

A Comparison of Vital Capacity between Normal Weight and Underweight Women in their 20s in South Korea

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Abstract. [Purpose] The aim of this study was to compare the vital capacity (FVC, FEV₁, MVV) of normal and underweight women in their 20s. [Subjects] Thirty-four healthy non-smoking young women (age 20–25 years) participated in this study. [Methods] Based on body mass index (BMI), subjects were divided into two groups: the normal weight group (n=18, 18.5<BMI≤25.0) and the underweight group (n=16, BMI≤18.5). FVC, FEV₁ and MVV were measured using a respiratory function instrument, Spiropalm (A-M systems, USA), which fulfills the American Thoracic recommendation for diagnostic spirometry. The independent t-test was used to compare vital capacities (FVC, FEV₁ and MVV) between the normal and underweight group. [Results] The underweight group had significantly lower FVC and FEV₁ than the normal weight group. MVV of the underweight group was also lower than that of the normal weight group, but the difference was not significant. [Conclusion] Our results indicate that low body weight is related to reduction of vital capacity in women. These results also suggest that the maintenance of adequate body weight may be important for improving the vital capacity of women.

Key words: BMI, Underweight, Vital capacity

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INTRODUCTION

A lot of studies have researched relationships with obesity^{1–3)}. Formiguera and Cantón reported that two of most the common respiratory disturbances found in obesity are obstructive sleep apnea and obesity hypoventilation syndrome⁴⁾. Underweight women are also at risk of various health disorders.

In South Korea, the National Statistical Office⁵⁾ estimates that 4.64% of those aged 20 and above are underweight. Recently, many young women have been going on diets aiming for a slim body. However, an unhealthy diet may lead to weakness, frailty, functional impairment, anorexia and bulimia, and ultimately, death^{6, 7)}. Despite the health risks that being underweight can pose, there is no study in the literature reporting on the functional problems of underweight women⁸⁾, particularly, respiratory function.

Spirometry is a physical test that measures how an individual inhales or exhales volumes of air as a function of time and is a pulmonary function test that measures forced vital capacity (FVC), forced expiratory volume in 1s (FEV₁) and maximum voluntary ventilation (MVV). FVC is the maximum volume of air exhaled with maximally forced effort from a maximal inspiration, and FEV₁ is the volume of air expelled during the first second of maximal expiration⁹⁾. MVV is the maximum volume of air a subject can breathe over a specified period of time (12 s for normal subjects). MVV demonstrates the mechanical factors of breathing and provides information regarding increase in airway resis-

tance, reduced compliances or respiratory muscle force^{10, 11)}.

The aim of this study was to compare the vital capacities (FVC, FEV₁, MVV) of normal and underweight women in their 20s, and the results suggest that the assessment of the respiratory function in women who are underweight is clinically important.

SUBJECTS AND METHODS

Thirty-four healthy non-smoking young women (age 20–25 years) participated in this study. Based on body mass index (BMI), subjects were divided into two groups: the normal weight group (n=18, 18.5<BMI≤25.0) and the underweight group (n=16, BMI≤18.5). BMI is routinely used to estimate underweight or the degree of obesity^{12, 13)}, and it is calculated as body weight divided by body height squared (kg/m²). All subjects read and signed consent forms, in accordance with the ethical standards of the Declaration of Helsinki.

FVC, FEV₁ and MVV were measured using a respiratory function instrument, Spiropalm (A-M systems, USA), which fulfills the American Thoracic recommendation for diagnostic spirometry¹⁴⁾. To measure the FVC and FEV₁, the subjects are asked to take a rapid full inspiration through the mouthpiece; then, without hesitation, perform an expiration with maximum force until no more gas could be expelled, followed by a quick maximum inspiration. To measure MVV, at least three resting tidal breaths should be obtained. The subjects followed that performance of the procedure by

breathing as rapidly and deeply as possible for 12 seconds¹⁰). Prior to the tests, the required maneuvers were demonstrated by a trained operator. All maneuvers were performed in the sitting position and repeated as many as times as necessary until two acceptable maneuvers were obtained.

The independent t-test was used to compare the vital capacities (FVC, FEV₁ and MVV) of the normal and the underweight groups. Data are expressed as means \pm SD, and P-values less than 0.05 were considered significant.

RESULTS

The subjects' characteristics are shown in Table 1. Age and height were similar in the two groups. However, when compared with the normal weight group, the underweight group had significantly lower body weight and BMI.

Comparisons of FVC, FEV₁ and MVV between the normal and underweight groups are shown in Table 2. The underweight group showed significantly lower FVC and FEV₁ than the normal weight group ($p < 0.05$). MVV of the underweight group was also lower than that of the normal weight group; however, the difference was not significant ($p > 0.05$).

DISCUSSION

The purpose of this study was to elucidate whether there is an association between being underweight and the vital capacity. Being underweight has been linked to increased morbidity and mortality compared with having a BMI within the normal range¹⁵). A low BMI may be a reflection of a state of malnourishment where the body has fewer reserves, cannot react to stress appropriately, and may have a weakened immune system¹⁶). Musculoskeletal consequences of being underweight include less muscle mass, less soft tissue, and greater probability of osteoporosis^{16, 17}).

BMI can be easily measured and it is therefore used frequently in large-scale epidemiologic studies¹⁸). BMI was also used to classify the groups in this study. A limitation of BMI is that it does not distinguish between fat mass and muscle mass, which have opposite effects on pulmonary function^{19, 20}).

To measure the vital capacity in this study, a spiropalm was used. Spirometry is a pulmonary function test that helps to prevent, identify and quantify respiratory disorders as well as responses to therapy. In addition to its use in clinical case management, spirometry has become a routine examination in respiratory, occupational, and sports medicine as well as public health screening. However, it is necessary to consider that spirometry reference values can vary according to gender, age, height, race, technical factors and weight²¹).

In the results, FVC and FEV₁ of the underweight group were lower than those of the normal group, a result similar to those of some previous studies²¹). We believe that these results arise from muscle weakness and a reduction of pulmonary volume in the underweight group. However, MVV of the underweight group was no different from that of the normal weight group. In a previous study, MVV of males was higher than that of females¹¹), but there was no

Table 1.

Variable	Underweight (n=16)	Normal weight (n=18)
Age(yr)	21.7 \pm 1.7	21.2 \pm 0.4
Height(cm)	157.7 \pm 2.7	160.0 \pm 5.5
Weight(kg) **	44.7 \pm 3.3	52.7 \pm 7.5
BMI(kg/m ²) **	17.8 \pm 1.4	20.6 \pm 3.3

** $p < 0.01$, BMI: body mass index

Table 2. Comparison of vital capacity between normal and underweight group

Variable	Underweight (n=16)	Normal weight (n=18)
FVC(L) **	2.5 \pm 0.2	3.0 \pm 0.2
FEV ₁ (L) *	2.0 \pm 0.3	2.4 \pm 0.5
MVV(L/min)	75.5 \pm 17.8	87.4 \pm 17.2

Mean \pm SD, * $p < 0.05$, ** $p < 0.01$, FVC: forced vital capacity, FEV₁: forced expiratory volume in 1s, MVV: maximum voluntary ventilation

data reported for underweight women.

Some young women want to be slim, so they diet severely. We believe that severe diet can aggravate the condition of the lung and reduce pulmonary function and vital capacity.

In conclusion, our results indicate that low body weight is related to the reduction of vital capacity of women. The results also indicate that the maintenance of adequate body weight is always important for improving the vital capacity of women. Further studies are needed to clarify these findings.

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