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Effect of Aerobic and Anaerobic Exercises on Anthropometric Parameters, Chemerin and Adiponectin Levels in Non-Athletic Men

Mansour Karajibani,[1,*] Farzaneh Montazerifar,[2] Karim Dehghani,[3] Mehdi Mogharnasi,[4] Seyed Reza Mousavi Gillani,[5] and Alireza Dashipour[6]

[1]Health Promotion Research Center, Department of Nutrition and Food Science, School of Medicine, Zahedan University of Medical Sciences, Zahedan, Iran
[2]Pregnancy Health Research Center, Department of Nutrition and Food Science, School of Medicine, Zahedan University of Medical Sciences, Zahedan, Iran
[3]Ph.D Student in Exercise Physiology, Department of Sport Sciences, University of Birjand, Birjand, Iran
[4]Department of Sport Sciences, University of Birjand, Birjand, Iran
[5]Department of Physical Education, School of Medicine, Zahedan University of Medical Sciences, Zahedan, Iran
[6]Department of Nutritionand Food Science, School of Medicine, Zahedan University of Medical Sciences, Zahedan, Iran

[*]*Corresponding author*: Mansour Karajibani, Associate Professor, Nutrition and Food Science Department, Medical School, Zahedan University of Medical Sciences, Zahedan, Iran. Tel: +98-5433295717, Fax: +98-5433295728, E-mail: mkarajibani@yahoo.com

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Abstract

Background and Objectives: Several studies have been shown the beneficial effect of exercise on markers of health. This study was designed to evaluate the effect of two aerobic and anaerobic exercise protocols on triglyceride, cholesterol, anthropometric indices, chemerin, and adiponectin levels in non-athletic men.

Methods: A total of 39 non-athletic men were recruited to the present study. According to protocol, participants in three categories including; aerobic, anaerobic, and control groups, which had endurance, speedy exercise, and without activity, respectively. The duration of interventional program was two months. Body weight, height, and waist circumference (WC) were determined. Body fat percent, waist-to-hip ratio (WHpR) and body mass index (BMI) were calculated. Dietary intake was recorded by 48-hours recall method. Briefly, Total cholesterol and triglyceride levels were determined by an automated analyzer. Serum levels chemerin and adiponectin were measured by enzyme-linked immune-sorbent assay (ELISA) by commercial kits. Data was analyzed using the SPSS statistical software version 16. $P < 0.05$ was considered as the level of significant.

Results: No significant difference among groups was observed according to BMI, WC, and WHR. Significant difference was observed based on percent of body fat in the aerobic group. There was no significant difference in the cholesterol and triglyceride levels and daily calorie intake between groups. There was a significant difference in adiponectin level in three steps between two groups ($P < 0.001$). There was a significant difference on chemerin level between baseline training and detraining steps in aerobic groups as compared to control ($P = 0.01$). There was an increase in chemerin level between baseline, training, and detraining steps in anerobic groups ($P = 0.01$). A significant increase in adiponectin level was observed after training. Whilst, after detraining, it was decreased significantly ($P < 0.001$).

Conclusions: Aerobic exercise caused chemerin levels to decrease significantly after training and detraining. Whereas it increased in anaerobic groups. Besides, adiponectin level significantly increased in aerobic and anaerobic groups. It seems that the difference in the type of activity between the two groups led to the changes in the above indicators that require more extensive studies.

Keywords: Exercise, Training, Anthropometric indices, Chemerin, Adiponectin

1. Background

Physical activity (PA) has different effects on human health. Lack of it in combination with other risk factors can lead to problems in health (1). PA and exercise are considered main interventions for applying in primary and secondary prevention of chronic diseases (2). PA and proper nutrition are essential for physiological activities (3). It has been shown that aerobic interval training (AIT) could decrease total cholesterol, low-density lipoprotein (LDL). However, low energy diet (LED) and AIT could decrease lipid profile (4). According to WHO recommendations, the physical activity level for maintaining a good health condition should include aerobic exercises with moderate strengths per week (5). Several studies have been shown the beneficial effect of exercise on markers of health such as reduction of BMI, adipose tissue, increasing of lean body mass, decreasing resting heart rate, and modification of lipid profile (6, 7).

Adipocytokines are hormones that secreted by adipose tissue and regulate metabolism activities such as lipid and glucose (8). They are in the brain, liver, and muscle (9, 10).

Chemerin is an adipocytokine, which is secreted as a precursor protein named prochemerin and expressed from tissues including the spleen and lymph nodes. It is a novel protein identified and plays an important role in the pathogenesis of the metabolic syndrome (9, 11). A critical function of chemerin is to regulate adipogenesis and metabolic homeostasis in adipocytes in mice and humans (9). Several studies have been revealed that the levels of chemerin elevate in obesity and diabetics patients (12, 13). Chemerin positively correlates with BMI, WC, blood pressure, lipid profile including; triglyceride (TG), low-density lipoprotein -cholesterol (LDL-C), and insulin resistance. On the other hand, there was negative correlation between adiponectin and high-density lipoprotein cholesterol (HDL-C) levels (14).

Adipose tissue releases energy and different kinds of cytokines such as adiponectin (10, 15). It has been reported that adiponectin has anti-oxidative and anti-inflammatory effects (16). Adiponectin causes to sensitize tissues to insulin in the body. A significant inverse association between adiponectin and its receptors with insulin resistance has been observed (17). Adiponectin plasma levels are associated with the amount of visceral fat, which shows the relationship between obesity and cardio vascular diseases (CVD) (18, 19). Adiponectin levels are not clear after exercise is decreased or unchanged (20, 21). Physical activity such as severe aerobic exercise can cause a significant increase in adiponectin level in men with abdominal obesity (22). However, aerobic exercise, at a moderate activity, has a slight effect on adiponectin levels in healthy subjects (23). Jamurtas AZ et al., in a study of the effect of aerobic exercise on adiponectin level as well as insulin sensitivity in healthy overweight males have reported that a submaximal aerobic activity was not lead to significant changes in adiponectin levels up to 48 h post-exercise. The relationship between adiponectin level with insulin sensitivity was not observed (20).

The aim of this study was to determine whether two types of activity including, speedy and endurance activity, influence on the serum chemerin and adiponectin levels in the non- athletic men or not. With attention to the data scarcity and controversy, this study designed to evaluate the effect of two aerobic and anaerobic exercise protocols on triglyceride, cholesterol, anthropometric indices, as well as chemerin and adiponectin levels in non-athletic men.

2. Methods

2.1. Subjects

A total of 39 non-athletic men, middle aged (19.9 $\pm$ 2.1 years) were recruited to the present study. All participants were selected from physical education students of the University of Sistan and Baluchistan, Zahedan city, which is located in southeast Iran. Subjects were divided in three groups randomly including, aerobic (n = 13), anaerobic (n = 13), and control (n = 13) groups. Eligible participants were also randomized to exercise training in three groups including aerobic, anaerobic, and control groups. Briefly, aerobic and anaerobic groups had endurance and a speedy exercise, respectively.

The inclusion criteria included;18 - 25 years, all participants were using the university's self-service, lack of professional training, lack of physical ills, all students living in dorms, a stable weight for at least 3 months in subjects, and confirmation public health certificates provided by a doctor in the clinic of the university. The exclusion criteria included subjects who were smokers, failure to adhere to exercise regularly, do not use the university's self-service, had CVD or any other underlying medical condition, or consumed any type of drug that would affect laboratory test results.

The ethics committee of Zahedan University of Medical Sciences (ZAUMS) approved this project (Code number; 6992; 31. Jan. 2015). Therefore, all protocol aims were clearly elucidated to the subjects.

2.2. Protocol of Physical Activity

Participants in the protocol were divided into three categories including, aerobic, anaerobic, and control groups, which had endurance, speedy exercise, and without activity, respectively. Aerobic training was supervised by an exercise physiologist in 60 min/d, 3 d/wk, for 10 weeks. At every training session, in the first step, the subjects in the aerobic group completed warm up activities during 6 minutes, and performed stretching and flexibility exercise during 4 minutes, which was a total of 10 minutes that followed by a 15 - 50 minutes walking-running at 55% - 85% of HRmax. Relaxation exercise was performed 10 minutes at the end of exercise period. Heart rate has gradually increased, which was recorded for each participant. Cold up step performed at the end of the process contains 3 to 4 minutes including, jogging, walking, and then 5 minutes of stretching after every workout session. This phase will usually be considered in less than 10 minutes.

In the aerobic training, it is performed according to protocol, running 30 m, 60 m, and 100 m, respectively. During the first week, three replications of 30 meters, three replications of 60 meters, and a 100-meter repetitions were

performed. In the last session, running 30 meters, 60 m, and 100 m to reach twice. Also 1, 2, and 3-minute rests between sprints 30 meters, 60 meters, and 100 were considered. Exercise strength gradually improved from 20 min at 60% of HRmax through the first week to 21 and 22 minutes at 65% of HRmax by week 2 and 3, 23 and 24 minutes at 70% of HRmax by week 4 and 5, 25 and 26 minutes at 75% of HRmax by week 6 and 7, 27 and 28 minutes at 80% of HRmax by week 8, 9, and also 29 minutes, at 85% of HRmax by the end of the 10th week. Heart rate during the study was checked by the manometer. Briefly, aerobic activities involved walking and running. The control groups included participants like another two groups (aerobic and anaerobic), however, without any physical activity. They are free according to the criteria of this study in duration of the study. The general characteristics were clear. Biochemical, nutritional, and adipkine levels were recorded three times, the same as another two groups (aerobic and anaerobic). The control group has been participated in this study for two months.

All of training and activities were performed and checked by an exercise physiologist. Anthropometric and body composition measurements, body weight, and height were measured using standard methods by athletic trainer. Body weight and height were measured by Seca scale to the nearest 100 g and 0.5 cm, respectively.The waist circumference was determined between the lower border of the rib and the iliac crest by a non-stretchable tape. Body mass index (BMI) was evaluated based on the calculation body weight (kg)/ height (m^2) (24). Percentage of body fat was determined by skinfold thickness measurements, Skinfold Fat Caliper SAEHAN, SH5020; South Korea. The body fat was calculate based on following formula:

Body density (BD) = 109.38 - 0.000267 (S) + (0.0000016 (S2) - 0.0002574 (Age))

% Body fat = (4.95/ BD - 4.5) × 100

S = Total fat under the skin in three points, including chest, abdomen, and thigh (Sum of skinfolds).

This formula has been approved by Jackson and Pollock for men (25). Three points of body was used for determination of body fat in the participants including; pectoral, superailiac crest, and midthigh area of the body. According to the standard, obesity percentage body fat of 24% or greater was considered (25). All skinfold thickness measurement was performed by an athletic trainer, which was supervised by a sports physiologist.

2.3. Nutritional Assessment

Dietary intakes were evaluated using 24-hours recall questionnaire. All of consumed foods were recorded in the questionnaire for two days. The mean values of calorie and macro-nutrients intake were measured on one weekday and the weekend. Dietary intake data on the kind and amount of daily food intake was recorded by the recall 48-hours questionnaire. The calorie and macro-nutrients intake were analyzed with a computer software program developed for analyzing Iranian foods (24, 26).

The participants educated by a nutritionist and followed up regularly. According to the recall questionnaire, all of participants mentioned type and amount of different foods, which were consumed in two days of the week.

2.4. Blood Sampling

In three groups, taken blood (10 mL) was performed three times including; pre- training, post-training, and after 4 weeks detraining. At first, blood was taken from subjects in the morning (8.00 to 10.00 AM) after 10 - 12 hour overnight fast in three groups. In the second step, 10 mL blood was taken from subjects after training in two groups (48 hours after their last exercise session). After this step, subjects in two groups of aerobic and anaerobic were without exercise (detraining) for four weeks. Finally, in the third step blood was also taken fasting, like previous steps, from all subjects in three groups.

2.5. Determination of Triglyceride and Cholesterol Levels

After collection, blood samples were centrifuged at 1500 × g for 10 minutes. Serum triglyceride and cholesterol levels were measured by an Automated Analyzer Technicon RA-1000 (Technical Publication NO, UBA-7638-00/USA) using commercial kits (27). The remained samples were stored at -70°C until analyzed.

2.6. Determination of Adipokines; Chemerin and Adiponectin

Serum levels of adipokines, chemerin, and adiponectin were measured by enzyme- linked immune-sorbent assay (ELISA) by commercial kits: Human chemerin (CHEMERIN) ELISA kit (Cat No: CK- E11406; Hangzhou Eastbiopharm CO.,LTO) and adiponectin levels were determined by a (.! LSA) kit (BioVendor; Cat No: RD 191001100, USA).

2.7. Statistical Analysis

The SPSS 16 software was used for statistical analysis. Data were expressed as mean ± SD. Variables with normal distribution were determined by the one-way ANOVA among groups and repeated measurement ANOVA within groups. When distributions of variables were not normal, Kruskal- Wallis and Friedman tests were used. $P < 0.05$ was considered significant.

3. Results

The general characteristics of subjects in three groups before and after 10 weeks of training have been shown in Table 1. At baseline, the mean of anthropometric indices was normal in three groups and there was no significant difference between groups according to BMI, WC, and WHR.

As shown in Table 2, there was no significant difference according to percent of body fat between groups in the three steps. According to percent of body fat, significant difference was only observed in three steps within the aerobic group (14 $\pm$ 1.6 and 13 $\pm$ 2.2 vs. 11.2 $\pm$ 2.6) ($P < 0.01$). Table 3 showed that the levels of cholesterol and triglyceride were not significantly different between the groups. Serum chemerin level in aerobic groups before (baseline), after 10 weeks of aerobic training, and also after one month detraining was decreased. A significant difference was only observed on chemerin level between baseline training and detraining steps in aerobic groups ($P = 0.01$). However, there was an increase in chemerin level between baseline training and detraining steps in anaerobic groups ($P = 0.01$). On the other hand, there was no significant difference on chemerin level during three steps in control (Table 4).

According to the adiponectin level, there was a significant difference in three steps of the study within two group including aerobic and anaerobic groups separately ($P < 0.001$). Significant increase in adiponectin level was only observed after training steps in this study ($P < 0.001$). However, after detraining, it was decreased significantly (Table 5).

Dietary analysis has shown no significant variation in the daily calorie intake between groups. The mean daily calorie intake 2383.7 $\pm$ 265.7, 2424.3 $\pm$ 210.3, and 2412.7 $\pm$ 285.2 kcal/d in aerobic, anaerobic, and control groups was found, respectively, which were, similar to the recommended dietary allowances (RDA). Besides, the results showed that the percent of macronutrients intake, such as carbohydrates (59.3 $\pm$ 1.5%), proteins (17.6 $\pm$ 2.7%), and fats (23.1 $\pm$ 4.1%), for providing daily total energy intake, were in acceptable macronutrient distribution Ranges (AMDR) in three groups (24) (It has not been shown).

4. Discussion

The results revealed that there was no significant difference in BMI and WHpR in the participants at baseline. Body weight, BMI, WC, and WHpR were normal at baseline. After one month of training and detraining no dramatic changes were shown. Body mass index could represent body weight, no body composition. In athletes, lean body mass is more than adipose tissue. Therefore, it is probable that they are incorrectly assessed as obese based on BMI. For determination of body composition in athletes measuring of skinfold is better than body weight (28). The BMI can not differentiate between the different components of the body and represents the fat distribution in the body (29, 30). Nevertheless, the results showed that the WHpR was in normal range. There was no significant difference based on anthropometric indices between groups.

Totally, the nutritional assessment of subjects reflects that calorie and macronutrients intake in them were proper. In another study, the percentages of daily energy intake has been estimated, include; carbohydrate (60%), protein (15%), and fat (25%), which is similar to the results of our study (31). A significant difference in body fat percent was observed at baseline, after training, and detraining in aerobic groups ($P = 0.01$). It has been reported that body fat percentage can be used as a quick method for accurate evaluation of body composition and fat in the athletic population (32). Proper changes in the somatic indices was observed, including, waist circumference, WHpR, and sum of skinfolds regardless of type of training and physical exercise. Therefore, WHpR and sum of skinfolds were significantly reduced in aerobic interval cycle exercise training than in the control group. It has been reported that endurance and resistance training decrease weight, body fat mass (BFM), BMI, and WHpR in overweight and obese female students. Whilst, the means of weight, BFM, and BMI increased significantly after the study in the control (33). Except for the aerobic group ($P = 0.01$), no significant difference was observed in the percent of body fat in aerobic and control groups based on three steps. The exercise program can arrange the physical activity to a person and facilitate to maintain physical condition and strength (34).

After training, a reduction in levels of cholesterol and triglyceride was observed in both aerobic and anaerobic groups. While, after detraining, the levels were slightly increased in two groups. Although, the levels of cholesterol and triglyceride after training have been decreased in both groups, it has been established that lower lipid levels decrease cardiovascular risk more than any other intervention (35). Aerobic activity can stimulate fat oxidation for energy production. It has been reported that moderate aerobics can improve body composition and serum lipid profile in obese individuals (36). The results showed that 10 weeks of aerobic and anaerobic training improved chemerin levels in subjects. The beneficial effect of training on chemerin was significant in parallel to changes in body fat, trygelecride, and cholesterol levels. It was observed to increase in chemerin level after training and detraining in aerobic group significantly. Whilst, chemerin level had significantly decrease in the anerobic group com-

Table 1. The General Characteristics of Participants Before and After 10 Weeks of Training[a]

Groups	Characteristics				
	Age, y	Weight, kg	BMI, kg/m^2	WC, cm	WHpR
Aerobic	20.0 ± 0.9, (19 - 22)	63.7 ± 9.6, (53.5 - 82)	21.8 ± 3.4, (17.7 - 28.7)	76.7 ± 12.6, (61 - 69)	0.82± 0.1, (0.6 - 0.9)
Anerobic	20 .2 ± 1.4, (19 - 24)	71.7 ± 13.3, (55 - 102)	23.3 ± 4.1, (19 - 34.7)	78.7 ± 15.8, (64 - 123)	0.80 ± 0.06, (0.71 - 0.93)
Control	19.9 ± 0.95, (18 - 22)	70.9 ± 12.9, (58 - 101)	22.4 ± 3.4, (19.1 - 32.6)	73.1 ± 8.2, (63 - 91)	0.80 ± 0.06, (0.71 - 0.92)

[a]Values are expressed as mean ± SD, (range).

Table 2. Comparison of Percent of Body Fat in the Studied Groups[a]

Steps	Groups			P Value
	Aerobic	Anerobic	Control	
Base line, %	14 ± 1.6#	11.9 ± 2.9	11.2± 2.6#	0.01#
Training, %	13 ± 2.2#	11.6 ± 4.6	10.9 ± 6.2	0.22
Detraining, %	13.3 ± 2.1#	12.1 ± 4.3	10.9 ± 2.5	0.17
P value	0.01	0.75	0.38	

[a]Values are expressed as mean ± SD.

Table 3. Mean Serum Levels of Cholesterol and Triglyceride Levels in the Studied Groups[a]

Groups	Aerobic			Anaerobic			Control		
Steps	**Baseline**	**After Training**	**After Detraining**	**Baseline**	**After Training**	**After Detraining**	**Baseline**	**After Training**	**After Detraining**
Cholesterol, mg/dL	137 ± 21[b]	133 ± 26[b]	138 ± 22[b]	145 ± 46[c]	140 ± 50[c]	152 ± 43[c]	117 ± 29[d]	124 ± 28[d]	109 ± 25[d]
Triglyceride, mg/dL	82 ± 22[e]	71 ± 23[e]	89 ± 23[e]	106 ± 48[f]	82 ± 45[f]	86 ± 38[f]	67 ± 17[g]	71 ± 23[g]	68 ± 18[g]

[a]Values are expressed as mean ± SD.
[b]After and before training vs. baseline within the aerobic group, P = 0.49.
[c]After and before training vs. baseline within the anaerobic group, P = 0.17.
[d]After and before training vs. baseline within the control group, P < 0.001.
[e]After and before training vs. baseline within the aerobic group, P = 0.18.
[f]After and before training vs. baseline within the anaerobic group, P = 0.29.
[g]After and before training vs. baseline within the control group, P = 0.14.

Table 4. Mean Serum Levels of Chemerin in the Studied Groups[a]

Steps	Groups			P Value
	Aerobic	Anerobic	Control	
Base line, ng/mL	1018.1 ± 1007.6, (265 - 3152)	397.1 ± 154.7, (243.9 - 660.4)	255.9 ± 165.6, (89.4 - 661.3)	0.004
After training, ng/mL	990.5 ± 1101.9, (221.8 - 3294)	402.8 ± 177.6, (241.8 - 708.4)	253.5 ± 165.8, (100.4 - 665.3)	0.006
After detraining, ng/mL	534.1 ± 473.6, (248.3 - 1836)	526.4 ± 438.3, (174.2 - 1676)	253.8 ± 159.6, (95.4 - 641.3)	0.013
P value	0.01	0.05	0.58	

[a]Values are expressed as mean ± SD, (range).

Table 5. Mean Serum Levels of Adiponectin in the Studied Groups[a]

Steps	Groups			P Value
	Aerobic	Anerobic	Control	
Base line, ng/mL	2.1 ± 0.31, (1.7 - 2.7)	1.9 ± 0.41, (1.2 - 2.4)	2.1 ± 0.34, (1.3 - 2.4)	0.34
After training, ng/mL	4.5 ± 0.88, (3.8 - 6.2)	6.6 ± 1.9, (3.9 - 9.1)	2.0 ± 0.55, 90.5 - 2.4)	< 0.001
After detraining, ng/mL	2.0 ± 0.35, (1.4 - 2.7)	1.8 ± 0.4, (1.2 - 2.3)	1.9 ± 0.6, (0.3 - 2.4)	0.54
P value	< 0.001	< 0.001	0.94	

[a]Values are expressed as mean ± SD, (range).

pared to control. This finding is consistent with the results of Saremi et al., (37). They found a significant decrease in the level of chemerin and a significant decrease in the body fat percent after a 12-week circuit resistance training.

Regular aerobic exercise improves cardiac activity and decreases chemerin levels (37).

We observed a significant decrease in chemerin levels after 10 weeks of aerobic training. There was more decrease in chemerin level after training and detraining in aerobic group. Chemerin plays in several roles including; regulator of adipogenesis, inflammation and glucose metabolism, metabolic syndrome, BMI, blood triglycerides, and blood pressure in healthy subjects (38-40). Physical activity changes visceral fat, circulating chemerin levels and also increases insulin sensitivity (41). Further studies is necessary to clear the role of chemerin adipokine in the metabolism of glucose, adipose tissue and also related to signal transduction pathways.

The current findings have been shown that aerobic and anaerobic exercise protocols can increase plasma adiponectin levels after training in subjects. These results were confirmed by the Saunders et al., (22) study who reported short and intensive aerobic activity was significantly increased adiponectin levels in obese and inactive men. Whereas, the adiponectin level was not changed in another study (40). It is reported immediately following the cessation of exercise unchanged adiponectin levels or make even decreased in trained subjects (42, 43). In addition, the study demonstrated a severe or moderate exercise slightly effect on adiponectin levels in healthy subjects (23). A negative correlation between adiponectin levels with obesity, insulin resistance (16, 18, 19), type 2 diabetes (16, 20), and metabolic syndrome (44, 45) has been reported in previous studies.

Adiponectin modulates food intake and energy expenditure, increases fatty acid oxidation in the body, insulin secretion, and glucose metabolism (39). In the present study, findings have shown that exercise improves the anthropometric, biochemical, and adipokines indicators. It has been reported that 5% - 10% decrease in visceral and subcutaneous adipose tissues following physical exercise increases the level of adiponectin (46). Reducing the levels of adiponectin causes increase oxidative stress and the oxidation of LDL in patients with type 2 diabetes mellitus and coronary artery disease (47).

The results represent that there was a significant difference based on percent of body fat after training within the aerobic group. No significant difference was observed in the triglyceride and cholesterol levels in three groups between three steps. Besides, aerobic exercise caused to significantly decrease chemerin levels after training and detraining. On the other hand, exercise significantly increased the level of adiponectin in aerobic and anaerobic groups after training. It seems that the difference in the type of activity between the two groups lead to the changes in the above indicators.

The limitations of the study included environmental temperature, psychological stress, endocrine hormones, and genetic characteristics. For analyzing food intake, it has been tried to reduce the possible errors by education of subjects in all groups. Nevertheless, further studies are needed to understand factors affecting adipokine levels during exercise.

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Footnotes

Authors' Contribution: Mansour Karajibani and Karim Dehghani contributed equally and performed the concept and design of research; Mehdi Mogharnasi and Seyed Reza Mousavi Gillani performed experiments and prepared tools and facilities for field study; Alireza Dashipour performed statically analysis; Mansour Karajibani and Farzaneh Montazerifar drafted and revised the manuscript.

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