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Original Research

Modest weight loss through a 12-week weight management program with behavioral modification seems to attenuate inflammatory responses in young obese Koreans

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ABSTRACT

Obesity has been reported to impair immune functions and lead to low-grade long-term inflammation; however, studies that have investigated the impact of weight loss on these among the young and slightly obese are limited. Thus, we investigated the effect of a 12-week weight management program with behavioral modifications on cell-mediated immune functions and inflammatory responses in young obese participants. Our hypothesis was that weight loss would result in improved immune functions and decreased inflammatory responses. Sixty-four participants (45 obese and 19 normal weight) finished the program. Obese (body mass index ≥25) participants took part in 5 group education and 6 individual counseling sessions. Normal-weight (body mass index 18.5-23) participants only attended 6 individual sessions. The goal for the obese was to lose 0.5 kg/wk by reducing their intake by 300 to 500 kcal/d and increasing their physical activity. Program participation resulted in a modest but significant decrease in weight (2.7 ± 0.4 kg, $P < .001$) and lipopolysaccharide-stimulated interleukin-1β production (from 0.85 ± 0.07 to 0.67 ± 0.07 ng/mL, $P < .05$) in the obese. In the obese group, increase in phytohemagglutinin-stimulated interleukin-10 production, a T_H2 and anti-inflammatory cytokine, approached significance after program participation (from 6181 ± 475 to 6970 ± 632 pg/mL, $P = .06$). No significant changes in proliferative responses to the optimal concentration of concanavalin A or phytohemagglutinin were observed in the obese after program participation. Collectively, modest weight loss did not change the cell-mediated immune functions significantly but did attenuate the inflammatory response in young and otherwise healthy obese adults.

Abbreviations: Con A, concanavalin A; ELISA, enzyme-linked immunosorbent assay; HMW, high molecular weight; IFN, interferon; IL, interleukin; LPS, lipopolysaccharide; PBMC, peripheral blood mononuclear cell; PHA, phytohemagglutinin; RBC, red blood cell; T_H, helper T cells; TNF, tumor necrosis factor; WBC, white blood cell.

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1. Introduction

The prevalence of obesity has increased in Korean young adults. People with obesity have been reported to have higher production of inflammatory cytokines such as interleukin (IL)-6, tumor necrosis factor (TNF)-α, and IL-1β[1]. Additionally, many obesity-related diseases such as cardiovascular disease and type 2 diabetes mellitus seem to be associated with inflammation [1–3].

Obesity is reported to contribute to the impairment of human T-cell function, which in turn is associated with a higher incidence of infection in obese people [4]. Studies have indicated that obesity can cause suppression of mitogen-induced lymphocyte proliferation [5,6]. Alterations in T-cell subpopulations including $CD4^+$ T cells have also been reported in obese participants [7–9].

The balance between helper T (T_H)1 and T_H2 responses plays an important role in the regulation of the immune response, and obesity has been reported to disturb the T_H1/T_H2 balance. However, directions of the reported shift in balance have not been consistent. Obesity is related to increased leptin levels, and some studies reported that leptin seemed to polarize the T_H cell response towards a proinflammatory T_H1 phenotype [10,11]. In contrast, an increased risk of T_H2-biased diseases such as allergy and asthma has been reported in obese people [12,13].

Weight loss seems to improve these obesity-induced alterations in inflammatory responses and immune function. Serum inflammatory cytokine levels (TNF-α and IL-6) in healthy premenopausal obese women (mean body mass index [BMI] 37.2 kg/m^2) decreased with weight loss of more than 10% of their original weight. [14] Viardot et al [15] reported that weight loss in morbidly obese participants (mean BMI 42.8 kg/m^2) led to a significant decrease in the number of proinflammatory T_H1 cells quantified by intracellular staining for interferon (IFN)-γ by flow cytometry. Ma et al [16] found that symptoms of asthma, a T_H2-biased disease, in people with a BMI greater than 30 kg/m^2 were relieved with weight loss through a 12-month lifestyle intervention.

According to the Korean National Health and Nutrition Examination Survey conducted in 2010 [17], the prevalence of obesity (BMI ≥ 25, criterion for Koreans) among people older than 19 years was 31.4%, although fewer than 5% of adults had a BMI higher than 30 kg/m^2. However, most studies that investigated the effect of weight loss on immune responses were conducted in participants with a BMI greater than 30 kg/m^2. Therefore, investigating the immunological changes associated with weight loss in an obese population with a BMI less than 30 kg/m^2 would be helpful in understanding the more realistic impact of obesity on the immune response among Koreans.

Thus, we investigated the effect of weight loss through a 12-week weight management program with nutritional counseling and behavioral modification on cell-mediated immune function and inflammatory responses in young and otherwise healthy obese participants (most with a BMI < 30 kg/m^2). The hypothesis of this study was that weight loss would improve immune function and alleviate inflammatory responses in obese participants. To examine cell-mediated immunity, we measured the production of T_H1/T_H2 cytokines and the proliferative response of immune cells. For the determination of inflammatory responses, we measured the production of inflammatory cytokines by immune cells.

2. Methods and materials

2.1. Participants

The study was conducted from September 2009 to June 2011. Obese and normal-weight participants were recruited separately based on their BMI; the normal-weight group was recruited as the "control" to compare the baseline parameters with those of the obese group and as a control for a possible time effect (12-week intervention period). The participants in the control group were selected to match variables including age and height (except obesity-related variables such as BMI) of the participants in the obese group.

One hundred fifty-four participants aged 19 to 45 years were screened using questionnaires, and 84 were excluded from the study. Those who were taking dietary supplements or medications known to affect immune function and inflammatory responses such as nonsteroidal anti-inflammatory drugs were excluded from the study (n = 35). Those with a high Beck Depression Inventory score (>15; n = 28) or any chronic diseases (n = 21), including endocrine, hepatic, renal, thyroid, or cardiac dysfunction, were also excluded from the study. Forty-nine participants with a BMI greater than 25 kg/m^2 were included in the obese group, and 21 participants with a BMI between 18.5 and 23 kg/m^2 were included in the normal-weight group. Of these, 64 participants (45 obese and 19 normal weight) completed the study (Fig. 1).

The protocol was approved by the Seoul National University Institutional Review Board (IRB No. 0908-001-007), and written informed consent was obtained from all participants.

2.2. The 12-week weight management program

At baseline, all participants received information about the aims and schedule of the study. The intervention program for obese participants included 5 group education and 6 individual counseling sessions at baseline and the 2-, 4-, 6-, 10- (individual counseling only), and 12-week time points. Participants in the normal-weight group were asked to maintain their usual dietary and exercise patterns. These participants attended 6 individual meetings (but did not attend the group sessions) for the evaluation of dietary intake and exercise patterns.

The topics of the group education for obese participants were as follows: (1) planning for weight loss and how to write a diet record (week 0), (2) how to lose weight in a healthy way (week 2), (3) understanding food exchange lists and food labeling (week 4), (4) portion size control (week 6), and (5) strategies to maintain weight loss (week 12). During the individual counseling sessions, a registered dietitian evaluated the 3-day dietary record and reinforced the need to incorporate low-fat, low-sugar, low-salt, high-fiber, and low-energy density foods into their diets. The obese participants were also encouraged to exercise regularly and to modify undesirable eating behaviors such as late-night snacking or binge eating.