

# Using Social Network Effect to Impose Weight Loss Intervention for College Students

## -- A Randomized Controlled Trial

Leqi Zhou

Department of Physical Education, Shanghai Maritime University, Shanghai 201306, China

### Abstract

**In China, the rate of obesity in adolescents has increased year by year and has become a serious public health problem. Social networks, as connection between people, organizations, political entities, nations and nations, have a significant influence on human health behaviors through behavioral imitation and behavioral norms. At present, the experiment in foreign countries has proved that the use of social network effects to weight loss intervention has positive and effective results, but there is still no similar research in China. By designed a randomized controlled trial, and through the using of social network effects, overweight and obese college students were given physical exercise and dietary interventions to assess the effect of social network effects on weight lose interventions. The results showed that under the influence of “perfection” students' weight loss effect in social networks, the effect of social network intervention experimental group was better than the ordinary intervention control group, and female subjects had better compliance and more weekly exercise time than male.**

### Keywords

**Social Network; Weight Loss; Randomized Controlled Trial; Obesity.**

### 1. Introduction

The obesity rate of adolescents in China has been increasing year by year, and its disease burden has begun to affect the medical and health system, and then gradually spread to all levels of social life such as society, economy and culture, which has become a serious public health problem. According to the national physical fitness test in 2014, the obesity rate of male and female adolescents aged 19-22 in urban areas was 12.15% and 3.23%, which was three times of the detected rate in 1990 [1]. The first and second grade students in colleges and universities, who have not long passed the college entrance examination, have relatively weak physical quality and light academic and job-hunting burden. At this stage, physical exercise intervention for overweight and obese students in lower grades can help effectively improve their body shape, develop good exercise habits and living habits, and lay a good physical foundation for their study and work [2]. In colleges and universities with relatively loose forms of education and life, it is difficult to arrange special personnel to intervene in physical exercise, which is not conducive to students' persistence. How to improve the subjective initiative of overweight and obese students and avoid negative emotional influence is one of the important tasks and difficulties of fat reduction intervention for college students [3].

Social networks are defined as connections between people, organizations, political entities, or states and nations [4]. Social networks play a pivotal role in the influence of health behaviors. It has been proved that diseases such as obesity, which are mainly caused by unhealthy lifestyles, are contagious in social networks [5], and the main mechanism is behavioral imitation and behavioral norms. Individuals have been deeply embedded in their social

network and the larger network of interaction in their daily behavior, and they are inevitably influenced by the social network through complex and diverse ways. When they are in different network groups, their behavioral choices will be affected by the individuals with higher influence and closer relationship in the social network, and there is an obvious network effect. Obesity can spread through social networks, proving that it is somewhat contagious. The peer effect of social networks can be used to prevent their spread. People are interrelated social attributes that determine their health behaviors are equally relevant. In college students, peer behavior and individual tight network have a strong influence on people's acceptance behavior, which can be explained by social learning theory, homogeneity and choice theory, and social support theory. Three degrees of influence is a strong connection effect on the network. Compared with the six-degree separation, the small-world characteristic can spread information [6]. Its actual effect in the network is to cause a member of the social network to change his behavior [7].

The use of social network effects in fat loss interventions has generally achieved positive and effective results, which can spread positive and healthy lifestyle habits and accelerate behavior change. At present, some foreign practices have proved that quitting smoking, abstaining from alcohol and losing weight [8]. If peer support can be provided, it is easier to achieve success by modifying social network in order to achieve the goal [9]. For example, WeightWatches, which draws on the concept of Alcoholics Abstinence Club and achieves good results, essentially carries out obesity intervention based on social network [10]. In China is still a lack of similar use of the network effect reduced fat intervention study, given the social, economic and cultural environment with foreign have bigger difference, this study used the social network effect, the overweight and obese college students exercise and dietary interventions, to conduct a randomized controlled trial, to evaluate the effect of social network effect on fat reduction intervention [11].

## 2. Research Objects and Methods

This study was combined with a sports science experimental design [12] and was reported according to the Consort Extended Statement of Non-drug RCTs 2017 Edition [13].

### 2.1. Target Population

The counselors of the students' classes received the specific exercise prescription and diet intervention plan, and confirmed with the enrolled students whether they were willing to participate. A total of 74 overweight or obese students were included in the study.

Inclusion criteria were:

- (1) First-year or second-year students, regardless of major, aged 18-22;
- (2) men and women;
- (3) Students with a body mass index (BMI) greater than 25 and less than 35; Signed the informed consent

Exclusion criteria were:

- (1) smoking, taking lipid-lowering drugs, hormone drugs, warfarin or other drugs that affect lipid metabolism in the past 6 months;
- (2) The following diseases: diabetes mellitus, hypothyroxine or hyperthyroidism, cardiovascular events, major systemic diseases, gastrointestinal diseases, proteinuria, liver disease, renal failure, etc.;
- (3) Vegetarians whose body weight fluctuated more than 20% in the past 6 months.

## 2.2. "Opinion Leader" Selection

For the selected overweight students, the social network questionnaire survey was conducted on them and their class to analyze their class social network and their position in the social network. The questionnaire referred to StarKey F's research and was modified into a simplified question in line with China's standards [14]. The index of centrality adopts closeness centrality, which can better reflect the degree of difficulty for a node to reach other nodes in the social network, that is, the reciprocal of the average distance to other nodes.

For members of the "social network effect intervention" group, we selected their "role models" based on the following principles:

- (1) If I am in a central position, I will be included in this study and select the member with the second highest BMI in the social network as a "role model" or an "opinion leader";
- (2) If I am not in the central position, the students in the central part of the network will be investigated, and the students with the largest BMI and the highest body fat percentage will be selected as "role models" or "opinion leaders", which will also be included in this study.
- (3) When students who meet the above two conditions are unwilling to participate in the study, we use the canteen and bathroom card swiping records of the school's "campus card" to select as "role models" those students who swipe their cards more than 3 times per week in the same place within a similar time (5min).

In order to prevent the "pollution effect" of the experiment, we took the following measures:

- (1) The social network of the ordinary intervention group members was considered in the selection of model students, and the students with overlapping network were not selected as the "model";
- (2) Inform "model" students to keep their participation in the experiment as secret as possible;
- (3) Inform the members of the "social network effect intervention" group and the ordinary intervention group to participate in this experiment as secret as possible try to arrange exercise at different times and places between the two groups, and try to follow the prior plan when eating to avoid being disturbed by others [15].

## 2.3. Intervention Measures

In order to ensure the validity of the experiment, professional teachers from sports nutrition and sports health direction of Shanghai University of Physical Education were invited to explain the diet knowledge and sports knowledge related to fat reduction to all group members once a month according to the different situations of the subjects.

The exercise intervention of two groups of subjects was aerobic exercise combined with resistance training. The amount of exercise was 4 times per week, and the duration of each exercise was 60min. The experiment lasted for 12 weeks in total. Considering that all subjects were heavier and had higher body fat, we adopted a safer moderate intensity exercise to avoid serious exercise risks such as muscle strain, joint injury, cardiovascular events, and sudden death.

Depending on the subject's health, each exercise consists of a 10-minute warm-up followed by 30 minutes of self-weight or instrument-resistance exercise followed by 30 minutes of moderate-intensity aerobic exercise (elliptical machine, jogging, or exercise bike). Dietary intervention based on respecting students' original eating habits as much as possible, it is recommended to reduce calorie intake by 10% only, and strictly control the intake of sugary foods.

For the "role models" in the social network group, we used more exercise and more restrictive dietary interventions. The weekly amount of exercise is 5 times per week, and the duration of each exercise is 90min. It is supervised by two full-time physical education teachers. The

intervention was started six weeks earlier than in the control group so that participants could "model" significant fat loss.

## 2.4. Measurement Indicators

The main test parameters were height, weight, BMI and body fat percentage. Secondary indicators included the number of hours of exercise per week and the OMRON HBF-370 body fat meter for body fat rate measurement using bioelectrical impedance. Weight and body fat percentage were measured at the beginning and end of the intervention to assess the progress of fat loss. In addition, we also used "WeChat steps" as an auxiliary indicator of students' physical activity, and recorded the dates when all participants took less than 3000 steps to assist in verifying their exercise adherence.

## 2.5. Statistical Methods

In addition to the necessary dietary and exercise intervention counseling, this study conducted the intervention for the subjects to reduce body fat by themselves. Therefore, the subjects were not blinded, only the evaluators of the intervention outcome were blinded. Randomly grouped by computer random number method, 2 groups of random list by sealed opaque envelope, designated personnel to keep.

The sample size was calculated according to the following conditions: Assuming a 10% weight loss ratio of 95%,  $\beta=0.1$ , POWER =90%, significance level of bilateral  $\alpha=0.05$ , and sample size of 61 persons/group. Assuming a 15% shedding rate, the sample size should be 72 cases. Finally, according to the inclusion and exclusion criteria, actually 43 people were included in each group and 86 people participated in the intervention trial.

The test measurement index data were expressed as ( $x\pm s$ ), and the counting data were compared by the chi-square test. Levene test was used for homogeneity of variance test, group design t-test was used for comparison of change rate of main indicators between groups, and t 'test was used for heterogeneity of variance test. Two-sided test was used for all tests (significance level  $\alpha=0.05$ ), with  $P<0.05$  indicating statistical significance and  $P<0.01$  indicating very significant difference. All statistical results were completed using SPSS19.0 software.

## 3. Results

### 3.1. Baseline Characteristics of Subjects

A total of 90 overweight and obese students were recruited, of which 4 were excluded from this study due to drug use and diabetes, and a total of 86 students were finally enrolled in this study. Through social network analysis, a total of 27 people were included in the "role model" group, 11 of whom were not overweight. Baseline data of the social network effect intervention group and the ordinary intervention group were basically the same, and the differences were not statistically significant ( $P>0.05$ ), which were comparable. The specific baseline characteristics were shown in Table 1.

### 3.2. Comparison of Intervention Effects of Fat Reduction

The effect of fat reduction intervention is shown in Table 2.

In terms of body weight, the average weight loss of male participants in the social network effect group was  $6.54\pm 8.42$ kg, while that of the control group was  $3.40\pm 8.63$ kg. Women's average weight loss in the social network intervention group was  $8.60\pm 6.29$ kg, compared with  $3.61\pm 6.51$ kg in the control group.

**Table 1.** Subjects baseline characteristics

Project	Social network effect intervention group (n=43)	General intervention group (n=43)	p	"Role Models" group (n=27)
Male/Female	27/16	25/18	0.915	17/10
Age (y)	18.44±0.73	18.39±0.58	0.541	18.92±0.31
Height (cm)	176.74±6.50/ 162.95±4.12	175.38±7.73/ 162.81±4.15	0.891/0.935	173.21/ 163.79
Weight (kg)	81.69±10.03/ 64.45±9.89	81.94±10.31/ 62.93±9.48	0.914/0.902	76.48±7.21/ 56.77±3.66
Body mass index (BMI)(kg/m <sup>2</sup> )	28.07±3.01/ 26.77±2.78	28.45±3.42/ 26.85±2.46	0.85/0.897	23.07±2.34/ 23.81±2.28
Body fat rate (%)	28.32±4.83/ 31.45±2.46	27.89±3.95/ 32.18±3.17	0.878/0.921	21.51±4.39/ 25.36±2.58

**Table 2.** Comparison of weightloss interventions

	Social network effect intervention group	General intervention group
	(N=43)	(N=43)
Male	(n=27)	(n=25)
Weight (kg)	75.15±8.78	78.54±8.62
BMI (kg/m <sup>2</sup> )	24.1±2.84	26.03±2.87
Body fat rate (%)	20.45±3.52	23.89±3.07
Weekly Exercise Time (h)	5.71	4.05
Female	(n=16)	(n=18)
Weight (kg)	55.85±6.78	59.32±6.23
BMI (kg/m <sup>2</sup> )	24.1±2.84	26.28±2.17
Body fat rate (%)	26.93±3.52	28.49±3.85
Weekly Exercise Time (h)	5.84	5.68

In terms of body fat percentage, the average loss of male participants in the social network effect group was 3.97±2.11, while that in the control group was 2.42±2.59. The mean reduction in the intervention group was 2.67±2.52, while that in the control group was 0.57±1.45.

BMI index; In the social network effect intervention group, the mean reduction in male group was 7.87±3.77, compared with 4.0±3.26 in the control group. The mean reduction in the intervention group was 4.52±3.71, while that in the control group was 3.69±3.86.

The results of this study showed that the social network effect intervention group was superior to the ordinary intervention control group in terms of weight loss, body fat percentage reduction and BMI reduction, and there were significant differences between the two groups.

### 3.3. Adverse Events and Compliance Analysis

In this study, the amount of exercise was basically strictly controlled within 1 hour, moderate and low intensity exercise was not intense, and diet intervention was not too strict, so all kinds

of adverse events related to fat reduction intervention did not occur, and sports injury accidents did not occur.

Due to the relevant health and exercise intervention education given to the enrolled members in advance, all the members stayed in the group and completed the 12-week intervention experiment, but the quality of completion was quite different. In terms of attendance, several subjects in both groups developed muscle soreness and joint pain, and were able to continue to complete the intervention after a week's rest, so attendance met the basic requirements.

## **4. Discussion**

### **4.1. The Intervention Effect of Social Network is Obvious, Especially the Role of Opinion Leaders**

This study explored the existence and availability of network effects in fat reduction interventions from the perspective of social networks. The results showed that, influenced by the fat loss effect of "model" students in the social network, the fat loss effect of the experimental group, namely the social network effect intervention group, was better than that of the ordinary intervention control group. This is inconsistent with the results reported by Woudenberg and Bell [16] and consistent with the results reported by Sebire [17]. This may be attributed to the fact that this study did not use online tools as social network intervention measures, but used face-to-face social network intervention, which objectively enhanced the influence of social network effect on the effect of fat loss to a certain extent. In addition, this is related to the different ways in which previous studies select "role models".

### **4.2. The Compliance of Women with Fat Reduction Intervention is Higher and Longer than That of Men**

In addition, the study found that the female participants had better compliance and exercised longer per week than the male participants. This may be related to female college students' stronger psychological demand for good body shape, as well as their monotonous after-school life. This gender advantage has also been observed in previous studies [18]. The women in the social network effect group exercised about the same amount of time as the control group, but the difference was significant, possibly because the group was motivated to do better in terms of diet by the "role model" students. This phenomenon can also be observed from the female body fat percentage index, indicating the importance of dietary intervention in the process of fat reduction intervention. Due to limited conditions, we did not measure the dietary thermal effect and other indicators, which need further study.

In this study, only body morphology indexes were used instead of physiological function and blood test indexes, which to a certain extent prevented students from dropping out of the group due to repeated examination, and it was also sufficient for the measurement of the intervention effect of fat reduction.

### **4.3. Limitations of this Study**

One of the limitations of this study is that the included population in the study is college students, whose environment is relatively closed due to the geographical location of the school and other reasons. Therefore, students' daily diet, daily life and rest are greatly affected by the environment and easy to control, which is also the main reason that no one left the experiment. However, this is an important factor affecting body fat loss for the general population, and the compliance and social network group effect of college students are also better than the general population due to age and identity. Therefore, the conclusion of this study should be extrapolated to the general population for further study. On the other hand, since students in school focus on learning tasks, the amount of exercise and food intake of the subjects are not

strictly controlled in this study, and the influence of social network effect on fat loss is mainly measured in this study, so the control of diet and exercise does not need to be too strict.

This experiment lasted for 12 weeks, and only observed the short-term effect of social network effect on the intervention of fat loss in the limited time, and did not follow up the long-term life habit formation. It is necessary to increase the sample size and prolong the experiment period to further observe the long-term intervention effect of social network effect.

Our study did not use mobile social network as an intermediary, but only used the common learning and living environment of school students as an intermediary for information transmission, which can explain to some extent the huge effect of fat reduction intervention influenced by social network effect [3]. For college students, who have lived in school for a long time, have a close social network and have good synchronicity in activities, they may have more advantages than other groups. Future studies will also further investigate the effect of using online mobile social networks (such as WeChat or sports social networking apps) on the intervention of fat loss, which is also in line with the mainstream way of information sharing in social networks [19].

## 5. Conclusions and Suggestions

In this study, a randomized controlled trial was used to conduct the intervention of fat loss exercise using social network effect, and the results showed that it had good feasibility and compliance. Compared with the ordinary intervention, the fat reduction intervention based on social network effect had better effect, which was superior to the ordinary intervention group in three aspects of body weight, body fat percentage and BMI, and the participation time of exercise was longer.

Future research directions include the design of a long-term cohort follow-up study to explore the influence of social network size, behavior frequency, and socioeconomic status of the sample population on the intervention effect, as well as the design of an intervention trial using an online mobile social network application for a fat loss campaign. This study will lay a theoretical and practical foundation for further prospective cohort study with large samples, and provide simple, scientific and effective intervention and monitoring tools for popularization and application.

## References

- [1] Chinese Student Physical Fitness and Health Research Group. 2014 Chinese Student Physical Fitness and Health Survey Report [M]. Beijing: Higher Education Press, 2016.
- [2] Wu Zhijian, Wang Zhuying, Song Yan and Li Qing. Meta-analysis of the effect of exercise on weight loss of obese adolescents in China [J]. Journal of Shenyang Institute of Physical Education. 2017 (03): 67 -75.
- [3] Hhuang Jiaai, The influence of negative emotions on executive function of obese youth [D]. Wuhan: Wuhan Institute of Physical Education, 2017.
- [4] Thomas W. Valente. Social Network and Health: Model, Method and Application [M]. Beijing: People's Health Publishing House, 2016.
- [5] Datar A, Nicosia N. Assessing Social Contagion in Body Mass Index, Overweight, and Obesity Using a Natural Experiment[J]. JAMA Pediatr. 2018, 172(3): 239-246.
- [6] Watts D J. Six degrees: The science of a connected age[M]. New York: W. W. Norton & Company, 2004.[7] Christakis N A, Fowler J H. Connected: The Surprising Power of Our Social Networks and How They Shape Our Lives[M]. America: Back Bay Books, 2011.
- [7] Powell K, Wilcox J, Clonan A, et al. The role of social networks in the development of overweight and obesity among adults: a scoping review[J]. BMC Public Health. 2015, 15: 996.

- [8] Zhang J, Brackbill D, Yang S, et al. Support or competition? How online social networks increase physical activity: A randomized controlled trial[J]. *Preventive Medicine Reports*. 2016, 4: 453-458.
- [9] The Spread of Physical Activity Through Social Networks[Z].
- [10] Patrick K, Marshall S J, Davila E P, et al. Design and implementation of a randomized controlled social and mobile weight loss trial for young adults (project SMART) [J]. *Contemp Clin Trials*. 2014, 37(1): 10-18.
- [11] Zhang Liancheng. Ten common problems and countermeasures of sports science experimental research design [J]. *Journal of Beijing Sport University* .2016 (05): 115-120.
- [12] Boutron I, Altman D G, Moher D, et al. CONSORT Statement for Randomized Trials of Nonpharmacologic Treatments: A 2017 Update and a CONSORT Extension for Nonpharmacologic Trial Abstracts [J]. *Ann Intern Med*. 2017, 167(1): 40-47.
- [13] Starkey F, Audrey S, Holliday J, et al. Identifying influential young people to undertake effective peer-led health promotion: the example of A Stop Smoking in Schools Trial (ASSIST)[J]. *Health Educ Res*. 2009, 24(6): 977-988.
- [14] A randomized controlled study of the effects of pollution [J].
- [15] van Woudenberg T J, Bevelander K E, Burk W J, et al. A randomized controlled trial testing a social network intervention to promote physical activity among adolescents[J]. *BMC Public Health*. 2018, 18 (1): 542.
- [16] The feasibility and acceptability of PLAN-A: a school-based peer-led physical activity intervention for adolescents girls in english secondary school, International Society for Behavioral Nutrition and Physical Activity[Z].
- [17] Sherar L B, Esliger D W, Baxter-Jones A D, et al. Age and gender differences in youth physical activity: does physical maturity matter? [J]. *Med Sci Sports Exerc*. 2007, 39(5): 830-835.
- [18] Maher C, Ferguson M, Vandelanotte C, et al. A Web-Based, Social Networking Physical Activity Intervention for Insufficiently Active Adults Delivered via Facebook App: Randomized Controlled Trial[J]. *J Med Internet Res*. 2015, 17(7): e174.
- [19] Su Minghui. Research on Library Microblogs in Northeast China Based on Social Network Analysis [J] *Information Science*, 2018, (05): 99-103.