Effects of auricular acupressure on obesity in adolescents

Hyun Su Cha[a,b], Hyojung Park[b,*]

[a] Department of Nursing, Sehan University, Yeongam, South Korea
[b] College of Nursing, Ewha Womans University, Seoul, South Korea

ABSTRACT

Background: and purpose: Adolescent obesity has been increasing globally, and intervention is important. This study examined the effects of auricular acupressure on reducing obesity in adolescents.
Materials and methods: Participants were 58 obese adolescents, divided into an experimental ($n = 32$) and a control group ($n = 26$). The study design was a randomized controlled trial. Auricular acupressure using vaccaria seeds was administered to the experimental group, while placebo auricular acupressure using vaccaria seeds was administered to the control group. Sessions continued for 8 weeks. Outcome measures included body weight, abdominal circumference, hip circumference, waist–hip ratio, body-mass index, body-fat mass, body-fat percentage, triglycerides, total cholesterol, low-density lipoprotein cholesterol, high-density lipoprotein cholesterol, serum glucose, and leptin.
Results: Adolescents in the experimental group showed significant improvement in total cholesterol levels and low-density lipoprotein cholesterol levels after 8 weeks compared with those in the control group ($p < 0.001$).
Conclusion: Auricular acupressure using vaccaria seeds was effective in decreasing total cholesterol levels and low-density lipoprotein cholesterol levels in adolescents with obesity.

1. Introduction

Like adult obesity, adolescent obesity has been increasing globally. In Korea, adolescent obesity is dramatically increasing due to lifestyle changes such as insufficient exercise and overnutrition. The adolescent obesity ratio in 2013 was 21.5%, whereas in 2017 it was 23.7%, showing a 2.2% point increase [1]. Unlike adult obesity, which results from increased fat-cell size, adolescent obesity results from not only an increase in fat-cell size but also in the number of fat cells [2]. In addition, adolescent obesity has a high possibility of leading to adult obesity in its most severe form [3]. Moreover, chances increase for adult complications such as cardiovascular disease, diabetes mellitus, and hyperlipidemia. Adolescent obesity may trigger serious socio-psychological issues, including lower self-esteem and eating disorders, due to lower satisfaction with one's personal appearance [4,5]. Therefore, adolescent obesity is a serious problem that must not be underestimated. It is quite important to prevent, detect, and treat adolescent obesity.

To prevent and treat adolescent obesity, health care providers use dietary therapy, therapeutic exercise, and behavior modifications. However, these approaches are difficult for adolescents to undertake as they prepare for university entrance examinations. In contrast, auricular acupuncture has been considered a form of complementary and alternative medicine that can be easily applied to prevent and treat obesity. Auricular acupuncture is a method of applying acupuncture to the auricle; when the acupoints corresponding to each part of the body are stimulated with needles, the effects manifest throughout the body. The effect of auricular acupuncture on obesity is a suppressed appetite [6,7], and it burns fat that accumulates in the body [8]. The anorectic mechanism increases the combination ratio of leptin receptors in the hypothalamus and reduces leptin resistance that is present among obese patients to decrease leptin in the blood [6]. Thus, auricular acupressure decreases the appetite peptide hormone while increasing the anorectic peptide hormone that suppresses appetite [7].

Leptin is a substance that suppresses appetite and, in obese patients, is higher than that in normal-weight people. However, the problem is the endogeny of leptin that fails to properly perform its role [9]. But as auricular acupuncture reduces blood leptin among obese patients, it decreases the endogeny of leptin accordingly. The mechanism to improve lipid metabolism starts by increasing β-endorphin levels of plasma through the central nervous system and decreasing blood lipids [8]. Because the working mechanism of auricular acupuncture and auricular acupressure is the same, their effects are also the same [10]. Nonetheless, auricular acupuncture can be performed only by a doctor

* Corresponding author. College of Nursing, Ewha Womans University, 52 Ewhayeodae-gil, Seodaemoon-gu, Seoul 03760, South Korea.
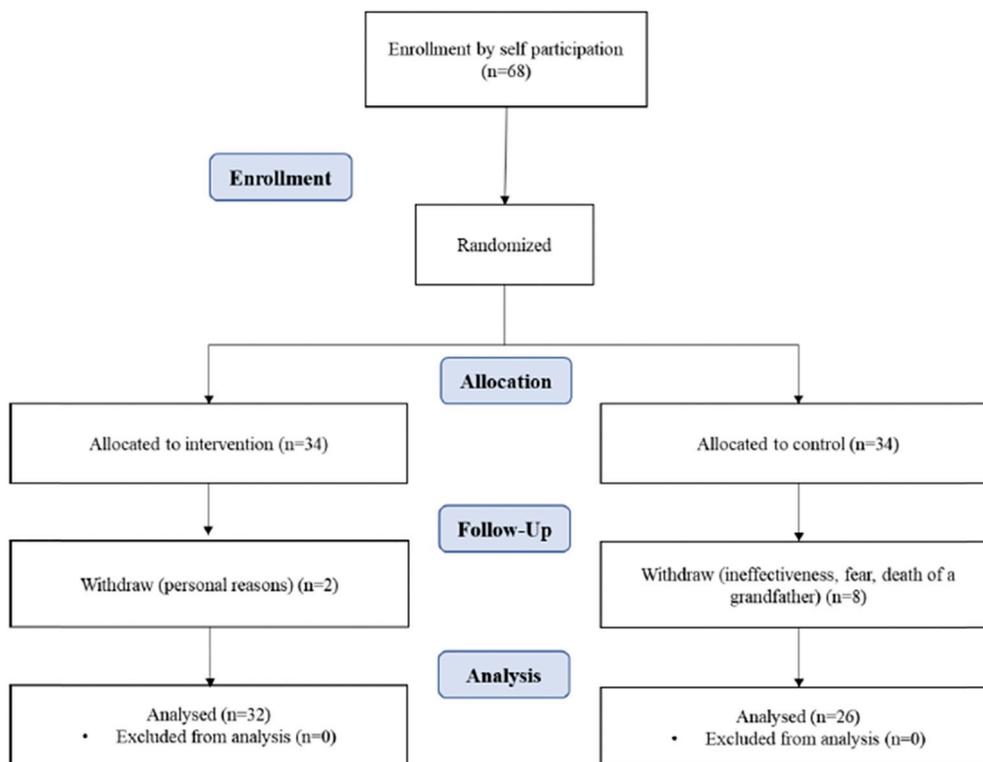E-mail address: hyojungp@ewha.ac.kr (H. Park).

Fig. 1. CONSORT flow diagram of the study.

of Oriental medicine, so it has limited practice among nurses.

Nurses can encourage the use of auricular acupressure, as it uses the working mechanism of auricular acupuncture. Auricular acupressure assumes that an ear is a microcosm of the body, and based on the idea that illnesses of internal organs correspond to auricular points on the ear, it was recognized as a disease treatment by the World Health Organization (WHO) in 1990. This therapeutic approach originated from auricular acupuncture. Auricular acupuncture treats diseases by acupuncturing acupoints; in contrast, auricular acupressure applies a small seed or magnetic bead to applicable acupoints. These acupoints are stimulated with pressure to treat a disease. This treatment process may generate fewer side effects than acupuncture and less discomfort. Because auricular acupressure does not require a needle, as auricular acupuncture does, it is easy to use with adolescents who are afraid of pain caused by acupuncture needles.

Domestic studies conducted with obese female college students [11] and obese children [12] have reported the effects of auricular acupressure on obesity improvement. In the Kim et al. [11] study, the effects of auricular acupressure were measured through changes in body-mass index (BMI), weight, body-fat ratio, waist-to-hip ratio (WHR), and self-efficacy. In contrast, the Youn et al. [12] study used a single-group study design without a control group and measured the effects of auricular acupressure only through changes in the Broca index. It was difficult to find a domestic study that measured the effects of auricular acupressure by measuring changes in blood parameters. In overseas research, a study targeted obese high school students [13–15]. In it, researchers measured changes in blood-lipid concentration (total cholesterol, triglycerides, high-density lipoprotein-cholesterol [HDL-C], low-density lipoprotein-cholesterol [LDL-C]), and BMI for 8 weeks after auricular acupressure. Study results showed that only the BMI of the group that received auricular acupressure had a statistically significant decrease, while blood-lipid concentration (total cholesterol, triglycerides, HDL-C, and LDL-C) did not decrease [13]. In two other studies that introduced the same intervention to the same targets, one measured changes in waist circumference, WHR, and weight and found statistically significant decreases with auricular acupressure [15]. The other

study measured changes in waist circumference, WHR, and weight; researchers noted no differences between the experimental and control groups in waist circumference and weight [14]. Another overseas study measured the effects of auricular acupressure through changes in blood parameters; however, it measured only blood-lipid concentration without measuring leptin hormone levels that work on the anorectic function of auricular acupressure. The purpose of this study was to examine the effects of auricular acupressure on adolescent obesity through anthropometric measurement and measurement of blood-lipid concentration and leptin hormone.

2. Materials and methods

2.1. Study design

A randomized controlled trial method was used to examine the effects of auricular acupressure on obesity among adolescents.

2.1.1. Participants

Participants were selected from a table of random numbers using computers of four high schools in Seoul, with a 1:1 ratio for the experimental and control groups. Inclusion criteria were as follows: subjects who (1) had a BMI of more than $25 \, \text{kg/m}^2$ according to the WHO standard for the Asia Pacific region, (2) did not have any wound or inflammation in the ears, (3) had not undergone surgery or other treatments in the last 6 months, (4) did not have a skin disease such as atopic dermatitis or allergy, (5) did not have a medical record of mental disease or endocrine-system disease (thyroid disorder, pituitary gland problem), and (6) did not use any other medical treatment such as medication or surgery during the research period for auricular acupressure for 8 weeks. In cases of severely obese adolescents whose BMI exceeded $30 \, \text{kg/m}^2$, however, intervention during the research period became an ethical issue. Therefore, severely obese subjects were excluded from the study.

The sample size was calculated using Cohen's (1988) [16] power analysis. According to the results derived from a previous study that

assessed the effects of auricular acupressure among obese high school students [11], to detect a small effect size (F = 0.15) at the 5% level of significance with 80% power, 26 people were chosen for the experimental group and 26 people for the control group. Considering a 25% drop-out rate, we collected data from 34 people in each of the experimental and control groups. In the experimental group, two respondents dropped out for personal reasons, and four in the control group failed to participate in the experiment, reasoning "It seemed ineffective" and "I am afraid that the tape may have detached." Also, one person in the control group was unable to participate in the experiment due to the death of a grandfather. Finally, the participants totaled 58 people: 32 people in the experimental group and 26 people in the control group (see Fig. 1).

2.2. Intervention

For this study, auricular acupressure was provided to the experimental and control groups for 8 weeks. This time period was based on a report that weight loss occurred after 8 weeks of auricular acupressure among high school students [13]. Application of auricular acupressure was set on a fixed day between Monday and Friday. On the scheduled days, the subjects were treated with auricular acupressure in the health room of the school during lunchtime. Based on data obtained from previous studies on auricular acupressure [10,13], each ear was treated for a week. The treatment used was a seed applied and then replaced, each time checking its position. Participants were instructed to slightly press the seed-applied areas before meals and whenever they felt hungry. Likewise, auricular acupressure was conducted a total of eight times, once for each participant at one-week intervals.

For auricular acupressure, the seed-applied areas were compressed. To prevent the Hawthorne effect, both the experimental and control groups received auricular acupressure. In the case of auricular points where the seeds were applied, the five points that, according to the WHO (1990) Standard Auricular Points [17], have been effective in obesity treatment were selected for the treatment of the experimental group; in contrast, five points that, according to the WHO (1990) Standard Auricular Points, have not been effective in obesity treatment were selected for the treatment of the control group. After cleaning alien substances from the ear with alcohol-applied cotton, the seeds were applied to the hunger point, endocrine point, spleen point, Shen Men point, and stomach point in one ear of each participant in the experimental group. In contrast, for the control group, seeds were applied to the knee zone, hip-joint zone, lumber zone, thoracic-vertebrae zone, and tooth zone. The seed-applied areas were compressed 10 times at intervals of 2 s using the thumb and index finger until participants felt pain. The areas were compressed for a total of 5 min. To control against exercise and meals as disruption variables in the study, participants were asked not to start new exercises and to eat three meals a day. The participants of the study were positioned not to notice the evaluator because their awareness of the evaluator could affect the results of the experiment.

2.3. Measures

2.3.1. Anthropometric index

We measured height using a height scale (HM202, Panix, Korea) and weight, BMI, body-fat mass, and body-fat ratio with Inbody (Inbody 270, Biospacr Co., Ltd., Korea). A measuring tape was used to measure waist and hip circumference.

2.3.2. Blood parameter

Participants fasted before blood collection for at least 8 h, and a medical technologist collected blood before (0 week) and after completing the experiment (8 weeks later) using a disposable syringe. Blood samples were sent to the laboratory of G Company for hemanalysis.

For hemanalysis, the blood sample was centrifuged for 10 min. Total

cholesterol, triglycerides, HDL-C, LDL-C, and blood glucose were examined using a blood analyzer. Also, enzymatic colorimetric assay was assessed using a blood analyzer (Modular Analytics PE, Roche, Germany). Leptin was measured by implementing γ-Counter (Packard, U.S.A.) through radioimmunoassay.

2.3.3. Procedure of data collection

The Institutional Review Board (IRB No. 94-13) granted approval before data were collected and before the intervention. Also, four high school principals in Seoul granted approval and posted announcements seeking study participation. The number of high school students who expressed interest in the study (after seeing the bulletin board) was 86. Among these, 21 students did not meet the inclusion criteria since their BMI was less than 25 kg/㎡ or they had dermatitis or allergies. The final number of high school students who applied to join the study and who met the requirements was 65.

Accordingly, study participants were identified. Researchers visited participants' schools and explained the purpose of the study to all participants. After obtaining consent from participants and legal representatives, researchers administered questionnaires, anthropometric examinations, and blood tests in the school health room to measure variables. Researchers collected participants' demographic characteristics through the structured questionnaire. Researchers then measured participants' weight, BMI, body-fat mass, body-fat ratio, waist circumference, and hip circumference and took blood samples. For waist circumference, researchers measured at the middle of the lowest lower rib and the iliac crest of the pelvis in the easy-breathing, upright posture, according to the WHO (1990) standard. For hip circumference, researchers measured the most projected area on the hip and calculated the ratio of waist measurement over hip circumference. To reduce measurement errors, the same researchers used the same instruments for the same measurement methods.

For randomly selected obese adolescents in the experimental group, we visited the school health room once a week. Allotting five minutes per person, we attached and replaced seeds while confirming the seed positions. We instructed participants to slightly press the seed-applied areas before having meals and whenever they felt hungry. Likewise, we conducted auricular acupressure a total of 8 times for each subject at 1-week intervals. Areas of auricular acupressure were the Shen Men point, hunger point, stomach point, endocrine point, and spleen point, as these have been identified as being effective in obesity treatment according to the WHO (1990) Standard Auricular Points. The randomly selected 32 obese adolescents in the control group took a pretest with the same instruments and underwent sham auricular acupressure applied to acupoints that were unrelated to obesity treatment (see Fig. 2). The treatment was conducted at the same times as the experimental group for 8 weeks.

Through phone calls and text messages, we checked and encouraged participants to ensure that the seeds were well positioned and that the
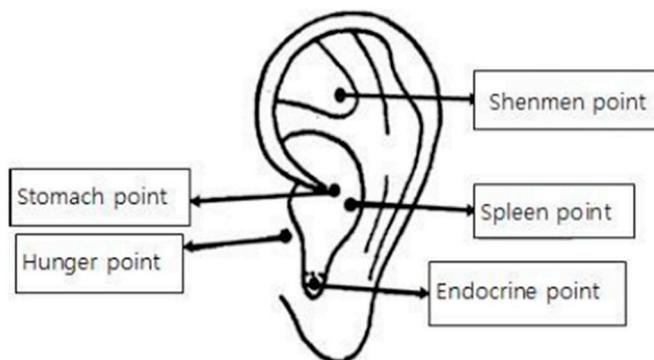

Fig. 2. Auricular points.

seed-applied areas were compressed as instructed. To analyze the effects of the auricular acupressure, we examined anthropometric and blood tests again 8 weeks later in the school health room for further comparison and analysis.

2.3.5. Data analysis

The collected data from the 32 people in the experimental group and the 26 people in the control group was analyzed using SPSS WIN 21.0. Because one of the groups had fewer than 30 people, we conducted Shapiro–Wilk normality tests. According to the results, some variables failed to satisfy the normality assumption; therefore, parametric and nonparametric statistics for analysis were used. Homogeneity was analyzed between the groups through independent *t*-tests and Chi-square tests. The difference between the two groups was analyzed using independent *t*-tests and Mann–Whitney. Also, the change between the groups was analyzed through paired *t*-tests and Wilcoxon.

3. Results

No statistically significant differences emerged between the experimental and control groups in demographic characteristics (see Table 1) and blood parameters. Therefore, the groups were homogeneous (see Table 2). Anthropometric index (weight, BMI, waist circumference, WHR, body-fat mass, and body-fat ratio) was assumed to have been decreased through auricular acupressure for 8 weeks. However, no statistically significant difference emerged in weight, BMI, waist circumference, WHR, or body-fat mass in the experimental and control groups before or after auricular acupressure. Moreover, body-fat ratio increased in both groups. However, differences emerged between the experimental and control groups before and after auricular acupressure (see Table 3, Fig. 3).

Total cholesterol was significantly decreased between the experimental and control groups after 8 weeks auricular acupressure ($z = -1.99$, $p = 0.047$). LDL-C decreased in the experimental group, whereas it increased in the control group, resulting in statistically significant differences between the groups after the experiment ($z = -1.97$, $p = 0.049$). Leptin decreased in the experimental group from 27.25 ± 12.89 ng/Mℓ to 23.63 ± 10.19 ng/Mℓ after auricular acupressure ($z = -2.15$, $p = 0.032$). No change emerged in the control group before or after auricular acupressure, and no difference emerged between the experimental and control groups after the experiment. Regarding triglycerides, HDL-C, and blood glucose, no statistically significant differences emerged in the experimental and control groups before or after conducting auricular acupressure (see Table 4).

4. Discussion

The purpose of this study was to examine the effects of auricular acupressure among adolescents with obesity. A few previous researchers applied auricular acupressure as an obesity treatment, and we compared results obtained from this study with those from previous studies that applied auricular acupressure. The mechanisms of auricular acupuncture and auricular acupressure are the same [10]; thus, the effects are similar. Following auricular acupressure, weight did not statistically significantly decrease in the experimental group compared to the control group. This result did not correspond to the results of previous studies [15,18,19] that reported weight reduction using auricular acupuncture and auricular acupressure. In previous studies [18,19], average BMI before the intervention was $32.2 \sim 36.00$ kg/㎡. This was greater than the average BMIs of the experimental and control groups, which were 27.62 ± 4.58 kg/㎡ and 26.48 ± 3.65 kg/㎡, respectively. Because the effects of auricular acupressure were greater when the degree of obesity was severe [20], weight loss in participants with more average weight was more striking in the previous studies [18,19]. Therefore, it was considered that the subjects of this study who weighed more showed a noticeable weight loss effect.

Waist circumference did not statistically significantly decrease in the experimental group compared to the control group. This result did not correspond to the results of a previous study [14] that reported waist circumference reduction using auricular acupuncture and auricular acupressure. In the study [14], auricular acupressure was applied during the 8 weeks using magnetic pearls, and the result showed a decrease in waist circumference. Since the use of magnetic pearls is considered to be more effective in decreasing the waist circumference than using vaccaria seeds when performing auricular acupressure, it is recommended to use magnetic pearls in future studies. In another study [24], there was no effect in terms of reducing waist circumference after 6 weeks of auricular acupressure. In still yet another study [21], auricular acupressure was applied for 6 weeks simultaneously with diet therapy, there was a noticeable decrease in waist circumference. Furthermore there is a possibility that no decrease in waist circumference was indicated in the current study, because the application period of 8 weeks of auricular acupressure was so short. Therefore, further intensive research is recommended to apply auricular acupressure for longer than 8 weeks.

After conducting auricular acupressure, blood parameters did not decrease significantly in the experimental group compared to the control group, except for total cholesterol and LDL-C. This result did not correspond to the results of the study conducted by Abdi et al., who reported decreased triglycerides through auricular and acupuncture therapies [21]. Because body acupuncture was supplemented with

Table 1
Homogeneity test of general characteristics between the two groups (N = 58).

Characteristics	Classification	Exp. (n = 32)		Con. (*n* = 26)		χ^2/t	p
		n (%)	*M* ± *SD*	*n* (%)	*M* ± *SD*		
Age		16.09	± 6.0	15.96	± 5.96	0.71	0.479
Gender	Male	17	53.1	15	57.7	0.12	0.728
	Female	15	46.9	11	42.3		
Health status	Good	6	18.8	7	26.9	2.17	0.338
	Average	23	71.9	14	53.8		
	Bad	3	9.4	5	19.2		
Regular three meals	Yes	18	56.3	14	53.8	0.034	0.855
	No	14	43.8	12	46.2		
Regular exercise	Yes	10	31.3	7	26.9	0.13	0.719
	No	22	68.8	19	73.1		
Economic status	High	0	0.0	5	19.2	2.12	0.307
	Middle	27	84.4	16	61.5		
	Low	5	15.6	5	19.2		

Note. Exp. = Experimental group; Con. = control group; *M* ± *SD* = Mean ± Standard Deviation.

Table 2
Homogeneity test for outcome variables between the two groups (N = 58).

Character	Normal range	Exp. (*n* = 32)	Con. (*n* = 26)	*Z*	*p*
		M ± SD	*M ± SD*		
Weight (kg)		83.25 ± 11.37	84.13 ± 13.19	−0.13	0.894
BMI (kg/m²)	18.5 ~ 22.9	29.51 ± 2.33	29.71 ± 2.84	−0.40	0.690
Waist cir. (cm)	< 85	93.40 ± 7.94	96.12 ± 7.79	−1.21	0.228
WHR		1.09 ± 1.29	0.88 ± 0.05	−1.42	0.155
Body fat mass (kg)		30.72 ± 6.34	32.05 ± 5.48	−0.74	0.458
Body fat ratio (%)	20~25	37.17 ± 6.75	38.28 ± 4.48	−0.38	0.707
T. col. (mg/dℓ)	< 240	190.72 ± 39.79	181.23 ± 27.59	−0.49	0.622
Trig. (mg/dℓ)	< 150	125.03 ± 62.78	148.46 ± 64.40	−1.66	0.097
HDL-C (mg/dℓ)	≥60	44.94 ± 9.06	44.38 ± 10.52	−0.07	0.944
LDL-C (mg/dℓ)	< 130	118.69 ± 36.56	105.46 ± 24.02	−1.35	0.179
Glucose (mg/dℓ)	70~100	101.44 ± 11.84	96.27 ± 9.51	−1.61	0.107
Leptin (ng/Mℓ)	4.1–25.0	26.73 ± 13.15	29.47 ± 9.85	−1.06	0.288

Note. Exp. = Experimental group; Con. = control group; *M ± SD = Mean ± Standard Deviation*; BMI = body-mass index; Waist cir. = waist circumference; WHR = waist–hip ratio; T. col = total cholesterol; Trig. = triglycerides; HDL-C = high-density lipoprotein cholesterol; LDL-C = low-density lipoprotein cholesterol.

auricular acupressure, results obtained in previous studies showed greater blood parameters. Results from the Cabioglu and Ergene study [18] showed reduced LDL-C through auricular and acupuncture therapy, corresponding to results obtained in this study. Auricular acupressure may decrease the LDL-C in plasma. Auricular acupressure increases β-endorphin levels in plasma through the central nervous system and eventually decreases blood-lipid concentrations [8].

Before and after applying auricular acupressure, leptin values decreased significantly in the experimental group. However, no difference emerged between the experimental and control groups before or after the experiment. For people of normal weight, auricular acupressure triggers anorectic mechanisms and increases the combined ratio of leptin receptors in the hypothalamus [6]. Accordingly, leptin, the anorectic peptide hormone, increases [7]. Obese people, however, have leptin resistance [7], so although they have high levels of leptin compared to people of normal weight, their leptin receptors fail to work effectively, resulting in ineffective work by leptin [22]. According to the study conducted by Gucel et al. [23], leptin in members of the experimental group decreased to 3.32 ng/ml (25%) after 5 weeks of acupuncture therapy, with no change in the control group. In the Hsu et al. [24] study, leptin in the experimental group decreased to 6.1 ± 7.3 ng/ml after 6 weeks of auricular acupressure, whereas that of the control group showed no change. The result of the Hsu et al. [24] study was different from the results obtained in this study. Adolescents who received auricular acupressure in this study showed decreased blood leptin. However, adolescents who participated in the control group might have reduced their food intake or exercised in recognition

of their participation in the study. Such unexpected variables may have caused lowered blood leptin in participants. In order to prevent exercise and diet from affecting the study as confounding variables, the subjects were instructed to have only three meals a day and not to engage in new exercise routines. Since the subjects were high school students, it was difficult to accurately control the increase in amount/level of exercise or the amount of food intake. Therefore, in the control group, an increased amount of exercise and reduced food intake might be considered as confounding variables.

Adipocytokine, leptin, ghrelin, and adiponectin are proteins secreted in fatty tissues that become active in other organs [25]. People who have shown no significant increase in adiponectin among adipocytokine are children, adolescents, women before and after menopause, and those who were in a period of growth or dramatic change in sex hormones [26]. Adiponectin is affected by sex hormones [27], and Kim et al. [28] pointed out the limitations in studies that failed to control factors like sex hormones and growth hormones in children and adolescents during their growth period. Therefore, the insignificance of leptin decrease in this study may result from the effect of sex hormones and growth hormones, as participants were adolescents.

No statistically significant differences emerged between the experimental and control groups in waist circumference after auricular acupressure. This result does not correspond to the results of a previous study [15] that reported decreased waist circumference through auricular acupressure. It was observed that the effect of auricular acupuncture was greater as the degree of obesity became more severe [20]. As mentioned earlier, in a previous study [15], waist size was reduced

Table 3
Comparison and difference of anthropometric index between the experimental and control groups (N = 58).

Character	Group	Pretest	Posttest	Within group	Mean difference	Between groups	*Z*	*p*
		M ± SD	*M ± SD*	*Z*	*p*	*M ± SD*		
Weight (kg)	Exp. (n = 32)	81.93 ± 10.32	83.45 ± 11.49	−0.46	0.645	−0.21 ± 1.65	−1.04	0.298
	Con. (n = 26)	84.13 ± 13.19	84.70 ± 13.66	−1.61	0.107	−0.57 ± 2.07		
BMI (kg/m²)	Exp. (n = 32)	28.68 ± 2.43	29.47 ± 2.40	−1.46	0.144	0.04 ± 0.56	−1.24	0.216
	Con. (n = 26)	29.71 ± 2.84	29.85 ± 2.89	−1.39	0.165	−0.13 ± 0.68		
Waist cir. (cm)	Exp. (n = 32)	91.94 ± 7.37	93.88 ± 7.62	−1.37	0.170	−0.48 ± 2.00	−0.09	0.931
	Con. (n = 26)	96.12 ± 7.79	96.56 ± 6.99	−0.85	0.397	−0.44 ± 3.00		
WHR	Exp. (n = 32)	1.09 ± 1.29	0.87 ± 0.05	−1.27	0.204	0.22 ± 1.29	−1.08	0.281
	Con. (n = 26)	0.88 ± 0.05	0.88 ± 0.04	−0.34	0.732	< −.001 ± 0.03		
Body fat mass (kg)	Exp. (n = 32)	30.72 ± 6.34	30.56 ± 6.23	−0.58	0.562	0.16 ± 1.30	1.73	0.089
	Con. (n = 26)	32.05 ± 5.48	32.55 ± 5.69	−1.87	0.061	−0.50 ± 1.57		
Body fat ratio (%)	Exp. (n = 32)	35.84 ± 7.60	36.81 ± 6.58	−0.95	0.340	0.36 ± 1.11	−2.21	0.027
	Con. (n = 26)	38.28 ± 4.48	38.60 ± 4.46	−1.22	0.222	−0.33 ± 1.31		

Note. Exp. = Experimental group; Con. = control group; M ± SD = Mean ± Standard Deviation; BMI = body-mass index; Waist cir. = waist circumference; WHR = waist–hip ratio.
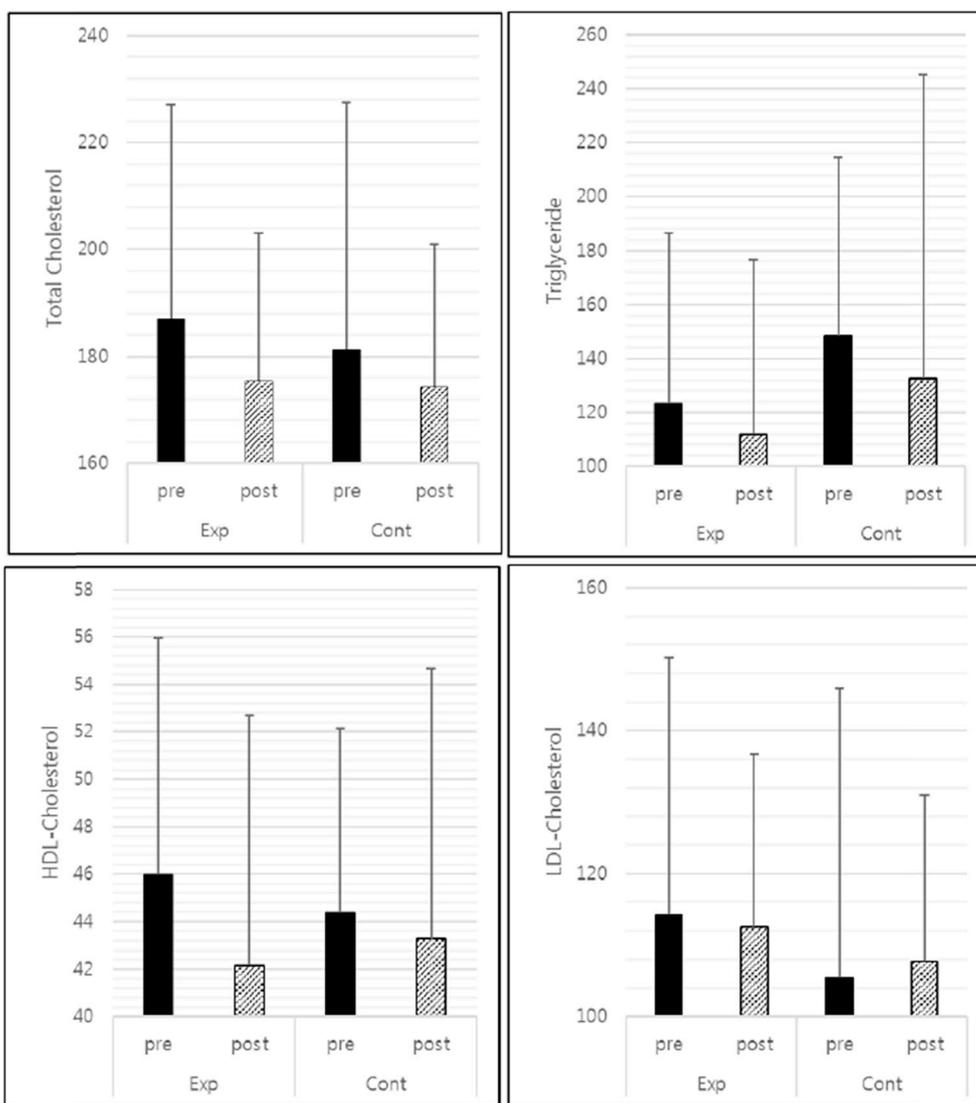
Fig. 3. Comparison and difference of lipids between the experimental and control groups.

among those with greater average BMI; however, in this study, the subjects had relatively low average BMI, so it was considered that the effect of waist size reduction was not manifested. Thus, it is recommended to apply auricular acupressure treatment for longer than 8

weeks to achieve waist size reduction. For the present study, the period set for applying auricular acupressure was 8 weeks for its effect to be felt. Nonetheless, longer than 8 weeks may be required to decrease waist measurements through auricular acupressure. Although two

Table 4
Comparison and difference of blood index between the experimental and control groups (N = 58).

Character	Group	Pretest	Posttest	Within group	Mean difference	Between groups		
		$M \pm SD$	$M \pm SD$	Z	p	$M \pm SD$	Z	p
T. col. (mg/dℓ)	Exp. ($n = 32$)	186.94 ± 40.17	175.47 ± 46.18	−1.83	0.067	15.25 ± 23.28	−1.99	0.047
	Con. ($n = 26$)	181.23 ± 27.59	174.31 ± 26.64	−1.46	0.144	6.92 ± 25.34		
Trig.(mg/dℓ)	Exp. ($n = 32$)	123.34 ± 63.29	112.00 ± 66.15	−1.55	0.121	13.03 ± 45.68	−0.90	0.369
	Con. ($n = 26$)	148.46 ± 64.40	132.62 ± 112.50	−1.97	0.049	15.85 ± 95.73		
HDL-C (mg/dℓ)	Exp. ($n = 32$)	45.97 ± 10.00	42.16 ± 7.75	−1.69	0.091	2.78 ± 6.40	−0.60	0.552
	Con. ($n = 26$)	44.38 ± 10.52	43.27 ± 11.41	−1.12	0.264	1.12 ± 6.66		
LDL-C (mg/dℓ)	Exp. ($n = 32$)	114.28 ± 35.92	112.63 ± 40.39	−0.36	0.721	6.06 ± 21.61	−1.97	0.049
	Con. ($n = 26$)	105.46 ± 24.02	107.77 ± 23.24	−0.70	0.484	−2.31 ± 22.18		
Glucose (mg/dℓ)	Exp. ($n = 32$)	101.44 ± 11.83	92.97 ± 15.09	−3.56	< .001	8.47 ± 10.72	−1.08	0.280
	Con. ($n = 26$)	96.27 ± 9.51	91.00 ± 16.63	−2.76	0.006	5.27 ± 11.46		
Leptin	Exp. ($n = 32$)	27.25 ± 12.89	23.63 ± 10.19	−2.15	0.032	3.10 ± 7.40	−0.34	0.737
	Con. ($n = 26$)	29.47 ± 9.85	27.12 ± 8.54	−1.36	0.174	2.35 ± 8.75		

Note. Exp. = Experimental group; Con. = control group; $M \pm SD$ = Mean ± Standard Deviation; T. col. = total cholesterol; Trig. = triglycerides; HDL-C = high-density lipoprotein cholesterol; LDL-C = low-density lipoprotein cholesterol.

participants complained of minor itching on the skin when the tape was attached during auricular acupressure, no participants complained of major side effects due to the therapy. Stimulation of the Shen Men point has a sedative effect [29], while stimulation of the hunger point reduces the tone of the gastrointestinal tract [30]. The stimulation of the stomach point regulates gastric functions [31]. In traditional Chinese medicine, the primary aspect of obesity is considered to be a spleen-kidney yang deficiency [32]. Stimulation of the spleen point, located in both ears, is effective in treating indigestion, gastrointestinal disturbance, myasthenia, and gastroduodenal ulceration. Meanwhile, stimulation of the endocrine point is effective in the treatment of endocrine diseases caused by abnormal functions of the hormonal system [33]. The present study used the Shen Men point, hunger point, stomach point, endocrine point, and spleen point for the obesity treatment.

In summary, the 8-week auricular acupressure decreased total cholesterol and LDL-C of adolescents with obesity. Therefore, auricular acupressure was considered to be effective in adolescents with obesity. Auricular acupressure caused neither physical burden nor attendant side effects to obese adolescents while reducing their total cholesterol and LDL-C. This study is significant for nursing science as it proved that positive effects emerged from auricular acupressure through objective assessments such as anthropometric measurements, blood-lipid concentrations, and blood hormone-level tests. This study failed to achieve a double-blind approach because the researcher knew the auricular points. Also, the study is limited as it is a single-blind study with a small sample, and the period of the effect continuation after completing the auricular therapy was not measured.

5. Conclusion

In this study, we applied auricular acupressure to adolescents with obesity to examine its effects on them. Results showed auricular acupressure to be effective in reducing total cholesterol and LDL-C. Based on study results, we suggest the following: First, there was a possibility that the effects of auricular acupressure would not manifest due to the low obesity levels of participants. Therefore, researchers should conduct further studies with extremely obese people. Second, the number of participants was insufficient in this study, so it is not possible to apply the results to all obese adolescents. Therefore, researchers should conduct a study with a larger number of participants.

Conflicts of interest

All authors declare that they have no conflict of interest.

Author contributions

H. P. contributed to the study design and was responsible for data collection and analysis. In addition, H. C. and H. P. read and approved the final manuscript.

Acknowledgments

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ctcp.2019.03.014.

References

[1] The Education Ministry, Year Student Health Examination Survey Sample Statistic, (2017) http://www.moe.go.kr/boardCnts/view.do?boardID=348&boardSeq= 73681&lev=0&searchType=null&statusYN=W&page=1&s=moe&m=040103& opType=N 2018 , Accessed date: 15 March 2018.

[2] S.H. Kim, Y.S. Kim, Y.H. Jang, J. Park, S.Y. Ryu, The association between sleep duration and quality and body mass index in Korean adolescents, J. Kor. Soc. School Health 25 (2012) 51–58.

[3] S.L. Kim, H.R. Park, The relationship of obesity and related behaviors among 4th and 5th grade-primary school children, J. Kor. Soc. Food Cult 10 (1) (1995) 19–28.

[4] S. Richardson, S. Paxton, J. Thomson, Is Body Think an efficacious body image and self-esteem program? A controlled evaluation with adolescents, Body Image 6 (2) (2009) 75–82 https://doi.org/10.1016/j.bodyim.2008.11.001.

[5] M. Shea, M. Pritchard, Is self-esteem the primary predictor of disordered eating? Pers. Indiv. Differ. 42 (8) (2007) 1527–1537 https://doi.org/10.1016/j.paid.2006.10.026.

[6] M. Gong, X. Wang, Z. Mao, Q. Shao, X. Xiang, B. Xu, Effect of electroacupuncture on leptin resistance in rats with diet-induced obesity, Am. J. Chin. Med. 40 (2012) 511–520 https://doi.org/10.1142/S0192415X12500395.

[7] L. Sherwood, Human Physiology: from Cells to Systems, seventh ed., Brooks/Cole, Boston, 2011.

[8] R. Vettor, C. Pagano, R. Fabris, A. Lombardi, C. Macor, G. Federspil, Lipolytic effect of beta-endorphin in human fat cells, Life Sci. 52 (7) (1993) 657–661 https://doi.org/10.1016/0024-3205(93)90457-e.

[9] K.K. Bence, M. Delibegovic, B. Xue, C.Z. Gorgun, G.S. Hotamisligil, B.G. Neel, B.B. Kahn, Neuronal PTP1B regulates body weight, adiposity and leptin action, Nat. Med. 12 (8) (2006) 917–924.

[10] P. Noigier, Introduction to Auricular Therapy, Maisonneuve, Paris, 1981.

[11] D.W. Kim, O.K. Ham, C.W. Kang, E.M. Jun, Effects of auricular acupressure using sinapsis alba seeds on obesity and self-efficacy in female college students, J. Altern. Complement. Med. 20 (2014) 258–264 https://doi.org/10.1089/acm.2012.0283.

[12] H.M. Youn, M.S. Kim, J.W. Lee, The effects of auricular acupressure in children's obesity, J. Acupunct. Res. 22 (5) (2005) 99–109.

[13] C. Hsieh, The effects of auricular acupressure on weight loss and serum lipid levels in overweight adolescents, Am. J. Chin. Med. 38 (2010) 675–682 https://doi.org/10.1142/S0192415X10008147.

[14] C. Hsieh, T. Su, Y. Fang, P. Chou, Effects of auricular acupressure on weight reduction and abdominal obesity in Asian young adults: a randomized controlled trial, Am. J. Chin. Med. 39 (2011) 433–440 https://doi.org/10.1142/S0192415X11008932.

[15] C. Hsieh, T. Su, Y. Fang, P. Chou, Efficacy of two different materials used in auricular acupressure on weight reduction and abdominal obesity, Am. J. Chin. Med. 40 (2012) 713–720 https://doi.org/10.1142/S0192415X1250053X.

[16] Y. Cohen, Statistical Power Analysis for the Behavioral Sciences, second ed., Lawren Erlabum Association Inc, Hillsdale, NJ, 2002.

[17] M. Romoli, Auricular Acupuncture Diagnosis, Churchill Livingston, Oxford, 2010.

[18] M. Cabioglu, N. Ergene, Electroacupuncture therapy for weight loss reduces serum total cholesterol, triglycerides and LDL cholesterol levels in obese women, Am. J. Chin. Med. 33 (2005) 525–533 https://doi.org/10.1142/S0192415X05003132.

[19] M. Cabioglu, N. Ergene, Changes in serum leptin and beta endorphin levels with weight loss by electroacupuncture and diet restriction in obesity treatment, Am. J. Chin. Med. 34 (2006) 1–11 https://doi.org/10.1142/S0192415X06003588.

[20] T. Shiraishi, M. Onoe, T. Kojima, Y. Sameshima, T. Kageyama, Effects of auricular stimulation on feeding-related hypothalamic neuronal activity in normal and obese rats, Brain Res. Bull. 36 (2) (1995) 141–148 https://doi.org/10.1016/0361-9230(94)00179-5.

[21] H. Abdi, B. Zhao, M. Darbandi, M. Ghayour-Mobarhan, S. Tavallaie, A.A. Rahsepar, S.M.R. Parizadeh, et al., The effects of body acupuncture on obesity anthropometric parameters, lipid profile and inflammatory and immunologic markers, Sci. World J. (2012) 603539 https://doi.org/10.1100/2012/603539.

[22] Korean Obesity Association, Clinic Bariatrics, Goryeo Medicine, Seoul, 2001.

[23] F. Gucel, B. Bahar, C. Demirtas, S. Mit, S. Cevik, Influence of acupuncture on leptin, ghrelin, insulin and cholecystokinin in obese women: a randomised, sham-controlled preliminary trial, Acupunct. Med. 30 (2012) 203–207 https://doi.org/10.1136/acupmed-2012-010127.

[24] C. Hsu, C. Wang, K. Hwang, T. Lee, P. Chou, H. Chang, The effect of auricular acupuncture in obese women: a randomized controlled trial, J. Womens Health 18 (2009) 813–818 https://doi.org/10.1089/jwh.2008.1005.

[25] T. Funahashi, T. Nakamura, I. Shimomura, K. Maeda, H. Kuriyama, M. Takahashi, Y. Arita, et al., Role of adipocytokines on the pathogenesis of atherosclerosis in visceral obesity, Intern. Med. 38 (1999) 202–206 https://doi.org/10.2169/internalmedicine.38.202.

[26] Y.S. Byeon, The analysis of research about adiponectin, J. Kor. Biol. Nurs. Sci. 12 (2010) 175–185.

[27] Y. Arita, S. Kihara, N. Ouchi, M. Takahasi, K. Maeda, J. Miyagawa, K. Hotta, et al., Paradoxical decrease of an adipose specific protein adiponectin in obesity, Biochem. Biophys. Res. Commun. 257 (1) (1999) 79–83 https://doi.org/10.1006/bbrc.1999.0255.

[28] S.H. Kim, Y.M. Lee, J.M. Lee, T.Y. Kim, S.W. Choi, The effect of combined exercise on change of leptin, adiponectin and bloods lipids change of obese female middle school students, Kor. J. Growth Develop. 7 (2009) 221–226.

[29] S.M. Wang, Z.N. Kain, Auricular acupuncture: a potential treatment for anxiety, Anesth. Analg. 92 (2) (2001) 548–553.

[30] J.H. Jiang, Ear acupuncture for hypotonia in gastrointestinal examination, Am. J. Roentrenol. 147 (4) (1986) 862 https://doi.org/10.2214/ajr.147.4.862.

[31] Y. Li, G. Tougas, S.G. Chiverton, R.H. Hunt, The effect of acupuncture on gastrointestinal function and disorder, Am. J. Gastroenterol. 87 (10) (1992) 1372–1381.

[32] W.L. Hu, C.H. Chang, Y.C. Hung, Clinical observations on laser acupuncture in simple obesity therapy, Am. J. Chin. Med. 38 (5) (2010) 861–867 https://doi.org/10.1142/50192415X10008305.

[33] Korean Acupuncture Medical Society, textbook compilation committee. Acupuncture Medicine. Seoul: Ji.