore, by preventing abdominal obesity, we can prevent cardiovascular diseases, coronary disorders, metabolic syndrome and type II diabetes.

An inverse association of fruit and vegetable intakes and metabolic syndrome and C-reactive protein (CRP) has also been shown in Tehranian adults [22].

Among Tehranian adults those in the highest quintile of vegetables intake have a 30% lower chance of metabolic syndrome than those in lowest quintile. Subjects in the highest quintile of vegetable intake have 34% lower risk of this syndrome than those in the lowest quintile.

Whole grains intake [23] and dairy consumption [20] also was inversely associated with metabolic syndrome. However, there was a direct relationship between red meat intake [25], hydrogenised vegetable oils [31] and metabolic syndrome.

Figure 2 shows the odds ratios of the risk of metabolic syndrome across the quintiles of red meat intake. Healthy diet is also characterized by high amounts of whole grain consumption, which can help prevention of abdominal obesity. Clinical trials indicated that soy consumption can be related to the decrease level of CRP and improvement of metabolic syndrome components [51-52].

Indeed, it is assumed that the favorable effects of soy intake on metabolic syndrome components are intermediated through its beneficial effects on obesity because soy isoflavones can prevent abdominal obesity by preventing central fat accumulation. Furthermore, soy consumption causes to a significant decrease in total fat accumulation as well as subcutaneous fat [53]. Therefore, moderate soy consumption can be an effective approach to decrease the prevalence of metabolic syndrome.

Table 1. Risk for having central adiposity in different groups of lifestyle factors

Lifestyle factors	Odds ratio	95%CI
Physical activity		
Light	2.11 ¹	1.40-2.53
Moderate	1.13	0.91-1.42
Heavy	1.00	
Parity		
0	1.00	
1-2	1.02	0.83-1.42
3 and more	1.31	1.18-1.62
Marriage		
Single	1.00	-
Married	1.31	1.10-1.82

Table 2. Multivariate adjusted odds ratios (95% CI) for general and central obesity in Iranian women across quintiles of dietary pattern scores¹

	Healthy pattern score			<i>p</i> for trend ³	Western pattern score			<i>p</i> for trend	Iranian pattern score			<i>p</i> for trend
	1	3	5		1	3	5		1	3	5	
General obesity	1.00	0.76 (0.38, 1.29)	0.41 (0.20, 0.75)	<0.05	1.00	1.85 (0.94, 3.41)	2.48 (1.20, 4.61)	<0.01	1.00	0.81 (0.54, 1.59)	0.88 (0.49, 1.45)	0.74
Central obesity	1.00	0.66 (0.37, 1.11)	0.48 (0.27, 0.67)	<0.05	1.00	2.42 (1.34, 4.59)	5.33 (2.85, 10.6)	<0.01	1.00	2.08 (1.09, 3.65)	1.61 (0.94, 2.61)	0.41

1 Values are OR (95% CI). 2 General obesity: BMI ≥ 30 kg/m².

3 Adjusted for age, smoking, current estrogen use, and socioeconomic status, physical activity, energy intake.

6 Central obesity: WC >88 cm.

7 From Mantel-Haenszel extension chi-square test.

Practical Strategies

Increasing physical activities and dietary modification are useful to reduce abdominal obesity. Therefore, consumption of a low glycemic index diet including high amounts of vegetables, whole grains, fruit and low-fat dairy products and moderate amounts of non-hydrogenated vegetable oils, olive oil, fish, poultry and a low amount of red meat and refined grains as well as regular daily physical activity are recommended.

Discussion

The most important contributing factors of abdominal obesity are low physical activity, unemployment and depression, smoking, menopause and marriage. Iranian calcium and fiber intake are lower than recommended dietary allowance (RDA) amounts [47], this also the case for dairy, fruit and vegetable consumption.

With respect to the inverse association of the above food groups and abdominal obesity, high prevalence of abdominal obesity and its ever-growing trend is obvious. On the other hand, limited food items can be prepared by grains in Iran is few, which limits people's options to choose among these foods. Whereas, the basic foundation of the Iranian diet is grains, consequently, people's major consuming grains constitute refined grains which in turn follows the reduction of fiber consumption, high glycemic index diet and hypertriglyceridemic waist (HW). Consuming a diet full of vegetables, fruits, whole grains and low-fat dairy may be related to reduce risk of abdominal obesity among the Iranian people.

Furthermore sufficient intake of calcium and vitamin C can reduce the risk of abdominal obesity among the Iranians. A recent trial also indicated that high calcium diets can reduce the weight and waist circumference and has favorable effects on the inflammatory markers [54]. The hydrogenised vegetable oils can increase the risk of abdominal obesity among the Iranians. It is good to

recommend higher fiber intake when intake of hydrogenated fat occurs [55].

Abdominal obesity is a risk factor for metabolic syndrome, type II diabetes as well as cardiovascular diseases. As obesity is a multi-causal disorder and many factors are involved in it; among the constraints of the reviewed studies, it can be referred to several important factors, including hereditary and genetic factors, which cannot be reviewed in such studies. As mentioned in "introduction" section, in most of the studies discussing factors involved in abdominal obesity, obesity is considered according to the criteria of the World Health Organization (WHO) or Adult Treatment Panel III. With respect to the great racial and national variety, it would be better to offer definitions for abdominal obesity, which are proportionate to the population under studied and/or a population similar to that. Moreover, with respect to the limitations of the cross-sectional studies in this field, it is recommended to conduct more prospective studies in this concern. All the studies carried out in our country are cross-sectional. Therefore, the issue of inaccessibility to the causal relationships is brought about which is due to identity limitations of these studies. As different aspects of dietary components are considered here, it is impossible to analyze all the food factors in a meta-analysis manner. Consequently, attempts have been made to bring it about within a systematic revision study.

Authors' Contributions

All authors had equal role in design, work, statistical analysis and manuscript writing.

Conflict of Interest

The authors declare no conflict of interest.

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