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ARYA Atherosclerosis

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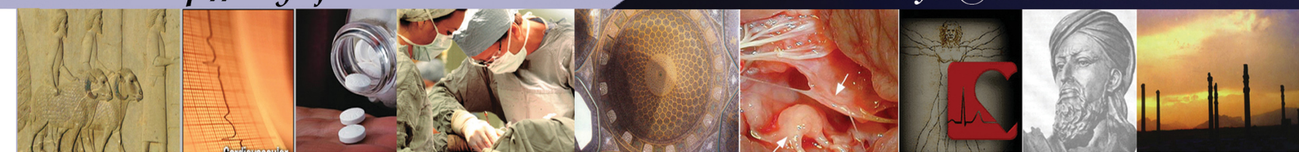

ARYA Atherosclerosis

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Table of Contents

Relationship of sodium intake with obesity among Iranian children and adolescents

Nahid Rafie[(1)], Noushin Mohammadifard[(2)], Alireza Khosravi[(3)], Awat Feizi[(4)], Sayyed Morteza Safavi[(5)]

Original Article

Abstract

BACKGROUND: Emerging evidence suggests a relationship between sodium (Na) intake and obesity risk. The aim of this study was to investigate the link between 24-hour (24-h) urinary Na excretion and adiposity measures in a sample of Iranian children and adolescents.

METHODS: This cross-sectional study was performed among 374 healthy individuals aged 11-18 years old. Random cluster sampling method was used to select the participants from 4 districts in Isfahan, Iran. Na excretion was estimated using a 24-h urinary sample. Creatinine (Cr) level was used to confirm the completeness of samples. Anthropometric measures including weight, height and waist circumference (WC) were obtained based on standard protocols.

RESULTS: The odds ratio (OR) for overweight/obesity in subjects with the highest tertile of Na excretion compared with the lowest tertile was 8.01 [95% confidence interval (CI) 4.20-15.3] in crude model and 8.33 (95% CI 4.14-16.8) after adjusting for potential confounders. The association was independent of intake of energy and sugar-sweetened beverages (SSBs). The OR for abdominal obesity in the highest tertile of Na excretion compared with the lowest tertile was 9.12 (95% CI 4.78- 17.4) in crude model and 9.75 (95% CI 4.88-19.5) after controlling for potential confounders. The association was independent of energy intake or SSBs consumption.

CONCLUSION: Our study showed a positive association between Na excretion and obesity among children and adolescents. Further investigation through longitudinal studies using a more representative sample of children and adolescents is suggested to determine whether this is a causal relationship.

Keywords: Sodium, Obesity, Children, Adolescents, Iran

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Introduction

Prevalence of overweight and obesity is rapidly increasing worldwide and it is projected that 57.8% of adults will be overweight or obese by year 2030.[1,2] Also, childhood obesity is now considered a major health problem both in developed and developing countries.[3,4] Iran, as a developing country, is also facing an increasing prevalence of obesity.[5] In 2012, a study estimated that the rate of obesity among 6 to 18 years old Iranian boys and girls was 10.2 and 13.6%, respectively. It is well established that pediatric obesity is associated with risk of many non-communicable diseases.[6] Therefore, it is important to identify major risk factors related to overweight and obesity in order to design and implement effective interventions.

Various reasons have been considered for the epidemic of obesity including dietary components.[7] Emerging studies suggest that dietary sodium (Na) may be a possible risk factor for obesity.[8] However, there are some controversies regarding the association between Na intake and obesity. It has been postulated that Na intake is accompanied by greater energy intake or increased consumption of energy-dense foods.[9] Also, there are evidences that Na intake is associated with higher weight, independent of calorie consumption.[10]

Na intake has increased in recent years mainly

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due to the higher consumption of processed foods, especially among children and adolescents.[11] Several studies have indicated that Na intake in Iranian adult population is also high and is about two times of the World Health Organization (WHO) recommendation.[12,13] A study among Iranian adults showed that the association between salt intake and blood pressure is related to adiposity measures.[14] However, few studies, with no study in Iran, have examined the effect of Na intake on overweight and obesity using 24-hour (24-h) urinary excretion, as the gold standard method, especially among children and adolescents. Thus, this study aimed to evaluate Na intake based on 24-h urinary Na excretion in relation to overweight/obesity in a sample of Iranian children and adolescents aged 11-18 years.

Materials and Methods

A cross-sectional study including children and adolescents aged 11 to 18 years living in Isfahan, Iran was carried out between September 2015 and February 2016. Sample size of 290 was estimated with the assumption of 80% power, and a 0.05 level of significance. Using random cluster sampling method, participants were recruited from 13 schools in 4 different districts. The main investigators then visited schools and invitations were sent to parents. Parents who agreed to study conditions were asked to complete an informed consent. Participants with acute or chronic diseases or on any medication or special diet were excluded. From 456 invited participants, 374 of them completed the study (response rate 82%). The study was approved by the Research and Ethics Committee of Isfahan University of Medical Sciences (IR.mui.rec.1394.3/294).

Twenty-four-hour urine collection containers were distributed among participants and parents, along with verbal and written instructions on how to complete the collection. It was emphasized that no change in dietary habits during the day of collection was allowed. The urine collection was completed over the weekends from Friday to Saturday during a 24-h period. Each participant was provided with a 2.5-litre polypropylene container used for the collection of 24-h urine sample. All participants were asked to initiate the collection by emptying their bladder, discarding first urine after getting up in the Friday morning, and continue the collection until next day morning. To help with urine collection, an additional 500 ml plastic cup was provided.

Measured parameters included 24-h urine volume, Na, and creatinine (Cr). Na was estimated using ion selective electrode method and urine Cr was measured by Jaffe reaction method.[15] Completeness of 24-h urine was defined by volume of collected urine ≥ 500 ml and 24-h Cr excretion ≥ 0.1 mg/kg body weight.[16]

Body weight was measured using a digital scale with minimal clothing and was recorded to the nearest 100 g. Height was estimated using an upstretched tape without shoes and was registered to the nearest 0.5 cm. Waist circumference (WC) was recorded halfway between the lowest rib and top of the hip bone to the nearest 0.5 cm. Body mass index (BMI) was calculated as weight in kg divided by height in m^2. Participants were grouped into weight categories (underweight, normal weight, overweight, obese) using the international obesity taskforce BMI reference cut-offs.[17] Abdominal obesity was defined as waist-to-height ratio (WHtR) of equal or more than 0.5.[6] Percent body fat (PBF) was measured using Omron BF511 body composition monitor (Omron Corp, Kyoto, Japan) and PBF > 25% for boys and > 35% for girls aged 11 years and older was defined as adiposity risk.[18]

A 168-item self-administered food frequency questionnaire (FFQ) was used to assess usual dietary intake. It consisted of a list of foods and a standard serving size for each.[19] The subjects were instructed to report the frequency of consumption of a given serving of each food item during the previous year on a daily, weekly or monthly basis. Portion sizes of consumed foods were converted to grams using household measures.[12] Dietary analysis was performed using Nutritionist IV software (First Databank, Hearst Corp, San Bruno, CA, USA).

Additional information regarding sociodemographic variables including age, sex and parents' education level, household income and past medical history were obtained using a self-administered questionnaire. The Physical Activity Questionnaire (PAQ), a self-administered, 7-day recall instrument with consistently high validity and moderate reliability[20] was used to assess the general levels of physical activity. The PAQ provides a summary of physical activity score derived from nine items, each scored on a 5-point scale. The mean score of these 9 items results in the final PAQ activity summary score. A score of 1 indicates low physical activity, a score of 2-4 indicates moderate physical activity and a score of 5 indicates high physical activity.

Descriptive statistics (mean values and standard

deviations for continuous variables or numbers and percentages for categorical variables) were used to describe participant characteristics. One-way ANOVA and chi-square tests were used where appropriate. Multiple logistic regression models were used to assess the association between 24-h urinary Na excretion and (i) weight category and (ii) abdominal obesity. The unadjusted and adjusted models (age, sex, parents' education level, household income, physical activity) are presented. To assess whether the association between 24-h urinary Na excretion and adiposity outcome measures was independent of energy and sugar-sweetened beverages (SSBs) intake (including carbonated soft drinks, soda, squashes, fruit drinks), additional models were constructed with these covariates. To calculate the trend of odds ratios across increasing categories of tertiles of Na excretion, we considered the tertile categories as an ordinal variable in the logistic regression models. Analyses were completed using SPSS for Windows (version 18, SPSS Inc., Chicago, IL., USA), and a P-value < 0.05 was considered statistically significant.

Results

Table 1 shows the demographic characteristics of participants and data on urinary excretion and dietary intake across tertiles of Na excretion. Of 456 participants who started the 24-h urine collection, 50 samples were not returned. Also, some collections were excluded (n = 32) due to incompleteness of 24-h collection. Thus, 374 participants had complete and valid urinary samples and were included in the final analysis. Overall, 58.8% (n = 220) were girls and the mean age (standard deviation) was 14.4 (2.02) years. As can be seen, significant differences were found in terms of all presented variables across tertiles of Na excretion except for age and intake of SSBs. Cr excretion increased significantly across tertiles of Na excretion and significant correlation was observed between these variables (r = 0.62; P < 0.001). Number of girls was significantly more than boys across tertiles of Na excretion. Participants had mostly moderate physical activity level and there were no children and adolescents with high physical activity in our sample.

As table 2 shows, significant differences were observed regarding all the anthropometric measurements across tertiles of Na excretion. The mean BMI of the sample was 20.9 (4.16) kg/m^2 and 18.2% (n = 68) and 8.6% (n = 32) of the sample were overweight and obese, respectively.

Table 1. Baseline characteristics according to tertile of 24-h urinary sodium excretion among Iranian children and adolescents aged 11-18 years, Isfahan, Iran

Characteristics	Tertile of Na excretion (mg/d)			P*
	T1 < 1750	T2 1750-3420	T3 > 3420	
	Mean ± SD	Mean ± SD	Mean ± SD	
Participants (n)	128	129	117	
Age (year)	14.4 ± 2.02	14.3 ± 2.22	14.6 ± 2.09	0.720
Sex [n (%)]	128.0 ± 34.20	129.0 ± 34.50	117.0 ± 31.30	0.050
Boy	42.0 ± 27.30	57.0 ± 37.00	55.0 ± 35.70	
Girl	86.0 ± 39.10	72.0 ± 32.70	62.0 ± 28.20	
Na excretion (mg/d)	1230.0 ± 350.00	2540.0 ± 480.00	5860.0 ± 1810.00	< 0.001
Cr excretion (mmol/kg/d)	0.1 ± 0.03	0.1 ± 0.04	0.2 ± 0.09	< 0.001
Urine output (ml/d)	610.0 ± 140.00	870.0 ± 190.00	1320.0 ± 3.00	< 0.001
Energy intake (kcal/d)	1567.0 ± 252.00	1655.0 ± 258.00	1821.0 ± 338.00	< 0.001
SSBs** (g/d)	39.8 ± 33.10	40.9 ± 42.60	51.2 ± 48.30	0.070
Physical activity£ [n (%)]	128.0 ± 34.20	129.0 ± 34.50	117.0 ± 31.30	0.010
Low	42.0 ± 30.90	39.0 ± 28.70	55.0 ± 40.40	
Moderate	86.0 ± 31.60	90.0 ±37.80	62.0 ± 26.10	
High	None	None	None	

T: Tertile; SD: Standard deviation

* P-value (obtained from ANOVA for continuous variables and χ^2 test for categorical variables); ** Sugar-sweetened beverages included carbonated soft drinks, soda, squashes and fruit drinks; £ Physical activity was calculated using the physical activity questionnaire, score of 1 indicates low physical activity, score of 2-4 indicates moderate physical activity and score of 5 indicates high physical activity

www.mui.ac.ir 15 Jan

Table 2. Anthropometric measurements according to tertile of 24-h urinary sodium excretion among Iranian children and adolescents aged 11-18 years, Isfahan, Iran

Variable	Total Mean ± SD	Tertile of Na excretion (mg/d)			P*
		T1 < 1750	T2 1750-3420	T3 > 3420	
		Mean ± SD	Mean ± SD	Mean ± SD	
Weight (kg)	53.2 ± 14.20	48.4 ± 11.60	51.10 ± 12.20	60.90 ± 15.80	< 0.001
BMI (kg/m)	20.9 ± 4.16	19.3 ± 3.38	20.10 ± 3.28	23.50 ± 4.61	< 0.001
WHtR	0.5 ± 0.06	0.4 ± 0.05	0.46 ± 0.05	0.51 ± 0.07	< 0.001
PBF (%)	25.0 ± 6.65	22.4 ± 8.85	24.20 ± 9.59	28.70 ± 9.48	< 0.001
Underweight	30.0 ± 8.00	20.0 ± 16.10	5.00 ± 4.00	5.00 ± 4.00	< 0.001
Normal weight	244.0 ± 65.20	89.0 ± 71.80	101.00 ± 80.20	54.00 ± 43.50	
Overweight	68.0 ± 18.20	12.0 ± 9.70	20.00 ± 15.10	36.00 ± 29.80	
Obesity	32.0 ± 8.60	3.0 ± 2.40	1.00 ± 0.80	28.00 ± 22.60	
Abdominal obesity [n (%)]	93.0 ± 26.20	12.0 ± 3.40	25.00 ± 7.00	56.00 ± 15.80	< 0.001
Adiposity by PBF [n (%)]	93.0 ± 25.60	13.0 ± 3.60	25.00 ± 6.90	55.00 ± 15.10	< 0.001

T: Tertile; SD: Standard deviation; BMI: Body mass index; WHtR: Waist to height ratio; PBF: Percent body fat

* P-value (Obtained from ANOVA for continuous variables and χ^2 test for categorical variables)

Underweight was defined as BMI < 5th; normal weight was defined as 5th ≤ BMI < 85th; overweight was defined as 85th ≤ BMI < 95th; obesity was defined as BMI ≥ 95th; abdominal obesity was defined as WHtR ≥ 0.05; adiposity was defined as PBF > 25% for boys and > 35% for girls

In total, 26.7% (n = 111) of participants were classified as centrally obese. Based on PBF as another marker of adiposity, 25.6% (n = 93) of participants had excess body fat.

Odds ratios (OR) for weight category (overweight/obesity) and abdominal obesity across tertiles of Na excretion are provided in tables 3 and 4. The OR for overweight/obesity in subjects with the highest tertile of Na excretion compared with the lowest tertile was 8.01 [95% confidence interval (CI) 4.20-15.6] in crude model and 8.33 (95% CI 4.14-16.8) after adjusting for potential confounding variables. The association remained significant after adjusting for intake of energy and SSBs. The OR for abdominal obesity in the highest tertile of Na excretion compared with the lowest tertile was 9.12 (95% CI 4.78-17.4) in crude model and 9.75 (95% CI 4.88-19.5) after controlling for potential confounders. The association was independent of energy intake or SSBs consumption.

Discussion

This study was the first to assess the relationship between 24-h urinary Na excretion and adiposity in a sample of Iranian children and adolescents. Among schoolchildren and adolescents aged 11- 18 years, we found significant associations between 24-h urinary Na excretion and overweight/obesity and abdominal obesity, independent of intake of energy and SSBs.

Table 3. Odds ratios (OR) for overweight and obesity according to tertile of 24-h sodium excretion among Iranian children and adolescents aged 11-18 years, Isfahan, Iran

Variable	Tertile of Na excretion (mg/d)			P for trend
	T1 < 1750	T2 1750- 3420	T3 > 3420	
		OR (95%CI)	OR (95%CI)	
Crude 1	1	1.37 (0.67-2.82)	8.01 (4.20-15.3)	P < 0.001
Model 1	1	1.36 (0.65-2.84)	8.70 (4.44-17.0)	P < 0.001
Model 2	1	1.47 (0.69-3.14)	8.33 (4.14-16.8)	P < 0.001
Model 3	1	1.43 (0.67-3.08)	7.80 (3.86-15.8)	P < 0.001
Model 4	1	1.12 (0.50-2.51)	4.97 (2.34-10.6)	P < 0.010

Overweight/obesity defined as BMI ≥ 85th

T: Tertile; OR: Odds ratio; CI: Confidence interval; Reference category: Low/normal body mass index vs overweight/obesity; Crude: Unadjusted

Model 1: Adjusted for age, sex, parents' education level and household income; Model 2: Additionally, adjusted for physical activity (low, moderate, high); Model 3: Additionally, adjusted for sugar-sweetened beverages (g/d); Model 4: Additionally, adjusted for energy intake (kcal/d)

www.mui.ac.ir 15 Jan

Table 4. Odds ratios (OR) for abdominal obesity according to tertile of 24-h sodium excretion among Iranian children and adolescents aged 11-18 years, Isfahan, Iran

Variable	Tertile of Na excretion (mg/d)			P for trend
	T1 < 1750	T2 1750-3420	T3 > 3420	
		OR (95%CI)	OR (95% CI)	
Crude	1	1.98 (0.10-3.94)	9.12 (4.78-17.4)	P < 0.001
Model 1	1	2.12 (1.06-4.24)	10.0 (5.13-19.5)	P < 0.001
Model 2	1	2.33 (1.13-4.78)	9.75 (4.88-19.5)	P < 0.001
Model 3	1	2.30 (1.11-4.75)	9.19 (4.58-18.4)	P < 0.001
Model 4	1	2.00 (0.96-4.20)	6.65 (3.24-13.7)	P < 0.010

Abdominal obesity defined as WHtR > 0.5 cm

T: Tertile; OR: Odds ratio; CI: Confidence interval; Crude: Unadjusted; WHtR: Waist to height ratio

Model 1: Adjusted for age, sex, parents' education level, household income; Model 2: Additionally, adjusted for physical activity (low, moderate, high); Model 3: Additionally, adjusted for sugar-sweetened beverages (g/d); Model 4: Additionally, adjusted for energy intake (kcal/d)

Our findings are consistent with previous studies performed in children and adolescents. For example, in a sample of Australian children aged 4-12 years, with an additional 17 mmol/d of Na, the risk of being overweight/obese or abdominally obese increased 23% and 15%, respectively.[21] They revealed that potential adipogenic effect of Na relates to total body weight and is not specific to central fat distribution. Similarly in a longitudinal study among German children and adolescents aged 3-18 years, positive association between Na intake and BMI z score was reported.[22] However, there was limited evidence for a temporal relationship. In contrast, among Canadian schoolchildren, no difference in Na intake was found, assessed by a web-based 24-h recall, across weight categories.[23] Differences in methodologies may explain the results.

Several possible mechanisms could explain the observed association between Na excretion and obesity. First, as Na excretion was correlated to energy intake in our study, it is possible that Na intake is associated with obesity through increased energy intake or intake of energy-dense SSBs. However, we found that the association between Na excretion and weight category was independent of energy or consumption of SSBs, suggesting that other pathways are involved. Another mechanism suggested by previous studies is that higher Na intake is accompanied by increased formation of adipocyte tissue which could be through altering fat metabolism in the body. In rats, those fed a high-Na diet, compared with those fed a normal-Na diet, had a greater increase in adipocyte mass despite the same amount of overall food consumed. In addition, rats fed the high-Na diet displayed greater uptake of glucose and conversion into lipids within adipocyte tissue.[7,24] More studies are needed to confirm these effects in humans.

First limitation of the present study is the cross-sectional design which keeps us from drawing a causal relationship between study parameters. Also, the sample may not be representative of Iranian population. Therefore, caution is warranted when interpreting the results. Furthermore, urine samples were collected through weekends which may not show the usual intake of Na since school day collections were not allowed by school administrators. However, participants were instructed not to alter their dietary routines during the day of urine collection. The main strength of this study is the use of 24-h urinary samples which is considered as the gold standard method for assessing Na intake. Also, our study is among few efforts to estimate the association between Na excretion and obesity in a relatively large sample of children and adolescents around the world.

Conclusion

In conclusion, our study showed a positive association between 24-h Na excretion and obesity among children and adolescents. Therefore, Na and salt reduction strategies could be important part of the programs aimed at reducing the burden of overweight/obesity. Future studies with prospective designs are warranted along with efforts to determine the exact mechanism of the effect of Na on overweight/obesity risk.

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Conflict of Interests

Authors have no conflict of interests.

www.mui.ac.ir 15 Jan

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Dietary approaches to stop hypertension diet and obesity: A cross-sectional study of Iranian children and adolescents

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Original Article

Abstract

BACKGROUND: Few studies have investigated the effects of dietary approaches to stop hypertension (DASH) diet on obesity in children. The present study was conducted to examine adherence to the DASH diet in relation to obesity in children and adolescents, Isfahan, Iran.

METHODS: A cross-sectional study was carried out among 456 children aged 11-18 years who were selected by random cluster sampling method. Dietary intakes were assessed using a validated Food Frequency Questionnaire (FFQ). The DASH score was constructed based on food items emphasized or minimized in the DASH diet. Anthropometric measurements were conducted based on standard protocols. General and abdominal obesity were defined based on body mass index ≥ 95th percentiles and waist: height ratio of more than 0.5, respectively.

RESULTS: Higher adherence to DASH diet was inversely associated with general obesity (odds ratio$_{T1 \text{ vs. } T3}$ 3.34, 95% confidence interval 1.28-8.75); however, after controlling for confounding factors, this association disappeared. Furthermore, higher adherence to DASH diet was negatively associated with central obesity in children, but the relation was not statistically significant.

CONCLUSION: We concluded that there was an inverse nonsignificant association between adherence to DASH diet and general obesity indices after adjustment for potential confounders. Further, well-designed randomized clinical trial studies are suggested to find out the effect of DASH diet on obesity obviously.

Keywords: Dietary Approaches to Stop Hypertension, Obesity, Anthropometry, Hypertension, Adolescents, Children

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Introduction

Obesity is a public health concern affecting all age groups in the world.[1] Childhood obesity has increased dramatically in 3 past decades in both developed and developing countries,[2] and it is considered as the first nutritional problem in children and adolescents.[3] In Iran, as a developing country, approximately 15.1% and 8.3% of children are overweight and obese, respectively.[4] Children who are overweight and obese are at increased risk for serious long-term health complications including metabolic syndrome, insulin resistance, vascular disease, and various forms of cancer.[5,6] To reduce financial burden associated with the treatment of obesity-related complications, prevention and treatment of childhood overweight and obesity should become a public health priority.[7]

Obesity is a complex issue connected with individual and environmental factors.[8] Diet is a major determinant of childhood overweight and obesity.[7] Recently, it has been shown that unhealthy dietary habits such as high intake of sugar-sweetened beverages and sodium lead to increased obesity in adolescents.[9] Evidence shows that dietary patterns in comparison to food and nutrients are stronger predictors of chronic disease such as obesity.[10] Despite the proven effects of diet on obesity, few studies have examined effects of dietary patterns on obesity, especially in children.[11] One examination of food-based dietary patterns is dietary approach to stop hypertension (DASH) diet, emphasizing on high intake of fruits, vegetables,

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whole grains, nuts and legumes, and low-fat dairy products[12] with protective effects on metabolic syndrome, cancer and obesity.[10]

Most studies assessing the relation between DASH diet and obesity have been conducted in adults or populations with diabetes mellitus, metabolic syndrome, or cardiovascular diseases (CVDs) with favorably effects of DASH diet on weight control.[13,14] Despite the pressing concerns of childhood overweight and obesity and the relation between metabolic disorders with obesity in childhood, a limited number of observational studies have assessed the impact of following DASH diet on measures of adiposity in children to date. The present study was carried out to assess how conformity to DASH diet was associated with anthropometric measures among children and adolescents in Isfahan city, Iran.

Materials and Methods

Data for this cross-sectional study were collected between September 2015 and February 2016 on a representative sample of students aged 11-18 years who were selected by random cluster sampling method. A sample size of 300 was estimated with the assumption of 80% power and a 0.05 level of significance. Participants were recruited from 13 schools of 4 different districts of Isfahan city. We excluded those with a chronic disease that affected their regimen or weight including diabetes mellitus, hypertension, hypo- and hyperthyroidism, kidney diseases, and liver disorders. From 500 healthy students who participated in the study, after excluding the missing food frequency questionnaires (FFQs) based on reported energy intake outside the range of 700-4000 kcal/d, data on a total of 456 children remained for current analysis. Informed written consent was obtained from each participant. This study was approved by the Research and Ethics Committee of School of Health, Isfahan University of Medical Sciences (No. 394295).

Dietary intake was evaluated by a self-administrated 168-item FFQ with assessing the validity and reliability in previous studies.[15] Participants were asked to report frequency consumption of each food item during the past year on a daily, weekly, monthly, or yearly basis. Portion sizes of consumed foods were converted to grams using household measure.[16] Then, each food and beverage was coded according to the prescribed protocol and analyzed for content of energy and the other nutrients using Nutritionist IV software (version 3.5.2, N-Squared Computing, Salem, OR, USA).

The DASH score was constructed based on food items emphasized or minimized in the DASH diet, focusing on eight components: high intake of fruits, vegetables, nuts and legumes, whole grains, and low-fat dairy products and also low intakes of sodium, red, and processed meat and sweetened beverages.[10] Participants were classified based on quintile categories of consuming each mentioned food items. For fruits, vegetables, nuts and legumes, low-fat dairy products, and whole grains, those in the first (lowest) dietary intake quintile were given the score of 1 and those in the fifth (highest) quintile were given the score of 5. Other quintiles (second, third, and fourth) for these dietary intakes were given the related score (2, 3, and 4, respectively). For sodium, red, and processed meats and sweetened beverages, the lowest quintile of intake was given a score of 5 and the highest quintile was given the score of 1 with the score of 2, 3, and 4 for those in the fourth, third, and second quintiles of intake. The scores were then summed up to construct the overall adherence to the DASH diet score that ranged from 8 to 40; individuals with the highest DASH score were more likely to follow DASH diet.

Anthropometric parameters including weight and height were measured by following standard protocols. Height and weight were measured with subjects wearing light clothing and without shoes. Weight, body mass index (BMI), percent body fat (PBF), and lean body mass (LBM) were also measured by body impedance analysis (Omron, BF511, Kyoto, Japan). Waist circumference was considered the narrowest level and the hip circumference was measured at the maximum level over light clothing using non-stretchable tape, measurements were recorded to the nearest 0.1 cm. General and central obesity were defined based on BMI $\geq$ 95th percentiles[17] and waist: height ratio of more than 0.5,[18] respectively.

Additional variables including sociodemographic information of age, sex, parent's education level, household income, and medical history were obtained from a self-administrated questionnaire. Furthermore, the physical activity of children was assessed through a 7-day recall questionnaire (PAQ) with high validity and moderate reliability.[19] It contains 9 items; each scored on a 5-point scale. Once a value from 1 to 5 was obtained for each of the 9 items used in the physical activity composite score, the mean of these nine items results in the final PAQ activity score. The score of 1 indicates low physical activity; the score of 2-4 indicates moderate physical activity, whereas the score of 5 indicates high physical activity.

www.mui.ac.ir 15 Jan

Participants were categorized based on tertiles of DASH dietary pattern scores. To compare general characteristics across tertiles, we used one-way analysis of variance for continuous variables and chi-square test for categorical variables. Dietary intakes (age and energy-adjusted) were compared using analysis of covariance. Association between tertiles of DASH score and obesity indices was evaluated using a multiple logistic regression controlling for age (years) and sex in model I; physical activity (low, moderate, and high) in model II; energy intake (kcal) in model III; and additionally for dietary intakes of sweets, refined grains, white meat, high-fat dairy products, oils, and eggs in model IV. In all multiple models, the highest tertile of DASH score was considered as the reference. All analyses were done with the SPSS Software (version 21, IBM Corporation, Armonk, NY, USA) and $P < 0.050$ was considered statistically significant.

Results

Baseline characteristics of study participants across tertiles of DASH scores are presented in table 1. A total of 456 children completed the study with mean ± standard deviation age of 14 ± 2.09 years and approximately 267 (59%) were girls. In total, 41 (9.0%) of children were obese, 22 (4.8%) boys and 19 (4.2%) girls. Furthermore, 39 (8.6%) were classified as central obese, 19 (4.2%) boys and 20 (4.4%) girls. As it is shown, significant differences were found in terms of all presented variables across tertiles of DASH score except for age and weight. Most participants had moderate physical activity level and there was no body with high physical activity level in our sample (Table 1).

Adherence to the DASH diet was significantly associated with greater intakes of fruits, vegetables, low-fat dairy, whole grains, and nuts and legumes (all $P < 0.001$). Individuals in the third tertile of DASH score had significantly lower intakes of sugar-sweetened beverages, red meat ($P < 0.001$), and refined grains ($P < 0.001$) compared with those in the first tertile. There was no significant association between adherence to the DASH diet and total energy, fat and oils intakes. Individuals in the last tertile of DASH diet score had significantly higher intakes of Ca, Mg, K, folate and total dietary fiber (all $P < 0.001$), and lower intake of Na ($P = 0.001$), mono-unsaturated fatty acid (MUFA) ($P = 0.004$) and polyunsaturated fatty acid (PUFA) ($P = 0.002$) compared with those in the first tertile (Table 2).

Table 3 indicates means of obesity indices across DASH tertiles among children and adolescents. As can be seen, there were no significant differences regarding all the anthropometric measurements across tertiles of DASH score except for PBF and LBM in the crude model.

Odds ratios (ORs) for obesity across tertiles of DASH diet scores are provided in table 4. Adherence to the DASH diet was associated with general obesity in the crude model [$OR_{T1\ vs.\ T3:}$ 3.34, 95% confidence interval (CI): 1.28-8.75]. When the models were further controlled for confounding variables, the association was positive but no longer significant ($OR_{T1\ vs.\ T3:}$ 3.30, 95% CI: 0.35-31.21).

Table 1. Baseline characteristics according to tertile of adherence to dietary approach to stop hypertension (DASH) diet score among children and adolescents aged 11-18 years

Participant characteristics	Tertile of DASH score			P*
	1	2	3	
	< 22	22-25	> 25	
Participants (n)	168	137	151	
Age (year)	14.3 ± 2.0	14.2 ± 2.1	14.6 ± 2.0	0.260
Weight (kg)	54.4 ± 16.2	50.9 ± 13.3	53.5 ±12.7	0.090
BMI (kg/m^2)	21.4 ± 4.8	20.3 ±3.7	20.6 ± 3.6	0.040
Waist circumference (cm)	75.5 ± 11.5	72.4 ± 9.6	74.3 ± 8.8	0.030
Sex [n (%)]				
Boy	60 (31.9)	54 (28.7)	75 (39.4)	0.040
Girl	108 (40.4)	83 (31.1)	76 (28.5)	
Physical activity** [n (%)]				
Total	168 (36.9)	137 (30.1)	150 (33.0)	0.030
Low	73 (45.1)	43 (26.5)	46 (28.4)	
Moderate	95 (32.4)	94 (32.1)	104 (35.5)	
High	None	None	None	

Values are presented as mean ± SD and frequency (percentage). * Obtained from ANOVA for continuous variables and χ^2 test for categorical variables. ** Physical activity was calculated using PAQ score which score of 1 indicates low physical activity, score of 2-4 indicates moderate physical activity, and score of 5 indicates high physical activity. DASH: Dietary approach to stop hypertension; BMI: Body mass index; PAQ: Physical activity questionnaire; SD: Standard deviation; ANOVA: Analysis of variance

www.mui.ac.ir 15 Jan

Table 2. Dietary intakes according to tertile of adherence to dietary approach to stop hypertension (DASH) diet score among children and adolescents aged 11-18 years

Daily intakes	Tertile of DASH score			P*
	1	2	3	
	< 22	22-25	> 25	
Participants (n)	168	137	151	
Food groups (g/day)				
Fruits	180 ±105	244 ± 138	286 ± 125	< 0.001
Vegetables	176 ± 66	208 ± 83	253 ± 109	< 0.001
Red and processed meat	48 ± 25	36 ± 22	30 ± 18	< 0.001
Low-fat dairy	254 ± 153	320 ± 139	377 ± 143	< 0.001
Sugar-sweetened beverages	56 ± 43	39 ± 42	32 ± 36	< 0.001
Oils	13 ± 9	13 ± 8	12 ± 7	0.280
Whole grains	14 ± 21	12 ± 16	22 ± 26	< 0.001
Nuts and legumes	30 ± 15	37 ± 19	50 ± 27	< 0.001
Sweets	65 ± 31	64 ± 28	59 ± 21	0.110
Refined grains	342 ± 138	305 ± 97	297 ± 109	< 0.001
High-fat dairy	98 ± 77	102 ± 93	82 ± 63	0.060
White meat	16 ± 8	15 ± 8	14 ± 9	0.760
Eggs	19 ± 10	22 ± 13	20 ± 9	0.170
Nutrients				
Energy (Kcal)	1684 ± 361	1665 ± 298	1699 ± 242	0.650
Protein (g/day)	56 ± 13	57 ± 11	60 ± 10	0.020
Total fat (g/day)	53 ± 14	52 ± 13	50 ± 10	0.240
Saturated fatty acid (mg/day)	17 ± 5	17 ± 5	17 ± 4	0.550
Mono-unsaturated fatty acid (mg/day)	14 ± 4	14 ± 4	13 ± 3	0.040
Poly-unsaturated fatty acid (mg/day)	11 ± 3	10 ± 3	10 ± 3	0.020
Sodium (mg/day)	2872 ± 1019	2688 ± 1254	2498 ± 1185	0.010
Potassium (mg/day)	2199 ± 579	2463 ± 595	2720 ± 562	< 0.001
Calcium (mg/day)	793 ± 243	887 ± 226	950 ± 198	< 0.001
Magnesium (mg/day)	187 ± 43	202 ± 44	220 ± 39	< 0.001
Folate (mg/day)	205 ± 51	225 ± 64	256 ± 65	< 0.001
Total dietary fiber (g/day)	9 ± 2	11 ± 3	13 ± 3	< 0.001

Values are presented as mean ± SD. Nutrients and food intakes have been adjusted for age and total energy intake using residual model.
* Obtained from ANCOVA. DASH: Dietary approach to stop hypertension; ANCOVA: Analysis of covariance; SD: Standard deviation

Furthermore, there was direct association between lower adherence to DASH diet and central obesity but not statistically significant in study participants.

Table 3. Means of obesity indices across tertiles of adherence to dietary approach to stop hypertension (DASH) diet score among children and adolescents aged 11-18 years

Variables	Tertiles of DASH score			P
	1	2	3	
	< 22	22-25	> 25	
Waist to hip ratio				
Crude*	0.82 ± 0.06	0.81 ± 0.06	0.82 ± 0.05	0.280
Adjusted**	0.82 ± 0.00	0.81 ± 0.01	0.82 ± 0.00	0.280
Waist to height ratio				
Crude	0.48 ± 0.06	0.46 ± 0.06	0.47 ± 0.06	0.170
Adjusted	0.48 ± 0.00	0.46 ± 0.00	0.47 ± 0.01	0.310
Percent of body fat (%)				
Crude	26.55 ± 10.50	23.63 ± 9.22	23.49 ± 9.86	0.010
Adjusted	26.50 ± 0.83	23.60 ± 0.81	23.40 ± 0.81	0.280
Lean body mass (%)				
Crude	32.06 ± 5.39	33.87 ± 6.76	34.66 ± 7.24	< 0.001
Adjusted	32.00 ± 0.43	33.80 ± 0.59	34.60 ± 0.60	0.170

* Values are presented as mean ± SD and P value obtained from ANOVA in crude model. ** Values are presented as mean ± SE. Adjusted for age, sex, physical activity, and energy intake and P value obtained from ANCOVA in adjusted model. DASH: Dietary approach to stop hypertension; ANOVA: Analysis of variance; ANCOVA: Analysis of covariance; SD: Standard deviation; SE: Standard error

www.mui.ac.ir 15 Jan

Table 4. Odds ratio (OR) confidence interval (95% CI) for association of obesity and adherence to dietary approach to stop hypertension (DASH)diet score among children and adolescents aged 11-18 years

Variables	Tertiles of DASH score		
	1	2	3
	< 22	22-25	> 25
	OR (95% CI)	OR (95% CI)	
General obesity			
Crude	3.34 (1.28-8.75)	1.24 (0.40-3.85)	1
Model I	3.76 (1.41-10.06)	1.26 (0.40-3.94)	1
Model II	3.44 (1.15-10.30)	1.02 (0.28-3.70)	1
Model III	2.79 (0.75-10.40)	0.62 (0.14-2.77)	1
Model IV	3.30 (0.35-31.21)	0.86 (0.11-6.59)	1
Abdominal obesity			
Crude	1.56 (0.92-2.70)	1.3 (0.78-2.2.17)	1
Model I	1.56 (0.92-2.70)	1.28 (0.76-2.13)	1
Model II	1.35 (0.76-2.44)	1.11 (0.64-1.92)	1
Model III	1.43 (0.75-2.78)	1.35 (0.55-1.92)	1
Model IV	1.26 (0.64-2.50)	0.81 (0.40-1.63)	1

General obesity and abdominal obesity were defined as BMI ≥ 95th percentiles and WHtR > 0.5, respectively. Model I: Adjusted for age and sex. Model II: Also adjusted for physical activity score. Model III: Additionally adjusted for energy intake. Model IV: Additionally adjusted for intakes of refined grains, sweets, white meat, oils, high-fat dairy and eggs. WHtR: Waist height ratio; BMI: Body mass index; DASH: Dietary approach to stop hypertension, OR: Odds ratio; CI: Confidence interval

Discussion

Despite the protective effects of DASH diet on obesity indices in current study, we failed to find a statistically significant association between adherence to DASH diet and general/abdominal obesity. To our knowledge, this is one of the first observational studies investigating the association between adherence to DASH diet and general and abdominal obesity in Iranian children.

Although there are few observational studies that have directly assessed the association between adherence to the DASH diet and obesity, especially in children, there are several reports addressing the linkage between DASH diet and obesity. In two studies conducted by Azadbakht et al., in two study[13,14] protective effects of DASH diet on central and general obesity were observed in patients with metabolic syndrome and diabetics. Furthermore, a greater adherence to the DASH diet was associated with lower mean values of waist-to-hip ratio and BMI among women in Folsom et al. study[20] as well as the protective effects of DASH diet on general obesity on female nurses in another study.[21] The favorable effects of DASH diet on children abdominal obesity were observed in Asghari et al. study.[22] Furthermore, a study of Canadian children has shown that a higher DASH adherence is associated with lower abdominal obesity.[5] However, in two studies assessing the role of adherence to the DASH diet on adiposity in a sample of youth with diabetes,[23,24] no association was found between adherence to the DASH diet and measures of adiposity. Furthermore, a cross-sectional study[25] of Korean preschool children found that a DASH-style diet was not associated with measured weight status. Different findings might be explained by the different definition of the DASH diet among studies, sample size, validity of the dietary assessment tools, and study population. Furthermore, we adjusted other dietary factors which were not included in DASH score, and it can effect on study results.

The biological mechanisms of DASH diet on obesity are not fully established yet. The high amounts of fiber, dairy, and Ca of DASH diet are inversely related to obesity.[26,27] DASH diet stimulates satiety as a low-glycemic index and low-energy density diet.[28] Furthermore, the influence of fiber intake on insulin and incretin hormones secretion, such as glucagon-like peptide-1, can reduce fat storage.[29] Furthermore, the lack of relation between adherence to DASH diet and general obesity after adjustment for energy intake in this study, indicates DASH dietary pattern depends on energy intake reduction to exert protective effects on obesity management.

Despite some strengths of our study including a large sample size and school-based population, there are some limitations which should be noted. Due to the cross-sectional study design, a causal relationship cannot be inferred. There are some

www.mui.ac.ir 15 Jan

misclassifications of biases because of an FFQ usage to assess the dietary intakes. In addition, since the study was only conducted in Isfahan, it is difficult to generalize the results of the study to the whole populations of adolescents in Iran.

Conclusion

We concluded that adherence to DASH diet had an inverse association with general obesity, but not abdominal obesity which was attenuated after adjustment for potential confounders. Overall, protective effects of DASH diet are visible and it can be suggested as a healthy diet to weight management. Further well-designed randomized clinical trials are needed to discover the effect of DASH diet on obesity.

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Conflict of Interests

Authors have no conflict of interests.

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www.mui.ac.ir 15 Jan

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www.mui.ac.ir 15 Jan

Lipidemic effects of common edible oils and risk of atherosclerosis in diabetic Wistar rats

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Original Article

Abstract

BACKGROUND: Diabetic state potentiates atherosclerosis and the type of edible oil consumed by the individual may affect this further. This study aimed to determine if the common edible oils in Nigeria have any effects on the lipid profiles and arteries of alloxan-induced diabetic male Wistar rats.

METHODS: Thirty male Wistar rats were randomly divided into five groups of normal control, diabetic control, animals on diet enriched with refined, bleached deodorized palm oil (RBD-PO), animals on diet enriched with soya oil, and animals on diet enriched with olive oil. At the end of 8 weeks, the lipid profiles of the animals were determined before sacrificing them. Their aortas were subsequently harvested for histological examination.

RESULTS: The olive oil fed group had the highest level of total cholesterol (TC), non-high-density lipoprotein cholesterol (non-HDL-C), lowest HDL-C, and highest artherogenic index (AI). Diabetic animals fed on RBD-PO had a lower non-HDL-C, higher HDL-C, and lower AI than diabetic animals fed on olive oil or soya oil. However, the diabetic animals fed on RBD-PO had the highest triglyceride level. When the aortas were examined histologically, there were no atherosclerotic lesions in all the control and experimental groups except those fed on 10% soya oil enriched diet that had type II atherosclerotic lesions according to American Heart Association (AHA).

CONCLUSION: The result of our study showed that RBD-PO appears to offer a better lipid profile in the diabetic animals compared with olive oil and soya oil. Soya oil appears to cause the development of atherosclerosis in diabetic state.

Keywords: Diabetes, Wistar Rats, Atherosclerosis, Lipids

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Introduction

Atherosclerosis is the single largest cause of death and disability in the Western world and in the next two decades will be the leading cause of death worldwide.[1] The modifiable risk factors for atherosclerosis include dyslipidemia and diabetes mellitus. However, no risk factor on its own can sufficiently produce an atherosclerotic lesion.[2] The abnormal metabolic state in diabetes includes chronic hyperglycemia, dyslipidemia, and insulin resistance all of which render arteries susceptible to atherosclerosis. This may be worsened by decreased removal of triglycerides (TGs) into fat depots and decreased activity of lipoprotein lipase.[3] Dietary manipulation can exacerbate or ameliorate these processes. Common outbred rat strains such as Sprague–Dawley and Wistar rats have the capacity to develop elevated low-density lipoprotein cholesterol (LDL-C) and atherosclerosis with appropriate dietary manipulations.[4] These animal models are useful in studying the effects of edible oils on the development of atherosclerosis.

The edible oils of interest in our study were palm, soya, and olive oils. Palm oil is the most widely produced edible vegetable oil in the world[5] and its nutritional and health attributes have been well documented.[6] Its components include palm olein a mono-unsaturated fatty acid (MUFA) the liquid fraction and palm stearin a saturated fatty acid, the more solid fraction. Feeding experiments in various healthy animal species and humans have highlighted the beneficial role of fresh palm oil to health. These benefits include reduction in the risk of arterial thrombosis and atherosclerosis, inhibition of cholesterol biosynthesis and platelet aggregation, and

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www.mui.ac.ir 15 Jan

reduction in blood pressure.[7] Similar benefits have not been well documented in diabetes.

Soya oil contains approximately 60% of polyunsaturated fatty acids (PUFA), 24% MUFA, and 16% of saturated fatty acids.[8] This high level of PUFA dietary intake can improve the blood lipid profile status.[9,10] On the other hand, the composition of olive oil is complex, the major groups of compounds thought to contribute to its observed health benefits include oleic acid, phenolics, and squalene, all of which have been found to inhibit oxidative stress.[11,12]

Most of the studies on lipid profile and atherosclerosis in experimental animals have been conducted using edible oils available in the research location with little data in diabetic states. No work has been done on the effects of the common edible oils available in Nigeria on the lipid profile and the aortic wall of male diabetic Wistar rats. Considering the fact that vascular diseases are the principal cause of death and disability in people with diabetes,[13] a good knowledge of how these common dietary oils affect the lipid profile and the aorta would be of benefit in managing this chronic condition. The aim of this study is to determine if the common edible oils in Nigeria have any effects on the lipid profiles and arteries of alloxan-induced diabetic male Wistar rats.

Materials and Methods

Thirty 10-week-old male Wistar rats were used for this study. The animals were purchased from the common central animal house, University of Ibadan. They were housed in well-ventilated cages and were fed on standard rat pellets obtained from Capsfeed Ltd. They were allowed free access to drinking water. The animals were randomly divided into 5 groups with six rats in each group. Four groups were induced with diabetes using alloxan produced by Kem Light Laboratories, Limited, Mumbai, Maharashtra, India. After a week of acclimatization, animals to be induced were fasted for 48-hours, and weighed. The fasting blood glucose (FBG) of all the animals was taken using venous blood samples obtained from animal tail tips, and blood glucose level was analyzed with a portable glucose analyzer (Accu Chek Glucometer and test trips). This was done to confirm the non-diabetic state of the animals. Following this, a solution of 5% alloxan diluted in distilled water was administered intraperitoneally to each rat at a dose of 120 mg/kg body weight.[14] Two days after the induction, the FBG level of the induced animals was checked, and animals with FBG levels above 200 mg/dl were considered as having severe diabetes[15] and were chosen for the study. Three of the diabetic groups were fed on feeds containing three different common dietary oils at 10% for 8 weeks, based on method of dietary induction of hypercholesterolemia and atherosclerosis in rodent models.[4] The edible oils were obtained from a local market in Ibadan. The remaining two groups which served as the diabetic and normal control, respectively, received normal rat chow diet for 8 weeks.

Animals in Group A (normal control, non-diabetic) were feed on normal basal rat chow diet.

Animals in Group B (diabetic control) were feed on normal basal rat chow diet.

Animals in Group C (diabetic) were feed on 10% refined, bleached deodorized palm oil (RBD-PO) enriched basal rat chow diet.

Animals in Group D (diabetic) were feed on 10% soya oil enriched basal rat chow diet.

Animals in Group E (diabetic) were feed on 10% olive oil enriched basal rat chow diet.

At the end of 8 weeks, 2 ml of blood was collected from the orbital sinus of each animal with capillary tubes into ethylenediaminetetraacetic acid bottles for lipid profile analysis. The atherogenic index (AI) was calculated using the formula:

AI = Non high-density lipoprotein cholesterol (non-HDL-C)/HDL-C

Thereafter, the animals were sacrificed, and their aorta was harvested for histological examination. The tunica intima (TI) and tunica media (TM) thickness were measured using computerized image analyzer (Motic Image Plus, Version 2.0).

The TI thickness was measured from the lumen to the internal elastic lamina while the TM thickness was measured from the internal elastic lamina to the external elastic lamina.

The results were expressed as mean ± standard deviation. The statistical analysis was performed by means of one-way analysis of variance followed by Dunnett's test. $P < 0.050$ was considered as statistically significant. All the data were processed with Graph Pad Prism software, version 5.00.

Results

At the end of the experimental period of 8 weeks, all animals had an increase in body weight and those in the normal control group had the highest percentage weight increase (58.33 ± 37.64, 48%). There was no statistically significant difference in the mean weight gain in all the groups, at P value of 0.0872 ($P > 0.050$). The lipid profiles of the diabetic and control groups are shown in table 1.

www.mui.ac.ir 15 Jan

Table 1. Lipid profile of experimental and control animals

Group	TC	HDL-C	Non-HDL-C	TG	AI
NC	205.81 ± 96.52	117.16 ± 31.93	88.65 ± 81.25	205.81 ± 96.53	1.06 ± 0.62
DC	220.57 ± 59.06	121.15 ± 28.84	99.42 ± 67.97	226.90 ± 86.01	1.53 ± 0.66
RBD-PO	257.38 ± 57.08	142.07 ± 92.50	115.28 ± 82.99	492.90 ± 214.60*,**	1.426 ± 1.35
Soya oil	217.50 ± 23.50	67.89 ± 65.30*	150.21 ± 46.25	203.40 ± 147.07	17.82 ± 8.45
Olive oil	278.80 ± 58.75*,**	30.69 ± 1.45*,**	248.12 ± 58.83*,**	75.61 ± 27.15	30.07 ± 14.59

* Statistically significant values in comparison with the control group (P < 0.050). ** Statistically significant values in comparison with the diabetic control group (P < 0.050). TC: Total cholesterol; HDL-C: High-density lipoprotein cholesterol; TG: Triglyceride; AI: Atherogenic index; RBD-PO: Refined bleached deodorized palm oil; DC: Diabetic control; NC: Normal control

The total cholesterol (TC) at the end of the experiment was higher in the olive oil group than the RBD-PO and soya oil group. There were no significant differences in the mean plasma TC values of all animal groups at P value of 0.2215 (P > 0.050). The mean HDL-C values of soya and olive oil fed groups (67.89 ± 65.30, 30.69 ± 1.45), respectively, were significantly lower than the mean HDL-C value of the normal control group (117.16 ± 3.93), at P values < 0.050.

The mean HDL-C value of olive oil fed group (30.69 ± 1.45) was also significantly lower than the mean HDL-C value of the diabetic control group (121.15 ± 31.93), at P > 0.050. The mean TG value of RBD-PO fed group (492.9 ± 214.6) was significantly greater than the mean TG value of the normal control group (205.81 ± 96.53) and diabetic control group (226.90 ± 96.53) at P > 0.050. The mean plasma non-HDL-C value of olive oil fed group (248.12 ± 58.83) was significantly greater than the mean plasma non-HDL-C value of the diabetic control group (99.42 ± 67.97) and that of the normal control group (88.65 ± 81.25) at P > 0.050. When the AI was arranged in descending order, diabetic animals fed on 10% olive oil fortified diet had the highest AI value (30.70 ± 14.59), followed by diabetic animals fed on 10% soya oil (17.82 ± 8.45), followed by diabetic animals fed on normal diet (1.53 ± 0.66), followed by diabetic animal fed on RBD-PO (1.43 ± 1.35), and control animals fed on normal diet had the lowest AI value (1.06 ± 0.62). Statistically, the mean AI values of all the groups were significantly different at P value of 0.0001 (P < 0.050).

Table 2 shows the TI/TM ratio of the control and diabetic groups and the ratio of all the groups were not significantly different at P value of 0.1161 (P > 0.050).

Figure 1 shows the histological section of the aorta of the control male diabetic Wistar rat fed on normal chow for 8 weeks and figure 2 is that of male diabetic Wistar rat fed on 10% soya oil enriched diet for 8 weeks.

Table 2. Ratio of the aortic tunica intima (TI) and tunica media (TM)

Animal group	TI/TM ratio	P
Control	0.02883 ± 0.006795	
Diabetic control	0.02333 ± 0.005502	0.114
RBD-PO	0.02038 ± 0.019670	0.286
Soya oil	0.04725 ± 0.023470	0.267
Olive oil	0.02100 ± 0.003606	0.110

TI: Tunica intima; TM: Tunica media; RBD-PO: Refined bleached deodourised palm oil

There were no atherosclerotic lesions in all the control and experimental groups except those fed on 10% soya oil enriched diet that had type II AHA atherosclerotic lesions as shown in figure 2. The aortic endothelium had two to three layers of macrophages without lipid droplets.

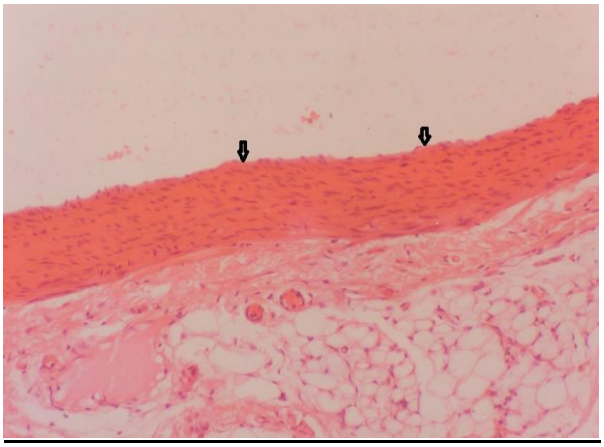

Figure 1. Aortic section of male diabetic Wistar rat fed on normal chow for 8 weeks. The arrowheads point to an intact endothelium without any interruption (stained with hematoxylin and eosin stain)

Discussion

The metabolic disorder of diabetes is characterized by accelerated atherosclerosis with widely distributed vascular lesions.[16] Dyslipidemia in form of hypercholesterolemia, high LDL-C, and low HDL-C in the blood will worsen this atherogenic

www.mui.ac.ir 15 Jan

process,[17] and dietary manipulation can exacerbate or ameliorate it.

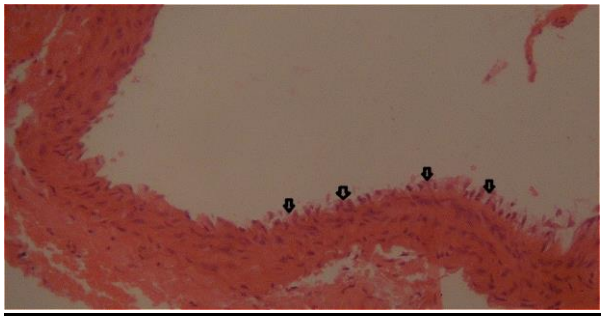

Figure 2. Aortic section of male diabetic Wistar rat fed on 10% soya oil enriched diet for 8 weeks. The arrowheads point to areas of disruption of the endothelium without lipid droplets that represents type II lesions (stained with hematoxylin and eosin stain)

Our study is the first to investigate the effects of edible oils in Nigeria in male Wistar diabetic rats. Diabetic animals fed on olive oil enriched diet had the highest TC, non HDL-C, and AI but the lowest level of TG. These findings from our study suggest that olive oil may be proatherogenic in the diabetic state. This contrasts with an earlier study that reported the antioxidant and hypolipidemic effects of olive oil in normal and male diabetic rats.[18] The non-HDL-C directly reflects the proatherogenic nature of oils. The HDL-C was also significantly low in animals fed on olive oil in our study, and this is the cholesterol that is associated with reduced risk of cardiovascular events when present at appropriately high concentration.[19] Vegetable oils, such as olive and soya oils, are recommended for consumption due to their high content of MUFA and PUFA.[20] A study comparing the effects of sunflower, fish, and virgin olive oils on the progression of experimental atherosclerosis in rabbits found that extra virgin olive oil, and to a lesser extent, fish oil, stops its progression.[21] In another study, the aorta and coronary arteries of albino rats administered olive oil showed less atheromatous lesions compared with animals fed on corn oil[22] or peanut oil.[23] The only explanation that we can give for the proatherogenic state of olive oil in our study is that it is possible that the locally available olive oil may be adulterated, and this is alarming and calls for prompt intervention by the consumer regulatory agency in Nigeria.

In our study, diabetic rats fed on soya oil had high levels of non-HDL-C, and the AI was highest in animals fed on olive oil followed by those fed on soya oil. In addition, only diabetic rats fed on soya oil had atherosclerotic lesions on their aortic endothelium though at an early stage, that is, type II atherosclerosis. Our findings are at variance with a study comparing fresh soya oil with repeatedly heated soya oil which showed that fresh soya oil offered vascular protection in the estrogen-deficient state, as rats had similar features to those of the normal control group, while animals fed on repeatedly heated soya oil had deleterious damage of their endothelium.[24] Another study comparing the effects of soymilk and probiotic soymilk on serum HDL-C and LDL-C in diabetic Wistar rats observed that probiotic soymilk increased HDL-C significantly more than soymilk.[25] The researchers recommended that probiotic soymilk may be considered in managing diabetes complications and atherosclerotic risks. Soya oil is the most widely marketed edible oil in the world, and it contains approximately 60% of PUFA, 24% MUFA, and 16% of saturated fatty acids.[8] This high level of PUFA can improve the blood lipid profile status.[9] In addition, with its high content of tocopherols, soya oil is known to exhibit various antioxidant actions against lipid peroxidation.[26]

In our study, diabetic rats fed on RBD-PO had high levels of HDL-C and low AI. Our study showed that RBD-PO has a better lipid profile and AI than olive oil and soya oil in diabetic rats. This is in line with various studies in animals[26] and humans[27-29] that showed that palm oil has the effect of decreasing TC and "bad" LDL-C and increasing the level of "good" HDL-C. However, in their study, soya oil and peanut oil had no effect on the blood cholesterol. The beneficial roles of fresh palm oil to health include reduction in the risk of arterial thrombosis and atherosclerosis, inhibition of cholesterol biosynthesis and platelet aggregation, and reduction in blood pressure.[30] This may be attributed to the tocopherol and tocotrienols antioxidant property of RBD-PO. A study that examined the effects of palm oil tocotrienol-rich fractions on streptozotocin-induced diabetic rats reported that tocotrienol-rich fraction lowers the blood glucose level and improves dyslipidemia.[31] Another study comparing hamsters fed on RBD-PO with those fed coconut oil found that the former had lower TC and non-HDL-C and higher HDL-C concentrations and accumulated less aortic cholesterol than the later.[32] We observed that the mean TG value of RBD-PO fed group was significantly greater than the mean TG value of the normal control and the diabetic control groups. The reason for the elevated level of TG is not clear but

www.mui.ac.ir 15 Jan

can be attributed to the high concentration of plasma TG that accompanies uncontrolled diabetic state.

When we studied the effect of oils on the aortic sections, the TI/TM ratios of all the experimental groups were not significantly different from that of the normal control and the diabetic control group. Diabetic animals fed on RBD-PO and olive oil also had an intact endothelial lining, but the aortic endothelial lining of diabetic animal fed on soya oil showed two-three layers of macrophages without lipid droplets, which is the feature of type II atherosclerotic lesion. This may indicate that the antioxidant properties of soya oil were not able to prevent the development of atherosclerotic lesion in diabetic animal. This result is not in agreements with a previous report that soya oil offered vascular protection in the estrogen-deficient state[23] although the animals were not diabetic. Another study showed that Citrus aurantifolia lime peel is more effective than the juice can decelerate the process of atherogenesis in rabbits because it increases plasma antioxidant capacity.[32]

Conclusion

In conclusion, the result of our study showed that RBD-PO offered a better lipid profile in the diabetic animals compared with olive oil and soya oil. This is because the diabetic animals fed on RBD-PO had a lower non-HDL-C, higher HDL-C, and lower AI than diabetic animals fed on olive oil or soya oil. However, animals fed on RBD-PO had the highest TG level that is not significantly different from the diabetic control and normal control groups. We attributed this to the high level of TG that is compatible with diabetic state. The diabetic group fed on olive oil had the highest level of TC, non-HDL-C, and AI. The only explanation we have for this may be that the oil may be adulterated; however, further studies may be needed to confirm or refute this. Type II atherosclerotic lesion was seen only in the soya oil fed diabetic group.

Acknowledgments

None.

Conflict of Interests

Authors have no conflict of interests.

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www.mui.ac.ir 15 Jan

The impact of educational intervention on self-care behaviors in overweight hypertensive women: A randomized control trial

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Original Article

Abstract

BACKGROUND: The improper control of self-care in hypertension imposes a lot of financial burden on the health-care system. On the other hand, the importance of participatory care and high effectiveness of self-management programs have been confirmed. This study was aimed to examine the effect of an educational intervention on self-efficacy, self-care behaviors and blood pressure (BP) of hypertensive obese or overweight women in the primary health-care setting in Isfahan, Iran.

METHODS: This randomized controlled trial was an educational intervention program. It was performed among 146 hypertensive women of 30-65 age range who referred to 6 health care centers of Isfahan that randomly assigned to a control and intervention groups. The interventional group participated in the 6 weekly sessions including exercises, weight control, medication adherence, and home self-monitoring based on goal setting, and promotion of self-efficacy. The control group received routine care from health-care center and any special intervention has been done for the control group. Output variables were analyzed after intervention, and 6-month follow-up.

RESULTS: There are no significant differences between age, weight, body mass index and BP and biochemical variables except lipids as well as behavioral factors at the baseline. After 6 months intervention self-efficacy (< 0.001) and physical activity (< 0.001) improvement of in the intervention group was significantly different in comparison with the control group. After 6 months, there was a significant reduction in systolic (P < 0.001) and diastolic BP (P = 0.010) in the intervention group.

CONCLUSION: Participatory method of education could help us to convince patients to have better self-care to control disease. Furthermore, since adherence to the treatment of hypertensive patients in our society is low, organizing such courses can teach essential knowledge and skills to lifestyle change and prevention of complications. Performing these courses is recommended for other chronic disease patients in health-care centers to assess self-management programs on self-care behavior.

Keywords: Hypertension, Self-Care, Education, Women

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Introduction

Hypertension is the important risk factor for premature death, stroke, and heart disease universal.[1] Hypertension is responsible for half of cardiovascular deaths.[2,3] The prevalence of hypertension among 30-55 and > 55-year-old population were approximately 23% and 50%, respectively, in Iran,[4] and this prevalence in women is higher than men.[5]

The previous studies have shown that lifestyle changes such as weight loss, reduction of sodium intake, the dietary approaches to stop hypertension

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www.mui.ac.ir 15 Jan

(DASH), regular exercise, reduction of stress, quitting smoking, and drinking in addition to medication affect the control of hypertension.[6,7] In spite of these recommendations, the majority of hypertension cases remain uncontrolled.[8] According to Esteghamati et al.,[5] only 6% of Iranian hypertensive patients had controlled blood pressure (BP). On the other hand, although the level of awareness increased among Iranian, the rate of control of hypertension and lifestyle changes is lower than standard among Iranian population.[5,9,10]

Since the patients' participation is the gold standard for the control of chronic disease such as hypertension,[11] in fact, the gap between knowledge and practice is resolved by patients' commitment in self-management model.[12]

Self-management is a relatively new paradigm in controlling chronic disease based on the behavioral theory of self-efficacy and an interactive approach between health-care providers, and patients.[13] It seems that training patients for doing self-management could improve the medication adherence and healthy nutrition among chronic disease patients.[14] This effectiveness is demonstrated in diabetic patients.[15] Self-management in hypertensive patients equals to medications as prescription, and lifestyle changes that lead to the reduction in the crises of hypertension, and control of its complication.[16] the advantages of home BP monitoring in international hypertension management guidelines have been accredited too.[7]

Moreover, using mobile technology as a new, accessible, and acceptable strategy has been effective in supporting healthy behavior such as weight reduction, hypertension control, and healthy nutrition too.[17]

Based on our knowledge, there are limited experiences to evaluate the impact of self-management in Iranian hypertensive patients. This study examined the effectiveness of integrative approach of self-management, home self-monitoring, and short message service (SMS) on some self-care behaviors and measurable variables such as weight and BP among hypertensive women attending to governmental health-care centers in Isfahan, Iran.

Materials and Methods

This study was a randomized controlled trial. The study population was selected by random cluster sampling from March 2015 to December 2015 in Isfahan. The methodology of the study approved by Isfahan University of Medical Sciences and after obtaining the ethical approval; informed consent form was obtained from each participant and registered in Iranian Randomized Control Trial (IRCT2014061218076N1).

After coordinating to the authorities, in the first step, six health-care centers considered randomly from 10 health-care centers in Isfahan. All obese or overweight hypertensive patients which registered in the health-care system were invited by telephone. In the introductory session, a subject who was eligible and signed the consent form was participated in the study. In the second step, we used the method of randomized binary blocks so that the national code of the subjects has been sorted decently and each binary block randomly assigned to one of the intervention or control groups. So from each of these health-care centers, between 20-30 hypertensive women (depending on the under covered in every health care center) were selected randomly. The selection of the blocks was done by randomly.

In the introductory session, obese or overweight hypertensive women enrolled. The inclusion criteria were being hypertensive (BP ≥ 140/90 mm Hg)[18] at least in recent 6 months, being on medication, having a body mass index (BMI) ≥ 25 kg/m^2, being in the 30-65 age range, willing to take part in the survey, lacking the ability to walk, having no serious diseases such as diabetes or hypothyroidism or severe complications. The patients who preferred not to continue or were absent for more than 2 sessions were excluded from the study.

To detect a change of 5 mmHg in systolic BP[19] with 95% confidence and 80% power, a sample size of 140 participants was considered with attention to the 20% attrition rate; the final sample size was estimated 170 ones for the two groups.

This study has been financially supported by the Vice Chancellor of Isfahan University of Medical Sciences with the project number (Reference: 393790.12/1/2014) and registered in Iran, Randomized Control Trial (IRCT2014061218076N1).

The subjects in the intervention group attended 6-weeks educational sessions weekly. The number of attendants was 8-15 to provide a dynamic group; the length of the session was 2-2.5 hours. One psychologist, a nutritionist and a sports coach (totally three trainers) administered the sessions in all of the health-care centers attended by the researcher. The bases of education were goal setting, promotion of self-efficacy[20] and home self-monitoring. Goal setting principal based on SMART goal (specific, measurable, achievable, realistic, and time-related) was explained to them.

www.mui.ac.ir 15 Jan

Then, they set out a reasonable action-specific plan regarding to training topics in every week. Those included physical activity, positive thinking and relaxation, salt restriction and DASH diet, weight control. Furthermore, measurement of BP by a calibrated digital barometer and stretching exercise were trained practically too. According to this method, they were asked to perform and record the trained self-care behaviors on a specific card in home during the week. The following session they attempted to define and show their action plan. The group discussed about the ways to overcome the challenges. They were encouraged by coaches and other attendants. During the follow-up periods, the subjects received text messages (SMS) of the mentioned topics twice a week. One cardiologist-supervised the study and visited them if they had a problem such as medication side effects.

The patients of the control group did not receive any intervention by the researcher. Although, necessary routine care, according to the national protocol for management of hypertension was taken for them in the health-care centers.[21] Screening of patients, measurement of BP, patient education and referral to the physician by the nurse on the certain time are headline of it.

These assessments (weight, BP, physical activity, self-efficacy, healthy nutrition) were done during the baseline before and after intervention and follow-up time. Biochemical tests were measured at baseline too. Conducting assessments and filling out the questionnaires performed by a trained nurse to minimize the possible observer-expectancy effect.

A standard mercury sphygmomanometer was used to measure BP according to international protocols.[22] The weight was recorded in kilogram and measured using a weight capacity pre-calibrated digital scale without shoes or a heavy cover. The height was obtained by calculating the average of two readings in meters using a portable audiometer. The BMI was determined by dividing weight (kg) by height squared (m^2). After at least 12 hours of overnight fasting, the venous blood specimen was collected at a certain laboratory for the measurement of blood-lipid. The participants were asked to complete a 24-hour urine sample. They were said to void their bladder at the first time in the morning. After that, all urine passed during the 24-hour period (day and night) must be collected and stored in a plastic container without any preservatives matter. Then, the samples were delivered to the referral lab to sodium measurement.

The general questionnaire was created for the collection of basic demographic and clinical data. The English translated questionnaire (Stanford self-management questionnaire in chronic disease patients**)** that will be described in the following lines contains self-efficacy and physical activity.[23] It was done through the translation-back-translation process. Nine experts were invited to assess the face and content validity index. The Persian version of the questionnaire was revised according to their comments. After the pilot test, the reliability coefficient of total scale was $\alpha = 0.79$ with the internal reliability of 0.76.

The scale of self-efficacy consists of six questions scored on a Likert scale from 1 to 10 ("not at all confident" to "totally confident)." The score was the mean of the six items. The higher numbers indicate higher self-efficacy. This scale was defined as one scale to study self-efficacy in arthritis patients for the first time by Lorig et al.[23] It evaluates the several domains that are common across lots of chronic diseases, such as the level of confidence in the symptom control, role function, and emotional functioning in control disease. The internal consistency reliability of this questionnaire was 0.91.[24]

Physical activity scale contains 6 items about the stretching exercise, walking, swimming, use of sports equipment, and other aerobic exercise in the past week (that explained to participants) and minutes of exercise during one week included; never, < 30, 30-60, 60-180, more than 180 minutes with 0-4 scores, respectively. Participants who scored 3-4 coded as adhering to walking recommendations. The test-retest correlation for the physical activities scale was 0.42-0.92.[23]

The DASH diet questionnaire is a research administrative scale based on DASH foundation. It consists of a diet rich in fruit and vegetables (8-10 servings/day), rich in low-fat dairy products (2-3 servings/day), and low in saturated fat, cholesterol, and salt (sodium chloride).[25] 13 questions concerning the participants' diet in the week before the completing of the questionnaire were addressed: 2 about the intake of cooking and table salt; 4 about the consumption of fast food, canned food, and sausage; 3 about the type and amount of meat being consumed (red, chicken, or fish); 2 about the cooking fat (hydrogenate or unsaturated fat); 1 about the way of cooking (fried or boiled); and 1 about fresh fruit and vegetables. Answers were scored on a 5-point Likert scale, from "never" to "always." (0-5). The reliability coefficient of total scale was $\alpha = 0.84$. Higher score means

www.mui.ac.ir 15 Jan

healthier nutrition and reverse. The internal reliability obtained 0.79 after completion by 30 patients.

Analyst, cardiologist, and assessor were blinded to the group allocation. Patients were assured that the questionnaires were anonymous so that number and type of disease would be held confidential. Blindness: one of the staffs was unaware to participants.

Statistical analysis was performed using SPSS software (version 17.0, SPSS Inc., Chicago, IL, USA). The Shapiro–Wilk test was used to assess the normality of variables. Continuous data were reported based on mean ± standard deviation and discrete data such as educational level and marital status were calculated with number and (percent). T-test and chi-square test were used for continues and no continues demographic variables. Therefore, the repeated-measures analysis of covariance (ANCOVA) after adjusting for age, low-density lipoprotein (LDL), and cholesterol before, after intervention, and 6 months later was used to test group and time effects and group-by-time. Before repeated-measures, the assumption of ANCOVA test (Boxes test, Leven and Spherocity were checked. Friedman test was used to compare the rate of physical activity before, after intervention, and after 6 months later. The Wilcoxon test for paired samples was used to compare physical activity before intervention, immediately after intervention and 6-month follow-up. $P < 0.050$ was considered significant.

Results

About 146 remained in the study. 10 of the control group left the study because of moving or not attending at the follow-up time. In the intervention group, 6 of them did not complete the study because of the absence of more than two sessions (n = 6). A total of 71 (87.6) in the control group and 74 (91.3) in the intervention group completed the follow-up. A diagram of enrollment and follow-up is shown in figure 1.

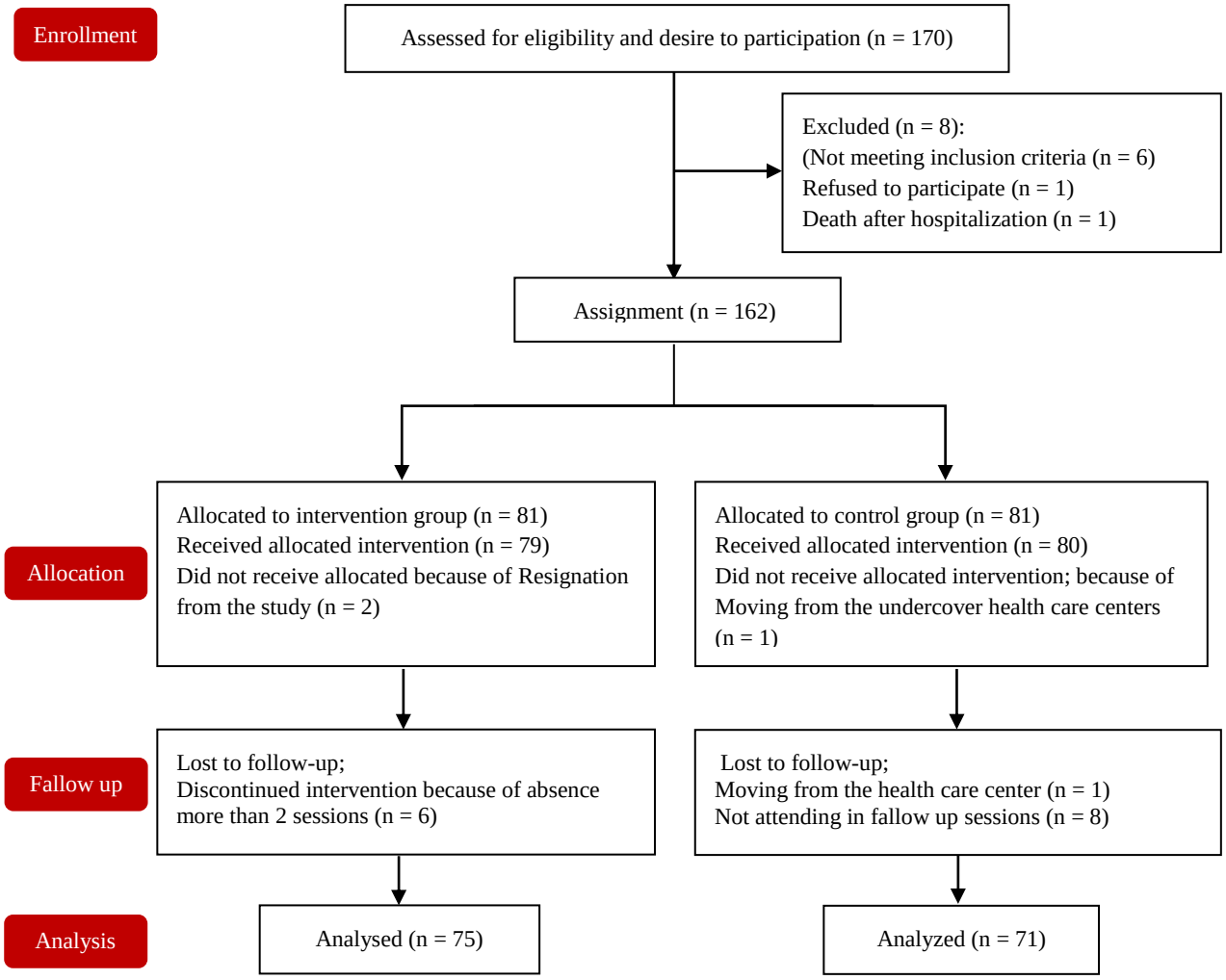

Figure 1. Consort diagram

www.mui.ac.ir 15 Jan

Table 1. Demographic characteristics of overweight or obese hypertensive women in two groups (n = 146)

Variable	Intervention group (n = 75)	Control group (n = 71)	P
Age (year)	54.14 ± 6.50	52.11 ± 6.50	0.062*
Weight (kg)	74.06 ± 10.85	73.27 ± 11.79	0.672*
BMI (kg/m^2)	30.15 ± 4.41	30.07 ± 4.27	0.913*
Biochemical tests			
Cholesterol (mg/dl)	191.54 ± 41.62	205.11 ± 39.19	0.046*
TG (mg/dl)	139.21 ± 70.55	159.12 ± 86.18	0.125*
HDL (mg/dl)	51.25 ± 14.56	48.74 ± 15.23	0.314*
LDL (mg/dl)	109.54 ± 36.86	124.94 ± 32.76	0.009*
Na (mg/dl)	131.38 ± 94.20	132.90 ± 109.38	0.928*
Systolic BP	135.53 ± 15.54	139.08 ± 13.84	0.148*
Diastolic BP	82.40 ± 8.47	84.43 ± 8.80	0.157*
Duration of diagnosis of hypertension	6.26 ± 5.86	5.68 ± 4.80	0.514*
Educational level number (%)			
Illiterate	25 (33.3)	21 (29.6)	0.606**
< 12 years education	37 (49.3)	33 (46.5)	
≥ 12 years and more education	13 (17.3)	17 (23.9)	
Marital status			
Married	65 (86.7)	59 (83.1)	0.646**
Divorced or widow	10 (13.3)	12 (16.9)	
Self-evaluation of economic situation			
Week	16 (21.3)	2 (16.9)	0.149**
Medium	50 (66.7)	56 (78.9)	
Good	9 (12.0)	3 (4.2)	
History of backache or arthrosis (%)	24 (32.0)	33 (46.5)	0.090**
The number of home self-monitoring			
When I have an appointment with a physician	19 (25.3)	15 (21.1)	0.293**
When I have headache	17 (22.7)	19 (26.8)	
Weekly-monthly	24 (32.0)	30 (42.3)	
Twice a week-twice a day	15 (20.0)	7 (9.9)	

Data shown as mean ± SD. * T-test, ** Chi-square. SD: Standard deviation; BP: Blood pressure; BMI: Body mass index; LDL: Low-density lipoprotein; HDL: High-density lipoprotein; TG: Triglycerides

The baseline characteristics such as age, weight, BMI, BP and biochemical variables ($P > 0.050$) except cholesterol ($P = 0.046$) and LDL ($P = 0.009$) as shown at table 1. Before intervention, total self-efficacy, healthy nutrition, and physical activity have not significant difference in the control and intervention groups ($P > 0.050$) (Table 2).

As shown in table 2, a significant difference is in the mean of self-efficacy between the groups ($P < 0.001$) and follow-up time ($P < 0.001$). So that the mean of self-efficacy improve immediately after intervention and 6 months later in comparison to control group after adjusting for baseline.

After adjusting for age, LDL, and cholesterol showed there is not significant difference in the mean of healthy nutrition between two groups ($P = 0.250$). Although the mean of healthy nutrition increases in the intervention group immediately after intervention ($P < 0.001$) and decreases after 6 months in the intervention group so that this improvement is not a sustainable change after 6 months. Furthermore, this difference between before intervention and 6 months later is not significant in the intervention group ($P > 0.050$).

Results showed there is not any significant difference between the mean of healthy nutrition in different times in control group.

Freidman test shows that there is a significant difference in physical activity between two groups after follow-up ($P < 0.001$). So that the intervention group immediately after intervention have a higher average of physical activity than the control group ($P < 0.001$). Although there is not any significant differences between immediately after intervention and 6 months later in terms of physical activity in the intervention group ($P = 0.120$) (Table 2).

Before intervention, there was not any significant difference between the mean of systolic BP between two groups (0.148). As shown in table 3, results show that there is a significant difference between systolic BP of intervention and control group overall ($P = 0.045$).

www.mui.ac.ir 15 Jan

Table 2. Self-efficacy, some self-management behaviors before, after intervention and 6-month follow-up in the two groups overweight or obese hypertensive women (n = 146)

Variable	Intervention group (n = 74) Mean ± SD		Control group (n = 71) Mean ± SD	P
Self-efficacy* (0-10)				
Before intervention	6.84 ± 2.11		6.52 ± 2.70	0.428
After intervention	8.88 ± 1.80		7.15 ± 2.15	< 0.001
6-month follow-up	8.18 ± 1.87		7.29 ± 1.90	0.005
P follow up**		< 0.001		
P group		< 0.001		
Healthy nutrition* (0-55)				
Before intervention	47.87 ± 4.95		46.38 ± 4.41	0.056***
After intervention	51.57 ± 4.16		48.52 ± 6.34	< 0.001
6-month follow-up	48.29 ± 4.84		47.49 ± 4.04	0.280
P follow-up**		< 0.001		
P group		0.250		
Physical activity (3-12)£				
Before intervention	2.97 ± 2.72		2.74 ± 2.57	0.262***
After intervention	4.96 ± 2.91		2.11 ± 3.18	< 0.001
6-month follow-up	4.30 ± 2.99		2.91 ± 2.78	0.030
P follow-up		< 0.001		
P group		< 0.001		

* Fridman; ** P value from repeated measure analysis covariance controlling by age, cholesterol, and LDL. *** T test, Paired comparison was used by Bonfferoni test. £ Two related samples (Wilcoxon test). SD: Standard deviation; LDL: Low-density lipoprotein

Trend of these changes is significant in two groups too (P < 0.001) so that systolic BP decrease as 7 mmHg in the intervention group, while this decrease is 3 mmHg in control group after 6 months (P < 0.001).

After adjusting for age, LDL, and cholesterol show, there is a significant difference in diastolic BP between the groups (P = 0.010) and follow-up time in the intervention group (P = 0.013). The changes of diastolic BP in control group is not significant at follow-up time (Table 3).

Table 3. Comparison of weight, systolic blood pressure (SBP), diastolic blood pressure (DBP) before, immediately after intervention and 6-month follow-up in the two groups of overweight or obese hypertensive women (n = 146)

Variable	Intervention group (n = 74) Mean ± SD		Control group (n = 71) Mean ± SD	P**
Systolic BP				
Before intervention	135.53 ± 15.54		139.08 ± 13.84	0.148
Immediately after intervention	129.53 ± 15.63		129.71 ± 15.48	0.943
6-month follow-up	128.80 ± 13.35		136.05 ± 14.48	< 0.002
P follow-up*		< 0.001		
P group		0.045		
Diastolic BP				
Before intervention	82.40 ± 8.47		84.43 ± 8.8	0.157
Immediately after intervention	81.77 ± 11.72		82.81 ± 10.71	0.576
6-month follow-up	79.13 ± 7.55		84.50 ± 7.66	< 0.001
P follow-up		0.120		
P group		0.010		
Weight				
Before intervention	74.06 ± 10.85		73.27 ± 10.79	0.674
Immediately after intervention	72.92 ± 10.40		72.95 ± 11.55	0.985
6-month follow-up	72.34 ± 10.61		72.85 ± 12.50	0.792
P follow up*		0.093		
P group		0.461		

* P value from repeated measure analysis covariance controlling by age, cholesterol, and LDL. ** T test, Paired comparison was used by Bonfferoni test. SD: Standard deviation; LDL: Low-density lipoprotein; BP: Blood pressure

www.mui.ac.ir 15 Jan

Before intervention, the control and intervention groups are not significantly different in the mean of weight ($P < 0.674$). Furthermore, there is not any significant difference in weight between two groups ($P = 0.461$). Although there was a decreasing trend in the mean of weight in two groups, this change is not a significant (Table 3).

Discussion

The results of this study showed that using the participatory method of education based on principals of chronic disease self-management among hypertensive women can improve the self-efficacy, physical activity, healthy nutrition, and reduces BP.

Similar to the results of Park et al.[12] and Jung and Lee,[26] our results showed significant improvement in self-efficacy, physical activity, and healthy nutrition after educational intervention. Therefore, control of behavior more efficient using this strategy as a key construct to boost of self-care behavior in educational programs. Physical activity in the intervention group improved significantly during follow ups. This result is similar to another behavioral interventions study.[27] Studies have shown inactivity elevated hypertension prevalence as 5-12%[28] and adherence to the physical activity is recommended to control of hypertension.[29] The rate of physical activity in the subjects of our research was very low and the significant difference was nearly according to the related studies.[30]

Siu et al.[27] and Obarzanek et al.[31] studies showed benefits of these programs in physical activity, healthy diet and weight loss in Chines population. However, our results demonstrated an increase of adherence to a healthy diet was notable in the intervention group, although it was not effective to weight loss. It seems this difference was due to stretching exercise. Our participants recommended to focus more on stretching exercises than aerobic exercises. While other studies have shown sports which involve big muscles are effective in weight loss. The reason of doing more stretching exercises in our study may be related to comorbidities such as arthritis and back pain preferred to do this type of activity.

Other self-management studies have pointed to increase of healthy nutrition after participation in the self-management programs as an outcome.[32] Hence, increases of exercise, as well as adherence to DASH, are different strategies to effect on one special group of hypertensive patients,[29,33,34] designing a combined intervention could be considered in educational intervention.

In this study, nutrition situation immediately after educational sessions was better than 6 months later. It could be attributed to encouragement, support and close relationship between coach and participants during the sessions, while after removing external motivators, these changes are dropped. Moreover, nutritional habits are derived from in cultural and familial aspects and its change takes a lot of time. Therefore, other studies pointed to difficulty in long-term lifestyle change among patients.[35]

In this study, systolic and diastolic BP decreased significantly after intervention (7 and 2 mm/Hg), respectively. However, the mean difference in systolic and diastolic BP in control group was not statistically significant. Glynn et al.[36] showed that the mean difference of changes in systolic BP was 1.7 mmHg to +1.3 mmHg and reduction of 1.8-2.5 mmHg in self-home monitoring of educational intervention, and the change of diastolic BP was no significant change to 8 mmHg. Decreases of systolic BP in other self-management studies have been confirmed too.[22]

Although this change of systolic BP in the current study was not substantial in clinical terms to prevent cardiovascular disease,[37] this success besides other changes in patients' lifestyle (healthy nutrition and physical activity) could be useful in the prognosis of hypertension in a long-term period. The use of a novel method of education in several health-care centers with different socioeconomic positions of patients is noticeable.

Conclusion

Obtained results showed using the participatory method of education, could help us to convince patients to have better self-care to control disease. Furthermore, since adherence to the treatment of hypertensive patients in our society is low, organizing such courses can teach essential knowledge and skills to lifestyle change and prevention of complications. Performing these courses is recommended for other chronic disease patients in healthcare centers to assess self-management programs on self-care behavior.

Limitations: The self-report of physical activity and nutrition were the limitations of our study. This study investigated behaviors of attended patients of urban government public health centers. Since subjects' willing was considered to participate in the study, the selection bias was not avoidable and these results cannot be generalized to all hypertensive patients.

www.mui.ac.ir 15 Jan

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Conflict of Interests

Authors have no conflict of interests.

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www.mui.ac.ir 15 Jan

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www.mui.ac.ir 15 Jan

Comparison of manual versus automated blood pressure measurement in intensive care unit, coronary care unit, and emergency room

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Original Article

Abstract

BACKGROUND: Accuracy of blood pressure (BP) measurement in clinical settings is one of the most concerns despite of promotion in techniques for the measurement of BP. Our aim was to compare automated versus manual BP measurement in intensive care unit (ICU), coronary care unit (CCU), and emergency room patients.

METHODS: Totally, 117 patients in ICU, CCU, and emergency department were registered in the study. Demographic information was recorded. The cardioset heart monitoring device was used for measuring BP and mercury sphygmomanometer with appropriate cuffs was used for manual method. Then, the mean BP of two methods was compared based on different age, sex, weight, and disease findings.

RESULTS: The mean systolic blood pressure (SBP) was 124.526 mmHg, with minimum and maximum of 123.111 and 125.940 mmHg, respectively (Cronbach's alpha = 0.893); furthermore, mean diastolic blood pressure (DBP) was 73.496 mmHg, with minimum and maximum of 72.718 and 74.247 mmHg, respectively (Cronbach's alpha = 0.852). SBP was significantly different between the two methods, and especially in patients below 60 years, hospitalized in ICU ward, overweight, mid-upper arm circumference below 27 cm, and with neurosurgery problems, it was higher by manual method ($P < 0.050$). Moreover, DBP was more in manual method in patients with female sex, below 60 years, hospitalized in ICU ward and with neurosurgery problems ($P < 0.050$).

CONCLUSION: The results of this study suggested that manual method in measurement of BP frequently shows higher BP, especially in patients admitted to hospitals-affecting up to 15 mmHg higher, and this discrepancy is more in critical situations.

Keywords: Intensive Care Unit, Coronary Care Unit, Automated, Manual, Blood Pressure

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Introduction

Accuracy of blood pressure (BP) measurement in clinical settings is one of the most concerns despite of considerable promotion in measurement techniques.[1,2] Manual BP measurement can be so accurate when using a device such as the mercury manometer which is similar to the mean awake ambulatory blood pressure (AABP).[2]

Recent studies demonstrate that an accurate BP measurement requires at least 14 minutes, including a period of rest and a conversation between physician and patient to reduce the white coat anxiety[3,4] which had low likelihood in routine clinics. This may lead to overestimate BP in healthy individuals.[5-7]

In recognizing the concerns about manual office blood pressure (MOBP) measurement, new techniques have been recommended. Proposals for improve assessment of BP status include greater reliance on home and 24 hours ambulatory BP monitoring.[8,9] This protocol eliminates white coat anxiety and receiving unnecessary drug treatment for hypertension in healthy individuals.[10] Advances in automated office blood pressure (AOBP) measurement provide a third option for accurate measurement of BP status which eliminates many factors influencing imprecise BP.[11-13]

Suokhrie et al.[14] showed that automated readings were averaged 3.9 points higher than manual method; and, based on these findings, a protocol was recommended in an acute care psychiatry unit that BP must be measured manually for each patient. In another study performed by Myers et al.[15] showed that the prevalence of masked hypertension was lower with AOBP compared with MOBP.

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www.mui.ac.ir 15 Jan

Table 1. Mean difference of systolic blood pressure (SBP) and diastolic blood pressure (DBP) based on two methods and age group

BP	Age	Mean difference	Standard error mean	P
SBP	Below 60 years (n = 55)	3.20	1.28	0.016
	Over 60 years (n = 62)	3.70	1.32	0.090
DBP	Below 60 years (n = 55)	2.18	1.32	0.004
	Over 60 years (n = 62)	1.00	1.29	0.463

DBP: Diastolic blood pressure; SBP: Systolic blood pressure; BP: Blood pressure

We sought to evaluate the difference between automated and manual BP measurement in various clinical conditions among our patients over a 1-year period.

Materials and Methods

This cross-sectional study was conducted in Shariati Hospital of Isfahan, center of Iran, from August to December 2014. Patients hospitalized in intensive care unit (ICU) and coronary care unit (CCU) and emergency department were enrolled to study. Exclusion criteria were lack of patients' consent to participate to study.

Totally, 125 patients in ICU, CCU, and emergency department who had been hospitalized for different chief complaint had considered for the study. Eight patients refused consent for entering the study, so the study accomplished with 117 patients.

Demographic information for each patient was recorded, as well as height, weight, BP and mid-upper arm circumference (MUAC), and body mass index (BMI). Standardized questionnaire was used to obtain the information of alcohol consumption, smoking, and medications status.

The cardioset heart monitoring device was used for measuring BP with noninvasive BP cuff. Meanwhile, BPs were measured manually, by an adult size cuff and standard sphygmomanometer. BP of patients was measured based on American Heart Association (AHA) recommendation, and after 5-minute rest, BP was measured by automated machine. In manual method of measurement, appropriate cuff was chosen. In adults with MUAC < 28 cm, a cuff with size of 23 cm × 12 cm was chosen and with MUAC more than 28 cm, a cuff with size of 28 × 36 was chosen to record systolic BP (SBP) and diastolic BP (DBP).

Data are expressed as mean ± standard error for continuous variables. One sample t-test was used to detect differences between SBP and DBP from two methods. Intraclass correlation coefficient evaluated agreement between automated and manual BP measurements.

$P < 0.050$ was considered statistically significant. Data analysis was done using SPSS software (version 15, SPSS Inc., Chicago, IL, USA).

Results

During the enrollment period, 117 adults were seen in the CCU, ICU, and emergency department, and agreed to participate in our study. The mean age of patients was 60.9 ± 16.84. A total of 66.7% (n = 78) of patients were male.

The mean difference between SBP was 3.47 ± 0.89 mmHg (Cronbach's alpha = 0.893), furthermore, mean difference between DBP was 1.55 ± 0.93 mmHg, (Cronbach's alpha = 0.852). As obtained, SBP in patients below 60 years was significantly more in manual method compared to automatic method (P = 0.016), but not for cases over 60 years (P = 0.090), and DBP shows a significant difference between two methods in patients below 60 years too (P = 0.004), but not for cases over 60 years (P = 0.463) (Table 1).

Mean difference of DBP in female was 4.58 (P = 0.035); this difference is existed on the subject of systole too (P = 0.028) (Table 2).

Table 2. Mean difference of systolic blood pressure (SBP) and diastolic blood pressure (DBP) based on two methods and sex

BP	Gender	Mean difference	Standard error mean	P
SBP	Male (n = 78)	3.21	1.02	0.002
	Female (n = 39)	3.97	1.74	0.028
DBP	Male (n = 78)	0.04	0.88	0.965
	Female (n = 39)	4.58	2.09	0.035

DBP: Diastolic blood pressure; SBP: Systolic blood pressure; BP: Blood pressure

www.mui.ac.ir 15 Jan

Table 3. Mean difference of systolic blood pressure (SBP) and diastolic blood pressure (DBP) based on two methods and ward

BP	Ward	Mean difference	Standard error mean	P
SBP	Emergency (n = 8)	−4.24	2.74	0.164
	CCU (n = 60)	0.02	0.98	0.968
	ICU (n = 39)	8.95	1.36	< 0.001
DBP	Emergency (n = 8)	−3.00	1.68	0.117
	CCU (n = 60)	−0.45	1.30	0.731
	ICU (n = 39)	4.75	1.40	0.001

DBP: Diastolic blood pressure; SBP: Systolic blood pressure; BP: Blood pressure; CCU: Coronary care unit; ICU: Intensive care unit

Moreover, both SBP and DBP were more in ICU patients by manual method. Mean difference of SBP was 8.95 (P < 0.001). Mean difference of DBP was 4.75 (P = 0.001) (Table 3).

As shown in table 4, mean difference of SBP was 4.40 in overweight patients (P = 0.002). Moreover, mean difference of SBP in patients with MUAC below 27 cm was 4.08 (P = 0.001) (Table 5).

Both SBP and DBP were more in neurosurgery patients in manual method. Mean difference of SBP was 10.9 (P < 0.001). Mean difference of DBP was 5.86 (P = 0.002) (Table 6).

On the strength of table of ranking base on differences between the two methods of measurement, automated SBP was higher mostly in obese patient, patients admitted in CCU and ones with cardiac complaint; on the other hand, manual SBP was higher mostly in overweight patients, patients admitted in ICU and ones with neurosurgery complaints. In this manner, automated DBP was higher in cases with multiple trauma, while, manual DBP was higher in neurosurgery cases, that almost all of them were ICU admitted.

Discussion

Based on our knowledge, this is the first independent, prospective, observational study on the potential association between BP measurement method and BP levels in Iran. The mean SBP was 124.526 mmHg, with minimum and maximum of 123.111 mmHg and 125.940 mmHg, respectively (Cronbach's alpha = 0.893). SBP was significantly different between the two methods, especially in patients below 60 years, hospitalized in ICU ward, overweight, MUAC below 27 cm, and with neurosurgery problems. Moreover, DBPs were more in manual method in patients with female gender, hospitalized in ICU ward, and with neurosurgery problems. In addition, on the basis of result of ranking table, more disagreement between two method was in critical cases.

Suokhrie et al.[14] revealed a significant difference between manual and automatic SBP readings (P < 0.050) so that automated readings averaged 3.9 points higher. No remarkable differences in diastolic readings (P = 0.720) were found. Care must be taken in using automated or manual BP readings in important clinical scenarios. According to these findings, a protocol was recommended in an acute care psychiatry unit that BP must be measured manually for all patients.

Myers et al.[16] showed that AOBP reduced office-induced hypertension. The decrease in MOBP was seen in participation in a research study, and it was not related to any specific intervention.

Myers et al.[17] demonstrated that using AOBP measurement in routine primary care significantly reduced the white coat response in comparison with MOBP assessment. AOBP measurement was more accurate than MOBP measurement regarding to AABP assessment.

Table 4. Mean difference of systolic blood pressure (SBP) and diastolic blood pressure (DBP) based on two methods and body mass index (BMI)

BP	BMI	Mean difference	Standard error mean	P
SBP	Normal (n = 40)	3.17	1.47	0.038
	Over weight (n = 58)	4.40	1.36	0.002
	Obese (n = 19)	1.26	1.83	0.501
DBP	Normal (n = 40)	0.55	1.63	0.738
	Over weight (n = 58)	1.18	1.07	0.272
	Obese (n = 19)	4.78	3.20	0.152

BP: Blood pressure; BMI: Body mass index; DBP: Diastolic blood pressure; SBP: Systolic blood pressure

www.mui.ac.ir 15 Jan

Table 5. Mean difference of systolic blood pressure (SBP) and diastolic blood pressure (DBP) based on method and mid-upper arm circumference (MUAC)

BP	MUAC (cm)	Mean difference	Standard error mean	P
SBP	Below 27 cm (n = 58)	4.08	1.15	0.001
	Above 27 cm (n = 59)	2.86	1.36	0.040
DBP	Below 27 cm (n = 58)	0.51	1.15	0.626
	Above 27 cm (n = 59)	2.57	1.51	0.095

DBP: Diastolic blood pressure; SBP: Systolic blood pressure; BP: Blood pressure; MUAC: Mid-upper arm circumference

Heinemann et al.[18] showed agreement between automated and manual readings on one set of criteria for SBP and DBP. It was mentioned automated machine underestimated SBP and DBP by comparing of mean values of two methods.

They concluded that the Dinamap 8100 machine can be used with some degree of confidence to measure SBP in a general population, but its DBP measurements should be considered accurate cautiously.[18]

The manual BP measurement, especially with mercury sphygmomanometer has been used for more than 100 years. Regarding to advances in BP recording methods, mercury method seemed to be removed from the clinics, but, mercury sphygmomanometer remains available as a reference standard until an alternative device will be recognized as much.[19,20]

Studies comparing manual with automated BP measurement have shown that manual method has more levels. This difference can be decreased if some rules for automated method are followed: patients rest in a quiet room, and multiple readings considered to make a decision.[2] The presence of a white coat hypertension is likely, if marked decreases in automated method are seen by leaving the patient alone in the room.[21]

Physicians in practice can use several examining rooms for performing physical exam for patients. This measure is suitable for automated and manual method, even when the manual way is used by considering 5 minutes of rest before the BP recording. An important point for automated method is that patients should be seated in a quiet room for some minutes while readings are being taken. If only one or two readings are considered without adequate rest, a white coat effect would interfere with recordings, as seen with the first two readings taken by BpTRU device.[21] Adequate patients' rest, in addition, to use validated automated device with multiple recordings lead to accurate BP measurement.

Manual BP recording is highly dependent to environment condition. BP will be detected higher when taken by physicians instead of nurses, in treatment settings in comparison to non-treatment settings and at office instead of home.[22,23] Manual method may be 15-18 mmHg higher than the AABP if recorded in routine clinics.[8] Automated and AABP measuring methods was disagreed less than 3 mmHg in research and clinical settings.[2] Manual BP recording also decreases if a non-treatment setting such as an ambulatory BP monitoring unit be used instead of physician's office.[23] It is not true for AOBP measuring.[24]

Table 6. Mean difference of systolic blood pressure (SBP) and diastolic blood pressure (DBP) based on method and disease

BP	Disease	Mean difference	Standard error mean	P
SBP	Heart disease (n = 56)	0.32	0.99	0.748
	Internal and orthopedic disease (n = 18)	2.38	2.29	0.312
	General surgery (n = 9)	4.44	2.79	0.150
	Neurosurgery (n = 22)	10.9	2.24	< 0.001
	Multiple trauma (n = 8)	6.62	4.93	0.222
	Other diseases (n = 4)	3.00	1.77	0.190
DBP	Heart disease (n = 56)	−0.46	1.35	0.734
	Internal and orthopedic disease (n = 18)	4.61	2.60	0.095
	General surgery (n = 9)	0.88	2.25	0.703
	Neurosurgery (n = 22)	5.86	7.84	0.002
	Multiple trauma (n = 8)	−1.00	4.84	0.824
	Other diseases (n = 4)	−1.00	2.85	0.750

BP: Blood pressure; DBP: Diastolic blood pressure; SBP: Systolic blood pressure

www.mui.ac.ir 15 Jan

Conclusion

The results of this study suggested that manual method in measurement of BP frequently show higher BP, especially in patients admitted to hospitals - affecting up to 15 mmHg higher - and is strongly associated with age, sex, different disease, and obesity.

Based on this study, we cannot completely trust to automatic findings in measurement of BP in hospital setting and especially in critical conditions, and manual method should be considered as a reference standard.

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Conflict of Interests

Authors have no conflict of interests.

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The prevalence of obesity among school-aged children and youth aged 6-18 years in Iran: A systematic review and meta-analysis study

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Review Article

Abstract

BACKGROUND: Obesity is considered as a major health problem of children and adolescents. The present meta-analysis was conducted by extensive search of studies on the prevalence of obesity among school-aged children and youth aged 6-18 years in Iran.

METHODS: All conducted cross-sectional studies on the prevalence of obesity in Iranian students in all grades were extracted, without applying any restriction on time in national and international databases including Magiran, Iranmedex, SID, Scopus, Google Scholar, and PubMed. Statistical software Stata 12 was used to analyze the data and to obtain the prevalence of obesity among Iranian students. The heterogeneity between the results was determined using statistical test I^2.

RESULTS: In this meta-analysis, 51 papers met our inclusion criteria and were therefore considered for the analysis. The prevalence of obesity was equal to 5.82% [95% confidence interval (CI): 5-6.66] in Iranian students. The prevalence of obesity was higher in boys than in girls (6.85% compared to 5.13%) (P = 0.300). The highest prevalence of obesity was related to students living in the North and Northwest areas with 7.07% (95% CI: 4.35-9.78).

CONCLUSION: The prevalence of obesity among Iranian students is not high when compared to Western countries. However, due to lifestyle changes in recent years, it is necessary to plan intervention programs within families and schools to improve dietary patterns and physical activity of this age group.

Keywords: Prevalence, Obesity, Meta-Analysis, Student, Iran

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Introduction

Obesity is mainly caused by an imbalance between energy intake and expenditure.[1] In recent years, the prevalence of obesity and being overweight has grown and now it has become a serious problem worldwide.[2] The obesity growth in childhood is not only limited to industrialized countries but also the existing reports about developing countries refer to this important matter. Existing reviews show that the countries of the Eastern Mediterranean region, North Africa, and Latin America have the highest prevalence rate.[3] Reports of the World Health Organization (WHO) showed that Iran is one of the seven countries having the highest prevalence of childhood obesity while the percentage of increase in obesity and being overweight doubled in Iranian children and adolescents between 1993 and 2001.[4] Obesity and being overweight in adolescence are the most common major health problems in countries mostly related to sedentary lifestyle and changes in dietary habits; the prevalence of obesity in some parts of Iran is alarming.[5]

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www.mui.ac.ir 15 Jan

General and abdominal obesity is significantly associated with some diseases such as cardiovascular, gastrointestinal diseases and cancers. In addition, obesity is considered an important risk factor in developing hypertension, type 2 diabetes, and hyperlipidemia. It is also noted that obesity is not only associated with medical consequences but also with social status.[6,7] In recent years, changes in lifestyles in different countries have led them to face the challenges and consequences of being overweight and obese in all ages. Meanwhile, childhood and adolescence obesity has become a public health problem whether in developed or developing countries.[8] The WHO studies show that the prevalence of being overweight in children in the Middle East is relatively higher than in other developing countries.[3] It is believed that several factors cause obesity in people, such as the compilation of unhealthy dietary pattern, incorrect lifestyle, lack of physical activity, biological factors such as race, gender, and age, consumption of some medications, alcohol consumption, and some diseases being major causes of the increased prevalence of obesity in the world.[8] Since obesity is considered as the most important modifiable risk factor of many diseases, and due to their increasing prevalence in all age groups especially children and adolescents, this study was conducted to provide comprehensive and reliable rate of obesity among school-aged children and youth aged 6-18 years in Iran to assist policy-makers in developing preventive strategies and guide further research.

Materials and Methods

In this systematic review and meta-analysis study, our inclusion criteria were all cross-sectional studies that have investigated the prevalence of obesity and overweight among school-aged children and youth aged 6-18 years and have used one of the three standard definitions, including Iranian reference,[9] the Centers for Disease Control and Prevention 2000,[10] as well as the International Obesity Task Force 2000.[11] Exclusion criterion was a lack of access to full text of articles.

All conducted studies in the field of the prevalence of obesity in Iranian students were investigated without any restriction on language, place, and year of publication. The study population was students studying in primary school, guidance school, and high school.

National databases, including Magiran, Iranmedex, and SID, and international databases, including PubMed and Scopus, were searched using relevant keywords to obtain studies from January 1, 1998 to April 1, 2015. Keyword combinations of "obesity/fat," "body mass index," "students," "pupils," "prevalence," and "Iran" in the Persian language for the Iranian database and in English for the international database were also used. No limits on date were imposed in the search, and all published cross-sectional studies with English and Persian language that is conducted in Iran included in the study.

The summary of articles has been studied by two independent authors, based on inclusion and exclusion criteria, then the related articles were identified to receive their full text and to do data extraction. The two coauthors have been responsible for selecting articles independently to ensure the correct selection of articles related to the subject of the research and in accordance with the inclusion criteria. After entering accepted articles, the required data were entered in a form of summarization and collected in a spreadsheet of pre-designed electronic data which included the variables: (1) name of the first author, (2) year of publication, (3) location of study conduction, (4) study sample size, (5) educational level (primary school/guidance school/high school), (6) overall prevalence of obesity and overweight, and (7) prevalence of obesity by gender (boy/girl).

At first, each study was weighted with inverse of their variance. The heterogeneity of results across studies was checked using Cochran's Q test (with $P < 0.100$) and it was quantified by the I^2 statistic. The I^2 statistic greater than 50% was considered as a significant heterogeneity across studies. Begg and Egger's linear regression test was used to investigate publication bias. Subgroups analysis was conducted on the basis of gender and geographical region.

To estimate a weighted mean estimate of the prevalence of obesity across included studies, prevalence estimates by each study were pooled using a random effects meta-analysis model at a confidence level of 95%. All meta-analyses were performed using Stata software (version 12, Stata Corp, College Station, TX, USA). We utilized PRISMA statement as a guide to enhance quality reporting of the review.

Results

Description of studies: In this study, a total of 305 references were identified after searching the national and international databases, and 16 references were found through search in reference lists and gray literatures. The title and abstract of 64

www.mui.ac.ir 15 Jan

articles were studied after removing duplicate references between two or more databases (215 references), and by considering inclusion and exclusion criteria of the study (42 references did not in relation to the objective of this study), a total of 54 articles remained. However, the text of three papers was incomplete despite the follow-up through email, and finally, a number of 51 articles remained in the final analysis (Figure 1). Total case study people in these studies during years 1998-2013 included 83,241 people of whom 35,348 were boys and 47,893 were girls. Specifications of investigated studies are shown in table 1.

From a total of 51 investigated studies, 25 studies investigated primary school students, 7 studies the grade of guidance students, 14 studies high school students, 3 studies guidance and high school students, and 2 studies all the grades. Fifteen of these articles studied the prevalence of obesity in girls, four articles the prevalence in boys, and the rest of the articles the prevalence in both sexes. The lowest prevalence of obesity was related to Tuyserkan city with 0.5%, and the highest prevalence was related to Ahwaz with 17.7%. The characteristics of studies are shown in table 1.

Estimated prevalence: The prevalence of obesity was estimated in students of Iran with the random effects model; accordingly, the prevalence of obesity in a sample of 83,241 Iranian students recruited in 51 studies was equal to 5.82% (95% confidence interval: 5.00-6.66). According to figure 2, heterogeneity index was $I^2 = 97.4$ in investigated studies that showed that the results are highly heterogeneous. In only five studies, the reported prevalence was 10% and above. Ten studies reported the prevalence as less than 3%. To reduce the heterogeneity, we divided the studies into subgroups by gender and geographical location to achieve homogeneity. Nonetheless, homogeneity was not achieved.

Subgroup analysis: The prevalence estimates in subgroups of gender and geographical region are also shown in table 2. The prevalence of obesity is higher in boys than girls (6.85% compared to 5.13%). The highest prevalence of obesity among students was related to the geographical regions of the north and northwest with 7.07%,[4,9,12] and the lowest prevalence was related to the East and Northeast regions of the country with 4.25%.[2,6,10,13]

Publication bias: The results of statistical test for publication bias, including Begg and Egger's linear regression test, for the prevalence of obesity among students were statistically significant ($P < 0.001$). These results indicated the presence of publication bias in this study.

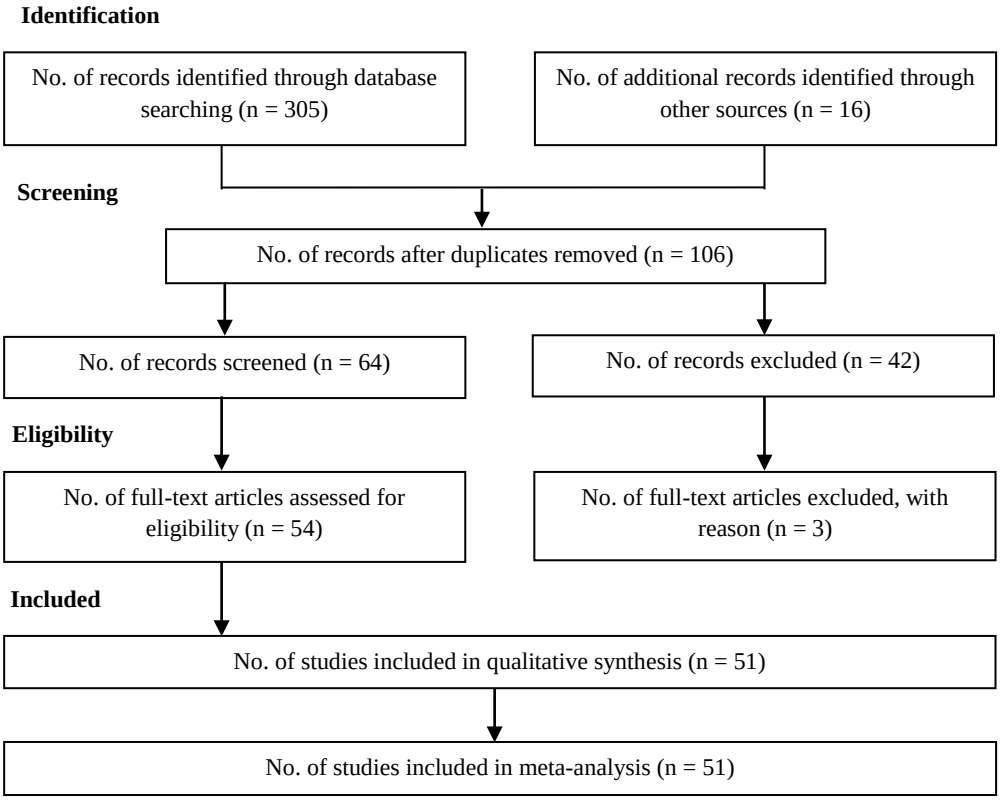

Figure 1. Flow diagram of the meta-analysis

www.mui.ac.ir 15 Jan

Table 1. Characteristics of studied articles about the prevalence of obesity among students in Iran

First author	City	Age (year)	Grade	Sample size (number)	Prevalence of obesity (%)			Scale
					Girl	Boy	Total	
Karandish et al.[12]	Tehran	11-16	G. school and H. school	2321	8.30	7.3	7.80	BMI > P95
Dorosty et al.[13]	Neishabour	6-12	P. school	1471	7.55	9.4	8.50	CDC2000
Basiratnia et al.[14]	Shiraz	11-17	G. school and H. school	2000	7.90	6.2	7.00	CDC2000
Pourgasem Gargari et al.[15]	Tabriz	14-18	H. school	1650	3.90	-	3.90	BMI > P95
Montazery Fard et al.[16]	Sistan	14-18	H. school	752	1.50	-	1.50	IOTF
Hajian et al.[17]	Babol	7-12	P. school	1000	3.80	8.8	5.80	CDC2000
Solki et al.[18]	Shahriar	7-12	P. school	325	3.63	10.3	7.10	BMI > P95
Dorosty Motlagh et al.[19]	Tuyserkan	14-18	H. school	400	0.50	-	0.50	WHO
Basirat et al.[20]	Farokhshahr	6-12	P. school	314	2.60	13.6	8.30	CDC2000
Shakeri et al.[21]	Tehran	12-16	G. school	810	4.40	-	4.40	BMI > P95
Soheilifar et al.[22]	Hamedan	6-11	P. school	1400	5.60	5.8	5.70	BMI > P95
Bazhan et al.[23]	Lahijan	14-17	H. school	400	5.30	-	5.30	WHO
Taheri et al.[24]	Birjand	7-12	P. school	1772	4.30	2.5	3.30	CDC2000
Akbari[25]	Khorramabad	14-18	H. school	986	3.70	-	3.70	BMI > 30
Assar et al.[26]	Ahwaz	7-14	P. school	4793	2.50	2.0	2.20	BMI > P95
Asadi Noghabi[27]	Bandar Abbas	7-11	P. school	1350	6.20	10.9	8.50	CDC2000
Mozafari and Nabaei[28]	Tehran	7-12	P. school	1800	7.70	-	7.70	BMI > P95
Shidfar et al.[29]	Tehran	10-13	P. school	1184	6.08	4.5	5.30	IOTF
Shahidi et al.[30]	Tabriz	14-16	H. school	341	-	4	4.00	NCHS
Mozaffari et al.[31]	Yazd	14-18	H. school	1400	3.90	-	3.90	CDC2000
Taheri et al.[32]	Birjand	11-15	G. school	2105	1.50	2.8	2.10	CDC2000
Taheri et al.[33]	Birjand	15-18	H. school	2230	1.80	2.8	2.30	CDC2000
Sodaei Zenoozagh et al.[34]	Marand	6-16	All grades	10649	3.50	3.6	3.50	WHO
Behzadnia et al.[35]	Sari	7-12	P. school*	653	12.00	12.0	12.00	BMI > P95
Mohamadpour Koldeh et al.[36]	Bushehr	14-17	H. school	500	7.10	-	7.10	CDC2000
Aminzadeh et al.[37]	Ahwaz	6-10	P. school	1594	21.10	14.6	17.70	BMI > P95
Mohammadpour-Ahranjani et al.[38]	Tehran	11-16	G. school** and H. school***	2321	8.30	7.3	7.80	NCHS
Sohailifar and Sadri [39]	Hamedan	6-11	P. school	2000	7.20	4	5.55	NCHS
Veghari and Rahmati[40]	Golestan	6-11	P. school	7399	12.60	15.3	14.10	CDC2000
Amanolahi et al.[41]	Tehran	9-12	P. school	1040	8.65	-	8.65	CDC2000-
Khabazkhoob et al.[42]	Dezful	7-19	All grades	5508	2.30	2.9	2.60	NCHS
Karajibani et al.[43]	Zahedan	6-11	P. school	2067	1.40	-	1.40	BMI > P95
Montazerifar et al.[44]	Zahedan	11-14	G. school	687	1.70	-	1.70	NCHS
Ahmadi et al.[45]	Sanandaj	14-18	H. school	694	1.10	5.3	3.20	WHO
Amidi Mazaheri and Hoseini[46]	Isfahan	14-18	H. school	384	1.04	-	1.04	NHANES-1
Mahmudi et al.[47]	Pakdasht	11-14	G. school	995	9.10	-	9.10	CDC2000
Mohammadian et al.[48]	Gorgan	11-13	G. school	844	6.30	-	6.30	WHO
Mirzaei and Karimi[49]	Yazd	6-8	P. school	2768	2.30	2.6	2.40	BMI > P95
Ghanbari et al.[50]	Shiraz	8-12	P. school	478	-	7.1	7.10	CDC2000
Nabavi et al.[51]	Semnan	7-12	P. school	400	10.40	17.9	14.30	BMI > P95
Amini et al.[52]	Tehran	10-15	G. school	398	6.50	13.0	10.00	CDC2000
Taheri et al.[53]	Birjand	6-11	P. school	1541	7.90	10.9	9.20	CDC2000
Ahmadi et al.[54]	Kerman	7-11	P. school	1566	0.12	1.04	9.70	CDC2000
Zekavat et al.[55]	Tehran	7-13	P. school	1158	4.90	5.1	5.00	CDC2000
Tabatabaei et al.[56]	Ahwaz	6-12	P. school	3482	3.50	3.7	3.60	IOTF 2000
Mozafari et al.[57]	Yazd	6-10	P. school	463	3.40	4.3	3.85	BMI > P95
Talaie-Zanjani et al.[58]	Arak	6-12	P. school	742	3.20	6.3	4.58	CDC2000
Jalilvand et al.[59]	Khorasan	14-17	H. school	450	7.00	2.7	4.90	CDC2000
Rahmaninia et al.[60]	Rasht	12-17	H. school	728	-	6.5	6.50	BMI > P95
Didarloo et al.[61]	Makoo	12-14	G. school	650	-	8.0	8.00	CDC2000
Sokhandani and Vizeshfar[62]	Lar	14-18	H. school	278	3.00	4.2	3.60	CDC2000

* P. school: Primary school; ** G. school: Guidance school; *** H. school: High school; BMI: Body mass index; NCHS: National Center for Health Statistics; CDC: Centers for Disease Control and Prevention; IOTF: International Obesity Task Force; WHO: World Health Organization; NHANES: National health and nutrition examination survey

www.mui.ac.ir 15 Jan

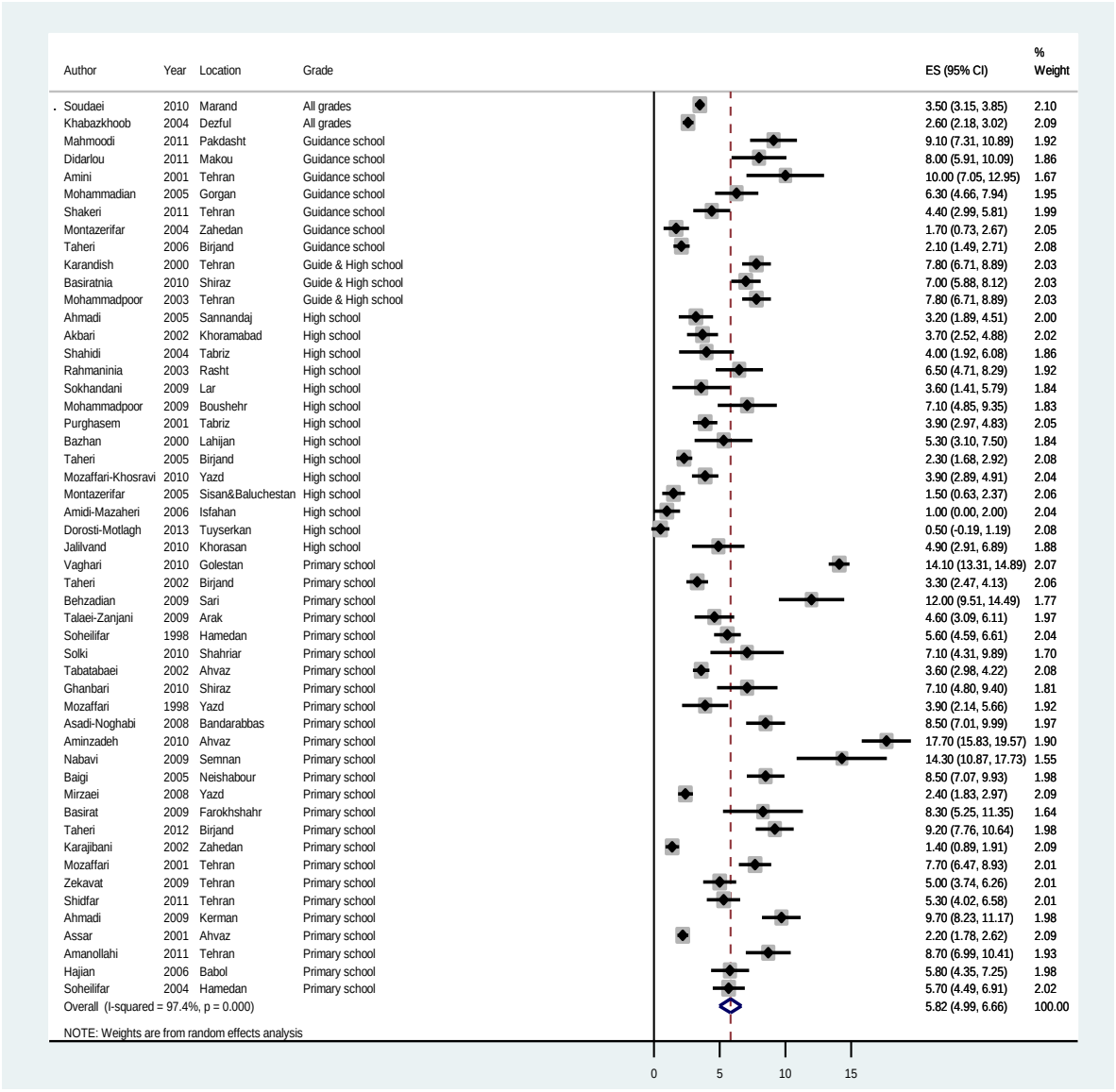

Figure 2. The prevalence rate of obesity among students and its 95% confidence interval

Discussion

In the present study, a total of 51 studies were investigated to conduct a meta-analysis. The prevalence of obesity in the entire studied population and that based on gender was calculated separately. The overall prevalence of obesity was 5.82% in all included studies; it was 5.3% and 6.85% in girls and boys, respectively. The prevalence was lower compared to Egypt in North Africa and was higher than countries of Central and Southern Africa. Although based on a meta-analysis study conducted on children aged 11-17 years in seven African countries in the year 2014, the prevalence of obesity was ranged from 0.6% in Benin to 9.3% in Egypt.[63] In China, the prevalence of being overweight and obesity was reported at 10.4% based on a meta-analysis which was conducted on elementary schoolchildren in the year 2013, and this amount was higher in boys than in girls (12.6% vs. 7.2%).[64] In a meta-analysis conducted in Brazil in 2015, the overall prevalence of obesity in adolescents was 14.1%. It was 16.1% in boys and 14.95% in girls.[65]

The prevalence of obesity was higher in boys than in girls in our study which was similar to other studies[64,65] as generally obesity is more common in boys than in girls in high-income countries. Our results were also similar to those obtained from studies in China and Brazil.[64,65] While the prevalence of being overweight and obesity was higher in girls in the conducted study in African countries, with the exception of Malawi and Egypt.[63]

www.mui.ac.ir 15 Jan

Table 2. Pooled prevalence of obesity among students by gender and area

Subgroups	Number of studies	Prevalence of obesity (95% CI)
Gender		
Boy	35	6.85 (5.73-7.97)
Girl	46	5.13 (4.29-6.00)
Geographical location		
North and Northwest (Lahijan, Tabriz, Rasht, Gorgan, Babol, Makoo, Marand, Golestan)	10	7.07 (4.35-9.78)
West and Southwest (Hamadan, Ahwaz, Khorramabad, Dezful, Sanandaj, Tuyserkan, Farokhshahr)	9	5.08 (3.50-6.65)
East and Northeast (Birjand, Neishabour, Khorasan)	4	4.25 (2.38-6.10)
South and Southeast (Zahedan, Sistan and Baluchestan, Kerman, Shiraz, Bushehr, Lar)	9	5.40 (3.32-7.47)
Center of the country (Yazd, Tehran, Isfahan, Arak, Pakdasht, Shahriar)	14	6.20 (4.72-7.65)

CI: Confidence interval

The cultural differences of mental image of the body can be one of the reasons to justify this difference. So that, in our culture, girls prefer to be thinner as opposed to boys who have a bigger and more powerful bulk physically and have more acceptability, or it may be related to some traditional beliefs in our families which lead them to consider bigger food portions for their sons. On the other hand, it may be that boys spend more time playing computer games and this leads to the reduction of physical activity and to obesity, as well as boys having more access to outdoor foods and the higher calories of these foods than homemade foods, which cause greater obesity in them.

In the present study, the prevalence of obesity in the North and Northwest regions of the country was higher than in the Eastern and Northeastern areas, which is similar to the study by Jin et al.[64] in which the prevalence of obesity was higher in Northern areas of China. These differences can be attributed to the socioeconomic status and different food habits of different areas in addition to genetic differences. Since a higher level of welfare and economic situation is seen in the Northern and Central areas of the country, people have tended to an urban life, and the subsequent decline in physical activity and use of high-calorie foods as an alternative to traditional foods may cause a higher rate of being overweight and obesity. Omigbodun et al. concluded that different distribution of populations in rural and urban areas has been considered as an important factor for generate difference in distribution of obesity among different geographical areas of a country.[66] The types of studies included which are cross-sectional, fluctuations in sample size, high heterogeneity in results, different scales in the studies to calculate obesity, and lack of access to some unpublished studies as well as lack of information about other subgroups affecting obesity, such as place of residence and the economic situation, can be mentioned as limitations of this study. This is similar to many systematic review studies and other meta-analyses, particularly regarding observational studies.

Conclusion

In this study, were investigated numerous articles on obesity among Iranian students related to the past 15 years, which were different with each other in terms of age groups and study location. A systematic review and meta-analysis were done, and the results showed that the prevalence of obesity is 5.82% in students, which was higher in boys than in girls, but not high compared to other countries. However, due to changes in lifestyle, especially in recent years, the need for planning and implementation of intervention programs to improve the lifestyles and dietary patterns of this age range in their families, schools, and community is essential.

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Conflict of Interests

Authors have no conflict of interests.

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www.mui.ac.ir 15 Jan

Meticulous observations essential before and after coil embolization of pulmonary arteriovenous malformation; lessons learned from two case

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Case Report

Abstract

BACKGROUND: Endovascular coil embolization is an approved treatment for pulmonary arteriovenous malformation (AVM) but it brings high rate of thromboembolic complications with subsequent morbidity and mortality. Hereby, we report two cases of AVM coil embolization and management of their compilations.

CASE REPORT: The first case was a 57-year-old male with five implanted coils in the lower lobe of right lung in which two of them were migrated soon after implantation. On exploration, a large atrial septal defect was detected and then repaired successfully. The next day, he was transferred for fluoroscopy. Two embolized coils were found at the site of the left iliac artery which was extracted via snare through sheath implanted in the left femoral artery. Coil migration to the left atrium and subsequently to the left iliac artery is reported for the first time. The second case was a 45-year-old male with central cyanosis and clubbing of upper and lower extremities from childhood. On computed tomography angiography (CTA), a vascular lesion was found. The patient underwent coil embolization for closure of AVM. The patient was still symptomatic after successful closure of AVM. On CTA, two feeding arteries were detected. He underwent second coil embolization procedure.

CONCLUSION: AVM coil embolization is a temptative procedure, which should be performed on its real indications by an expert centers who can handle complications of this procedure. The performance of CTA seems beneficial in some cases to confirm complete embolization of AVM.

Keywords: Arteriovenous Malformation, Computed Tomography Angiography, Atrial Septal Defect, Coil Embolization, Endovascular

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Introduction

Pulmonary arteriovenous malformation is a potentially dangerous vascular abnormality.[1] This lesion needs an early aggressive therapeutic approach.[1,2] Endovascular coil embolization is an approved treatment for arteriovenous malformation (AVM) but it brings high rate of thromboembolic complications with subsequent morbidity and mortality.[3] Hereby, we report two cases of AVM coil embolization and management of their compilations.

Case Report

The first case was a 57-year-old male with five implanted coils in the lower lobe of right lung in which two of them were migrated soon after implantation. Fluoroscopic examination revealed migration of two of them into the left atrium. He underwent surgical extraction of embolized coils but no coil was found. On exploration, a large atrial septal defect (ASD) was detected and then repaired successfully. The next day, he was transferred to catheterization laboratory for fluoroscopy. Two embolized coils were found at the site of left iliac artery which was extracted via snare through sheath implanted in the left femoral artery. Coil migration to the left atrium and subsequently to the left iliac artery is reported for the first time. After 10 days, he was discharged without any complication (Video 1).

The second case was a 45-year-old male with central cyanosis and clubbing of upper and lower extremities from childhood. Recently, he experienced gradual worsening of prolonged and repetitive coryza, cough and sputum. A continuous

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www.mui.ac.ir 15 Jan

murmur was audible on lower lobe of the right lung from both front and back sides. On chest X-ray, consolidation was seen exactly on the side of audible murmur. On computed tomography angiography (CTA), a vascular lesion was found. The patient underwent coil embolization for closure of AVM. After initial coil embolization, O_2 saturation was increased from 78% to 86%. Pulmonary artery pressure was 30 mmHg. The patient was still symptomatic after successful closure of AVM. Due to remained cyanosis, CTA was taken to confirm closure of AVM. On CTA, two feeding arteries were detected. He underwent second coil embolization procedure. After successful closure of remained feeding arteries, O_2 saturation reached to 92% and the patient became asymptomatic completely. He was discharged without any complications and on serial follow-up; he was acyanotic and free of symptom.

Discussion

Despite low prevalence (10-20 percent) of all congenital vascular malformations, AVM is the most common limb-threatening vascular abnormality.[4] Preliminary diagnosis and assessment should be commonly performed using no-invasive or minimally invasive methods as magnetic resonance imaging (MRI)/magnetic resonance angiography (MRA) and CTA, but the gold standard diagnostic method is angiography.[5]

Current therapeutic strategies are associated with high rate of complication and morbidity which needs a multi-disciplinary team approach and integration of surgical and non-surgical cares and appropriate trained physicians with sufficient experience for management of probable complications.[4]

As a conclusion, AVM coil embolization is a temptative procedure, which should be performed on its real indications by an expert centers who can handle complications of this procedure. We suggest through inspection for other sources of embolization like ASD or ventricular septal defect. Indeed, the performance of CTA seems beneficial in some cases to confirm complete embolization of AVM.

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Conflict of Interests

Authors have no conflict of interests.

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www.mui.ac.ir 15 Jan

Unusual presentation of extensive spontaneous coronary dissection: Case report and literature review

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Case Report

Abstract

BACKGROUND: The etiology of spontaneous dissection of coronary artery (SDCA) is not well understood yet. Different studies have linked this entity to pregnancy, physical stress, collagen diseases and vasculitis. In general, patients do not exhibit the classic risk factors for coronary artery disease, which mandates the suspicion of this condition, especially in young adults with acute coronary syndrome.

CASE REPORT: In this article, we report the case of a 63-year old male patient, asymptomatic, who came for periodic evaluation and after evaluation by exercise and myocardial scintigraphy had high suspicion for severe coronary artery disease and underwent coronary angiography, which showed spontaneous dissection of the left and right branches of the coronary arteries.

CONCLUSION: The choice of therapeutic strategies (clinics, percutaneous or surgical) remains uncertain and should be individualized by the features and form of presentation of the SDCA.

Keywords: Dissection, Coronary Angiography, Coronary, Computed Tomography Angiography (CTA)

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Introduction

The spontaneous dissection of coronary artery (SDCA) is defined as a non-traumatic and non-iatrogenic separation of the coronary artery walls, creating a false lumen.[1] This separation may occur between the intima and media, or between media and adventitia, with formation of intramural hematomas (IMH) which compresses the arterial lumen, decreasing the anterograde blood flow and causing myocardial ischemia and/or subsequent heart attack. The SDCA is a rare event, with an estimated incidence of 0.04% to 0.2% of coronary angiographies.[1,2]

Sudden death is the clinical presentation in 50% of cases. It is estimated that 75% of affected patients are female, 40-years old average. It is rare cause of acute coronary syndrome (ACS) and sudden death may be associated with several predisposing factors, such as: fibromuscular dysplasia (FMD), pregnancy, connective tissue diseases (systemic lupus erythematosus, Crohn's disease, polyarteritis nodosa sarcoidosis), Marfan syndrome, Ehlers-Danlos, cystic medial necrosis, hormone replacement therapy, cocaine use, severe hypertension, smoking, strenuous exercise and vasospasm.[2,3] The first case reports and case series about SDCA were formed through post-mortem diagnosis. The current wide availability of coronary angiography allowed the early diagnosis of SDCA.[4]

Case Report

Patient AVT, 63-years old, smoker, with hypertension and dyslipidemia performed ergometric test for cardiovascular risk stratification. There was no previous description of chest pain episodes. The ergometric stress test in Ellestad protocol stopped at 6:04 minutes because of limiting physical fatigue. There was a change of the test due to observation of blood pressure plateau in the effort, being interrogated an inotropic deficit. The same was repeated with performing myocardial scintigraphy with sestamibi injection. There was a description of images with sharp and persistent hypoperfusion predominantly affecting the entire cardiac apex, apical anteroseptal region, and septum associated with ischemic component. As a result, it was decided to carry out evaluation by coronary angiography. The

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www.mui.ac.ir 15 Jan

right coronary artery had good caliber, tortuous dissection image compromising proximal, middle and distal third involving the origin of the posterior and downward ventricular branches (Figure 1). Anterior descending artery (aDA) with atheromatous plaque and image dissected after origin of the first septal branch, involving the origin of the first two diagonal branches (Figure 1).

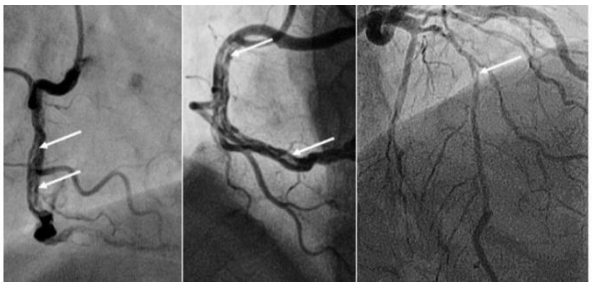

Figure 1. The tortuous dissection image compromising proximal, middle and distal third (I) involving the origin of the posterior and downward ventricular branches. Anterior descending artery with atheromatous plaque and image dissected after origin of the first septal branch, involving the origin of the first two diagonal branches (III)

Patient remained asymptomatic from diagnosis and so we opted for expectant management and prescription of the following medications: losartan, atenolol and aspirin. Patient underwent angiography of coronary arteries about two months after the diagnosis of SDCA that only showed multivessel atherosclerotic disease, with significant reduction of the lumen in aDA and to a lesser extent in the lumen of the right coronary artery (RCA) (Figure 2).

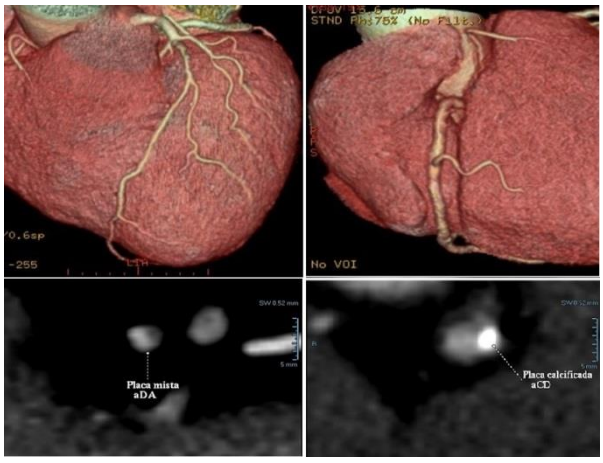

Figure 2. The anterior descending artery (aDA) displays mixed noncalcified plaques with 80% obstruction in the middle third (I/III). The right coronary artery (aCD) has a thick wall plate and calcified source and reduced lumen of about 50% at the distal end (II/IV)

Discussion

The occurrence of SDCA is substantially higher in young patients, and its incidence, etiology and pathophysiology remain unclear.[1,5] However, some authors propose mechanisms to explain the pathogenesis of SDCA.

The first involves a tear in the inner layer of the vessel wall, resulting in blood entry inside the endovascular space to the inner layer, creating a false light full of blood in the vessel.[5-7] The second mechanism of formation may be due to rupture of vasa vasorum, creating an intramural hematoma.[5,8]

Hormonal changes especially those resulting from estrogen levels during pregnancy alter the conformation of normal elastic fibers, alter collagen synthesis and hinder the formation of mucopolysaccharide content, causing the middle layer weakens and increases the risk of creating false lumen and thrombosis.[1,5,8]

Estrogen is believed to be involved by creating a hypercoagulable state. Eosinophilic infiltration in the arterial adventitia has been observed in autopsies of women in the peripartum. It is believed that these eosinophilic granules may cause collapse of the medial adventitial layer and increased lytic substances, predisposing the dissection of the artery.[2,5,8]

The proposed mechanism for our patient finds grounding in previous publications, as in patients with significant risk factors for artery diseases, the SDCA can be precipitated by stressors such as strenuous exercise or emotional stress, which can trigger the event.[9]

Vigorous exercise, especially in isometric form, can increase cardio-circulatory stress and shear forces against the wall of the coronary artery.[7,9] Some authors attribute an intense relationship between the SDCA and FMD. This disease is a non-inflammatory disorder, non-atherosclerotic arterial vasculature leading to arterial stenosis, occlusion, aneurysm formation or dissection. Some case series have a ratio of up to 72% between appearance of SDCA and FMD.[9,10,11] However, our patient had no history of FMD. The clinical presentation of the patients with SDCA is variable. In recent retrospective studies, chest pain was the most common presenting symptom.[2,12,13] Ventricular arrhythmia occurred in 8%-14% of patients.[14] In a recent series of cases, all cases of SDCA had troponin elevation, with 26% presenting with ST-segment elevation, and 3.6% with ventricular arrhythmia.[9,12] Three angiographic patterns are described for SDCA: (i) type 1 (evident

www.mui.ac.ir 15 Jan

defects of the arterial wall): this is pathognomonic angiographic appearance of SDCA, contrast shows arterial wall defects and multiple radiolucent lumens; (II) type 2 (diffuse stenosis with varying severity): this angiographic entity is not well appreciated and is often misdiagnosed. The SDCA commonly involves the middle and distal segments and can be so great that reaches the distal tip; (III) type 3 (atherosclerosis simulation): this is the most difficult appearance of atherosclerosis to differentiate and less likely to be diagnosed. Some features that favor the angiographic diagnosis of SDCA are: (i) absence of atherosclerotic changes in other coronary arteries, (ii) long lesions (11-20 mm); (iii) blurred stenosis; and (iv) the linear stenosis. The SDCA type I is easily diagnosed with coronary angiography, though type II with shorter lengths, and type III indistinguishable from atheromatous plaques require intravascular ultrasound for correct diagnosis, in order to provide better accuracy for evaluation of these lesions. The natural history of SDCA seems to imply spontaneous healing in most cases. The performance of a new angiography in selected patients in previous studies showed a variable cure, but a full resolution at 40 month follow-up.[15] In another series of cases, 100% of 79 patients treated conservatively had spontaneous healing in angiography performed in ≥ 4 weeks after their SDCA event.[5,8,14]

Coronary computed tomographic angiography (CTA) with multiple detectors were used for patient follow-up with SDCA and found the presence of IMH within 3 days after the event and images approaching the full resolution, with only slight thickening of the wall, at 10 days post-event. Despite improvements, the CTA still does not substitute coronary angiography in the diagnosis of SDCA, but serves as a good follow-up examination and evaluation of healing.[15,16] The standard medical therapy does not yet have a specific guideline and treatment is usually the same as ACS. For pharmacological treatment, the use of aspirin in all patients presenting with ACS and SDCA, as well as its maintenance in subsequent processing is recommended. However the majority of the authors differ in the real benefit of clopidogrel in untreated patients with stent. Some argue that a dual antithrombotic therapy would reduce the IMH and therefore could be beneficial to the patient, however there are cases in series to compare different groups in this specific situation.[17,18]

The role of the new P2Y12 antagonists (prasugrel and ticagrelor) to SDCA is not clear. The role of the GPIIb/IIIa inhibitors in acute management SDCA was also not evaluated, but because of its greater potency, increased bleeding risk and potential risk of prolongation of the dissection, they are not routinely used for SDCA.[18] The role of anticoagulation to SDCA is controversial as the risk of dissection extension overlaps the potential benefit of resolving thrombus and improved permeability of the true lumen. Heparins are routinely used in patient with ACS presentation, though some authors recommend their suspension from the diagnosis of coronary dissection regarding the risk of IMH extension.[19,20] Beta-blockers reduce blood pressure shearing forces and are presumably beneficial in reducing stress in the coronary artery wall, similar to the effect seen in the aortic dissection. Therefore, its use is always recommended, unless contraindications are present.[21]

The use of nitroglycerin can be useful in relieving the symptoms of ischemia superimposed in the vasospasm SDCA presentation, but are not used in the long term. Inhibitors of angiotensin converting enzyme are administered routinely in the same indications of ACS.[8,19] The use of statins for non-atherosclerotic SDCA has not been studied, and the recommendation of the principal authors is to administer statins to these patients only with pre-existing dyslipidemia.[19]

In recently published work, the choice of therapeutic strategies (clinics, percutaneous or surgical) confirmed the uncertain nature of the ideal approach to the SDCA. The predominance of conservative strategy (56%) was based probably on clinical stability, single-vessel feature and inaccurate location of the dissection flap. In most cases, the initial site of intimal rupture is difficult to locate. In case of persistence of symptoms and identification of the entrance hole dissection, percutaneous treatment may be indicated. Urgent surgical treatment seems to be the most suitable for dissections with coronary occlusion, involving multi-vessel or left main coronary artery, and in the presence of cardiogenic shock.[22,23]

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Conflict of Interests

Authors have no conflict of interests.

www.mui.ac.ir 15 Jan

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