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A Pilot Feasibility Study on Zero-Time Exercise Intervention to Enhance Physical Activity Levels and Reduce Sedentary Behavior Among College Students

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Abstract

Purpose: Exploring the effects of sedentary college students on physical activity and sedentary behavior in zero-time sports teams.

Methods: 45 sedentary college students were randomly divided into a ZTEx group (23 people) and a control group (22 people) using a random number table method. The ZETx group received a total of two focus group meetings for a period of 3 months.

Results: After intervention, the ZETx group significantly improved the duration of low-intensity physical activity (95% CI: -704.84, -147.45), number of sedentary interruptions (95% CI: -35.96, -21.08), grip strength (95% CI: -4.418, -1.608), 30 second continuous sitting (95% CI: -5.96, -2.9), general self-efficacy (95% CI: -8.007, -4.862), quality of life (PCS (95% CI: -7.82, -4.53), MCS (95% CI: -4.275, -1.271), and reduced sedentary duration (95% CI: 3507, -4.862).. 94, 1305.83).

Conclusion: ZTEx as a simple and economical intervention method, can effectively improve the low-intensity physical activity level and reduce sedentary behavior of sedentary college students, cultivate good exercise habits, improve individual physical health and quality of life, further enhance self-efficacy, and provide possibilities for promoting medium to high-intensity physical activity.

Keywords: Physical activity; Sitting for long periods of time; Zero-time exercise

Abbreviations: MVPA: Medium to High Intensity Physical Activity; LPA: Low-Intensity Physical Activity; ZTEx: Zero-Time Exercise; IPAQ: International Physical Activity Questionnaire; IPAQ-SF: International Physical Activity Questionnaire Short Form; GSES: General Self Efficacy Scale; PF: Physical Functioning; RP: Role Physical; BP: Bodily Pain; GH: General Health; VT: Vitality; SF: Social Functioning; RE: Role Emotional; MH: Mental Health.c

Introduction

In the process of life evolution, physical activity is considered a necessary condition for human survival. However, although human genes have not yet fully adapted to a sedentary lifestyle, sedentary behavior has become a new norm in today's social environment [1]. Physical activity, sedentary behavior, and sleep are all subcomponents of 24-hour activity behavior, and they interact and balance their allocation [2]. An increase in activity time will inevitably lead to a decrease in other activity times. Although people believe that an increase in sedentary behavior, when sleep time is fixed, will inevitably bring the same health hazards as a decrease in physical activity, there are different mechanisms of action between the two on one's own health. Targeted differentiation of them will have better value in demonstrating research results [3].

Early adulthood is an important transitional period, which is a crucial period for college students to strive for academic success in the new era. The unique learning and research life make this crucial period full of youth and responsibility seem extraordinary [4]. From the results of the national survey on student physical fitness and health, although the overall physical health level of students has increased at different stages, the problem of declining physical fitness among college students is still prominent [5]. The increase in sedentary behavior and decreased physical activity are closely related to these issues. A study has shown that college students sit for an average of 9.76hours per day [6]. Therefore, in the promotion and intervention of public health, there is an urgent need for cost-effective and time-consuming preventive physical activity interventions to cultivate a healthy lifestyle to

enhance physical health or prevent the occurrence of chronic non communicable diseases.

Medium to high intensity physical activity (MVPA) provides numerous positive evidence for research in the field of health promotion [7-11]. However, MVPA only accounts for a small portion (5%) of the 24 hours a day, even among active children and adolescents. In contrast, sleep (40%), sedentary behavior (40%), and low-intensity physical activity (LPA) (15%) account for approximately 95% of the day. When too much research is focused on MVPA, we also overlook the potential health benefits of LPA. More and more evidence suggests that the impact of excessive sedentary behavior on health benefits is not related to MVPA [12,13]. But reallocating sedentary time to LPA provides numerous possibilities for increasing exercise (i.e., daily steps) and obtaining health-related benefits by interrupting sedentary states [14].

Zero-time Exercise (ZTEx) is a lifestyle changing exercise initiated by the University of Hong Kong Animal Health Association (HKU-SPH) in 2015. It refers to the integration of simple physical activities to enhance strength and endurance into daily life, such as sitting or standing for simple exercises such as stretching the trunk and limbs, lifting feet in the air during meetings or work, squatting while waiting for buses and subways, standing on one foot, etc. [15]. It does not require any money, time, or equipment, and can be completed anytime, anywhere by anyone [16]. ZTEx is consistent with the American Physical Activity Guidelines, which hold that exercising more and sitting less is beneficial for almost everyone, and having physical activity is always better than not having it [17]. Pilot studies on ZTEx training among small sample community workers have shown that ZTEx can increase physical activity, reduce sedentary behavior, and improve physical health [18]. However, targeted exploration of such studies in sedentary populations is not common, and conducting pilot studies is worth looking forward to. The fundamental issue of starting from the beginning is difficult, and moving from the beginning to the end should be taken seriously by people. ZTEx, as the first step in changing behavioral habits and lifestyles, provides valuable intervention guidance for scholars. Therefore, this study aims to explore whether ZTEx can adjust the behavioral patterns of sedentary college students, effectively improve low-intensity physical activity levels, and reduce sedentary behavior. Assuming ZTEx can enhance the physical activity and health level of sedentary college students and reduce sedentary behavior. To provide practical basis and theoretical premise for engaging in high-intensity physical activities in the later stage and improving the physical health of college students to cultivate a good lifestyle.

Study Subjects and Methods

Subjects

Recruit 50 sedentary college students (18-35 years old) from a certain university, and randomly assign them to two groups using a random number table method: the ZTEx group and the Control group, with 25 people in each group. After excluding those who withdrew midway, the remaining number of people is 45, namely 23 in the ZTEx group and 22 in the Control group. Among them, 5 people withdrew midway, with a withdrawal rate of 10% (4% in the ZTEx group and 6% in the Control group). The included subjects signed informed consent forms and all voluntarily participated. This study follows the Helsinki Declaration. This study was approved by the Ethics Committee of Fujian Normal University (Ethics Number: FNU-L2024003). The basic information on the subjects is shown in [Table 1].

Table 1: Demographic characteristics of subjects.

Variable		Control group (N=22)	ZTEx group (N=23)
Age(years)		22.77±3.16	22.17±2.41
Gender	Female	17	17
	Male	5	6
Nation	Han Chinese	21	22
	national minority	1	1
Grade	Freshman year	3	1
	Sophomore year	3	2
	Junior year	3	4
	Senior year	2	2
	First year of graduate school	2	4
	Grade 2 or above	10	10

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The screening criteria are: inclusion criteria: [1] age range from 18 to 35 years old; [2] Sitting for at least 8 hours per day; [3] According to the definition of sedentary lifestyle in the International Physical Activity Questionnaire (IPAQ) and the ACSM Exercise Testing and Prescription Guidelines (9th edition), sedentary lifestyle is defined as not engaging in moderate intensity physical activity for ≥ 3 days per week and ≥ 30 minutes per day, and this state has persisted for more than 3 months; [4] Any meeting that has not received motivational motivation to exercise; [5] Can walk independently at normal speed for at least 1 minute without breathing difficulties; [6] Having basic literacy skills, able to understand and complete assessment questionnaires; [7] Able to engage in normal physical activities and develop healthily. [8] Voluntarily participate in sports and be able to complete sports interventions as required. Exclusion criteria: [1] Previous organic disease; [2] Have a history of mental illness such as depression and anxiety in the past; [3] He has a history of chronic diseases and operations that affect cardiovascular function, such as diabetes, hypertension, coronary heart disease, etc.

Procedure

This study used subjective and objective evaluation tools such as the Basic Situation Survey Questionnaire, International Physical Activity Questionnaire (IPAQ), and accelerometer to screen. The screening process is shown in [Figure 1].

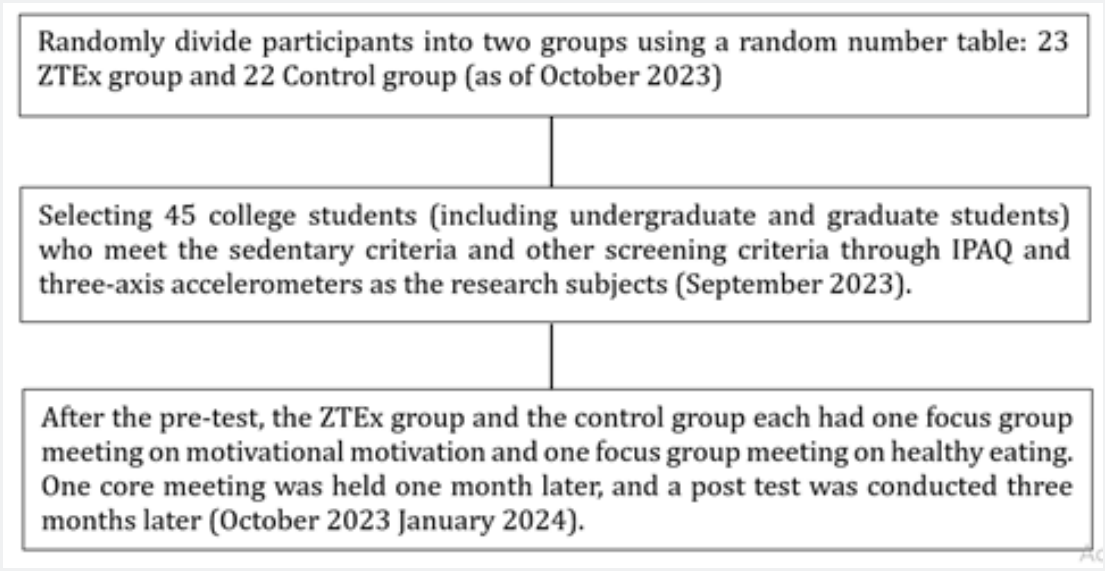

Figure1: A flowchart of the participants screening process.

Zero-time exercise (ZTEx) intervention

The exercise group received a 3-month zero-time exercise intervention, while the control group received safety and health education. Zero-time exercise intervention includes a 3-hour core meeting at the beginning of the experiment and a 2-hour reinforcement meeting at the first month. The intervention measures are based on cognitive behavioral therapy and motivational interviews, and regulate the cognitive factors (risk perception, self-efficacy, and outcome expectations) and action control (goal setting and planning) that form exercise motivation. Over time, the sustained control of actions may develop a habit of exercise. The focus of the core meeting is to use motivational incentives to encourage college students to actively change their lifestyles, increase physical activity, and reduce sedentary behavior. Detailed ZTEx actions are shown on YouTube (https://www.youtube. Com/watch? V=ym3nGLGE4fg). The intervention process is:

- At the beginning of the core meeting, participants are first invited to undergo physical composition, muscle strength, and mental health assessments to enhance their perception of the risk of physical inactivity (risk perception).
- Introduce physical health reference values for relevant age and gender, encourage participants to compare their health outcomes with standard data, and ask them to share their health beliefs, current exercise habits, and the adverse effects of prolonged sitting.
- To enhance the confidence of participants in regular exercise (exercise self-efficacy), we demonstrated and taught different types of zero-time exercise movements, invited all participants to practice together, and shared our personal experience and the benefits of regular zero-time exercise, which helped establish realistic expected results (outcome expectations) of using zero-time exercise regularly.

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➢ Discuss with participants how to conduct these exercises every day, as well as the time and location, and ask them to create new types of zero-time exercise (such as sports environment innovation and action innovation). Encourage participants to share relevant knowledge with their family and friends and compete with people around them to consolidate their knowledge, such as standing time on one leg.

➢ Participants set their own physical activity goals, clarify the details of the activities (time, location, and exercise type), and share their personal plans (goal setting and action plan) in the following group meetings. Each participant will receive a 1-liter dumbbell shaped water bottle and a gripper to help remind them to regularly undergo ZETx.

➢ The second stage (first month) is a one-hour reinforcement meeting phase aimed at maintaining behavioral changes and helping them develop exercise habits. The training content for ZTEx is shown in [Table 2].

Table 2: ZTEx Training Content.

Contents		Objective
Part 1: Core meetings	1. Invite participants to conduct baseline questionnaire evaluation and physical health assessment (30 minutes).	Understand the recent physical and psychological conditions and enhance the health awareness of participants towards the subsequent intervention measures taken.
	2. Introduce age and gender related reference values for physical health assessment. 3. Discuss the clinical relevance of these physical health indicators with the subjects (30 minutes).	Linking with one's own physical health and increasing people's awareness and perception of the harmful effects of lack of physical activity.
	4. Encourage participants to compare the gap between their own results and standard data. 5. Invite participants to discuss their health beliefs and existing exercise habits. 6. Discuss with participants how to reduce sedentary behavior and increase physical activity (15 minutes).	Motivate participants to reduce sedentary behavior and increase physical activity. Create a sense of disharmony between the subject's health beliefs and existing exercise habits. Inviting participants to actively participate in intervention
	Rest (15 minutes)	
	7. Introduce ZTEx, demonstrate and introduce different postures, and practice with participants (30 minutes).	Improve the awareness and understanding of ZTEx among participants.
	8. Share the organizer's personal experience and feelings with the participants, as well as the benefits of regularly practicing ZTEx (15 minutes).	Assist participants in developing realistic outcome expectations.
	9. Invite participants to set realistic goals and planned actions and encourage participants to publicly announce their plans to everyone present (30 minutes).	Enhance motivation and facilitate the transition from motivation to behavior.
	10. Summarize and make key statements (15 minutes).	Setting goals and developing action plans.
Part 2: Strengthening Meetings	1. Invite participants to undergo physical health assessment and questionnaire evaluation (30 minutes).	Progress monitoring.
	2. Inquire about participants' experience and obstacles encountered during ZTEx and explore solutions together (10 minutes).	Review and improve self-efficacy in ZTEx treatment.
	3. Based on encouragement for all positive changes in participants (5 minutes).	Provide positive feedback and reinforcement.
	4. ZTEx group practice (30 minutes).	
	Rest (10 minutes)	
	5. Introduce successful cases of oneself and others (15 minutes).	Set an example for motivation.
	6. Review the negative consequences of lack of physical activity and the positive consequences of physical activity and remind participants to pay attention to the positive changes brought about by regular ZTEx (15 minutes).	Promote risk perception and expected outcomes.
	7. Use a summary and key statements as concluding remarks and provide encouragement and support (5 minutes).	To strengthen exercise motivation and regulatory factors (goal setting and planning).

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Measurement of sedentary behavior and physical activity

The International Physical Activity Questionnaire and Triaxial Accelerometer were used to evaluate and measure the sedentary and physical activity of subjects. The International Physical Activity Questionnaire was used for the first round of subject screening, and the Triaxial Accelerometer was used to validate and evaluate the subjects selected from the Physical Activity Questionnaire and conduct pre-tests.

International physical activity questionnaire short form (IPAQ-SF)

The IPAQ-SF is a short Chinese version of the International Physical Activity Questionnaire used to evaluate physical activity levels over the past 7 days. Among Chinese university students, the questionnaire has good reliability and validity (reliability 0.78, validity 0.72), making it suitable for measuring physical activity levels and sedentary behavior among university students. The IPAQ-SF index includes one week of sitting time, walking time, and moderate to high-intensity activity time. Composed of 7 projects, inquire about information on 3 types of physical activities (walking, moderate activity, and vigorous activity) in different areas of physical activity. This information provides individual scores for each activity, as well as the sum of the frequency (days) and duration (minutes) of all activities performed, resulting in a comprehensive physical activity score.

Three axis accelerometers (Actigraph wGT3X-BT)

Using the Actigraph wGT3X-BT accelerometer, the subjects wore the accelerometer on the right side of their hips for one week (to be removed during bathing, swimming, or sleeping), and recorded the accelerometer measurement data at a 30 second time interval. The tester went to the school every day to check and supervise the wearing of the accelerometer by students to improve the efficiency of data recovery [19]. After the test is completed, use the software "Actilife 6.13.3" to filter and analyze the accelerometer data. Freedson (1998) calculated the raw data and found that wearing it for no less than 10 hours per day is considered one valid day and wearing it for at least three valid days per week (2 school days+1 weekend day) is considered effective physical activity data [20].

Physical Health Indicators

Quiet heart rate and blood pressure

This study used the D11 electronic sphygmomanometer produced by Omron Corporation in Japan to measure the heart rate and blood pressure of subjects at rest. The subjects were seated, and the blood pressure monitor was kept at the same level as the arms and heart. Resting blood pressure is usually measured twice, with a one-minute interval between the first measurement and the second measurement. The average of the two readings is taken and recorded. When it is found that the difference between the two measurements of systolic or diastolic blood pressure is more than 5mm Hg, a third measurement is required, and the average of the three values is taken to record the resting blood pressure status.

Weight and body composition

This study used the BCA-1A body composition analyzer produced by Tsinghua Tongfang Company in China to conduct body composition testing on participants, recording indicators such as body weight (kg), body fat percentage, waist to hip ratio, and visceral fat index. The subjects are tested on an empty stomach in the morning. Before the test, they should avoid prolonged sitting, lying down, vigorous exercise, and strength training. Women should not be tested during menstruation, and those wearing electronic medical devices such as pacemakers should not be tested; During testing, remove hats, shoes, socks, and various accessories, wear single clothes, and maintain consistent testing conditions before and after repeated testing.

Grip strength

This study used the LK-T5076 electronic grip strength meter produced by China Lingkang Company to test the grip strength of the subjects. The subjects were in a standing position, with their feet spread out shoulder width apart and their arms naturally drooping; The subjects used a handheld electronic grip force meter and held it firmly with their thumb and other four fingers. They tried their best to grip the upper and lower handles of the electronic grip force meter and observed to avoid changing the measurement posture to prevent compensation. A total of three tests were conducted on the grip strength of the dominant hand. After the test, the reading can be released, and the maximum value is taken as the result and recorded [21,22].

Sitting up continuously for 30 seconds

Sitting up continuously for 30 seconds is a classic test for evaluating lower limb strength. Testing process: At the beginning of the test, the subjects sat in the middle of a chair that was 43cm high and had no armrests, with their backs straight, their feet shoulder width apart, and their hands wrapped around their chest. After hearing the "start" command, the subjects stood up straight, then sat down, stood up again, and sat down again, repeating the cycle, recording the number of consecutive times the subjects sat up within 30 seconds [23].

Standing on one foot with eyes closed

Standing on one foot with closed eyes is a static balance measurement method. The subject relies on the coordination of the vestibular organs and limb joints in the brain to maintain overall muscle balance while keeping their eyes closed. The duration of maintaining balance is directly proportional to the static balance ability [24].

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Psychological Questionnaire Assessment

General self-efficacy scale (GSES)

The General Self Efficacy Scale (GSES) was first developed by German scholar Ralf Schwarzer in 1981. This study used the revised version by Wang Caikang et al. in 2002, which changed the original 20 items to 10 items. This scale is a unit scale without subscales, Cronbach's α the coefficient is 0.83. Using a 4-point scoring system, "completely incorrect" scores 1 point, "slightly correct" scores 2 points, "mostly correct" scores 3 points, and "completely correct" scores 4 points. The total score is calculated by adding up the scores of all items and dividing them by 10. The higher the score, the higher the self-efficacy.

The MOS item short from health survey (SF-36)

The SF-36 tool is used to analyze the health-related quality of life of a group of healthy individuals. SF-36 has a total of 36 entries, divided into 8 dimensions and 1 health change entry. The eight dimensions are: Physical Functioning (PF), Role Physical (RP), Bodily Pain (BP), General Health (GH), Vitality (VT), Social Functioning (SF), Role Emotional (RE), and Mental Health (MH). A health change item is not scored during calculation. Combining various parameters into groups, four parameters for physical domain evaluation of quality of life and four parameters for psychological domain have been added. The following allocation was made PF+RF+BT+GH+subjective perception of health changes=Summary of Body Composition (PCS); VT+SF+RE+MH=Summary of Psychological Components (MCS). The scores for each dimension are calculated according to the manual, with scores ranging from 0 to 100 for each dimension; A score close to 100 indicates a higher quality of life.

Statistical methods

Perform statistical analysis on the basic condition data of the subjects using Mean ± Standard deviation (M±SD). Statistical analysis was conducted on physical health, psychological questionnaire, sedentary behavior, and physical activity data at 0 and 12 weeks using mixed effects analysis of variance. Analyze the interaction effects of group, time, and group * time on physical health data, psychological questionnaire data, sedentary behavior, and physical activity separately. If $p<0.05$, the Bonferroni method was used for pairwise comparison between groups in the post hoc test. Perform statistical analysis using SPSS 22.0 software.

Results

Assessment results of sedentary and physical activity pre-exercise and post-exercise

Using mixed effects analysis of variance to explore the effects of group and time before and after intervention on sedentary behavior and physical activity. The results showed that time had a significant impact on sedentary duration ($p<0.05$, $F=6.641$, $df=1$), LPA duration ($p<0.05$, $F=5.241$, $df=1$), and number of sedentary breaks ($p<0.001$, $F=27.83$, $df=1$), while group had an impact on sedentary duration ($p<0.05$, $F=4.704$, $df=1$) and number of sedentary breaks ($p<0.01$, $F=10.624$, $df=1$). There was a significant interaction effect between group and time (sedentary duration: $p<0.05$, $F=5.364$, $df=1$; LPA duration: $p<0.05$, $F=4.063$, $df=1$; number of sedentary breaks).: $p<0.001$, $F=30.62$, $df=1$). Compared with before intervention, the ZETx group showed a significant decrease in sedentary duration (95% CI: 350.94, 1305.83) and an increase in LPA duration (95% CI: -704.84, -147.45) and number of sedentary breaks (95% CI: -35.96, -21.08) after intervention. See [Table 3].

Results of physical health assessment pre-exercise and post-exercise

Using mixed effects analysis of variance to explore the effects of group and time before and after intervention on physical health. The results showed that time had a significant impact on continuous sitting for 30 seconds ($p<0.001$, $F=22.39$, $df=1$), grip strength ($p<0.01$, $F=12.10$, $df=1$), while group had a significant impact on continuous sitting for 30 seconds ($p<0.05$, $F=5.094$, $df=1$). There was a significant interaction effect between group and time (continuous sitting for 30 seconds: $p<0.01$, $F=11.906$, $df=1$; grip strength: $p<0.05$, $F=6.59$, $df=1$). Compared with before intervention, after intervention, the ZETx group had continuous sitting for 30 seconds (95% CI: -5.96, -2.9), grip strength (95% CI: -4.418, -1.608) significantly increased. See [Table 4].

Psychological questionnaire evaluation results pre-exercise and post-exercise.

Using mixed effects analysis of variance to explore the effects of group and time before and after intervention on self-efficacy and quality of life. The results showed that time had a significant impact on general self-efficacy ($p<0.001$, $F=24.55$, $df=1$), PCS ($p<0.001$, $F=35.51$, $df=1$), MCS ($p<0.01$, $F=8.77$, $df=1$), and there was a significant interaction effect between group and time (general self-efficacy: $p<0.001$, $F=43.36$, $df=1$; PCS: $p<0.001$, $F=21.57$, $df=1$; MCS: $p<0.05$, $F=5.05$, $df=1$). Compared with before intervention, the ZETx group had a general self-efficacy after intervention (95% CI: -8.007, -4.88). 62), PCS (95% CI: -7.82, -4.53), and MCS (95% CI: -4.275, -1.271) significantly increased. See [Table 5].

Discussion

This pilot study aimed to explore the positive effects of a simple and low-cost ZETx approach on physical activity, sedentary behavior, physical and mental health of sedentary college students. The study showed that simple strength and endurance training through motivational incentives can improve the low-intensity physical activity level of sedentary college students and reduce their sedentary duration. At the same time, it has potential effectiveness in enhancing the physical health of participants (30 seconds of continuous sitting, grip strength), improving general self-efficacy, and quality of life. This provides a feasible basis for forming exercise habits and engaging in subsequent high-intensity physical activities, and to some extent verifies the purpose and hypotheses proposed in this study.

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Table 3: Comparison of sedentary and physical activity results before and after intervention

Variable	Group	Pre-exercise	Post-exercise	p(inter-group)	p(time)	p(inter-action)
Sedentary (min)	Control group	3786.32±1416.55	3742.15±925.84	<0.05	<0.05	<0.05
	ZTEx group	3694.28±687.56	2865.90±493.81△△**			
LPA (min)	Control group	1465.82±1143.10	1492.13±1161.04	0.334	<0.05	<0.05
	ZTEx group	1492.78±369.50	1918.93±354.63△△**			
MPA (min)	Control group	146.32±112.10	123.40±23.37	0.728	0.991	0.299
	ZTEx group	131.57±33.34	154.03±131.80			
VPA (min)	Control group	6.08±13.23	6.25±13.16	0.438	0.878	0.95
	ZTEx group	3.91±3.38	3.98±6.11			
Sedentary interrup-tion(frequency)	Control group	45.45±18.47	44.77±19.74	<0.01	<0.001	<0.001
	ZTEx group	45.26±13.69	73.78±16.74△△**			

△△P<0.01, compared with the Control group ; ** P<0.01, compared with pre-exercise.

Table 4: Comparison of physical health results pre-exercise and post-exercise.

Variable	Group	Pre-exercise	Post-exercise	p(intergroup)	p(time)	p(interaction)
Heart rate(bmp)	Control group	74.95±11.17	77.55.15±12.56	0.094	0.861	0.05
	ZTEx group	82.91±11.85	79.83±8.39			
Systolic blood pres-sure(mmHg)	Control group	65.41±5.63	67.23±5.80	0.334	<0.05	<0.05
	ZTEx group	71.57±9.07	69.39±8.90			
Diastolic blood pres-sure(mmHg)	Control group	106.95±10.15	107.14±10.09	0.705	0.15	0.118
	ZTEx group	110.39±10.05	106.04±14.46			
Weight(kg)	Control group	59.39±12.68	58.53±14.78	0.427	0.479	0.866
	ZTEx group	61.25±7.84	61.78±7.98			
Body fat percentage (%)	Control sgroup	25.10±5.59	25.10±5.84	0.36	0.212	0.215
	ZTEx group	27.38±7.00	25.85±4.57			
Sitting up continu-ously for 30 seconds (frequency)	Control group	20.67±6.65	21.36±6.68	<0.05	<0.001	<0.01
	ZTEx group	22.52±4.90	26.96±4.87△△**			
Grip(kg)	Control group	28.89±12.46	29.35±11.91	0.711	<0.01	<0.05
	ZTEx group	28.77±9.23	31.78±8.00**			
Standing with eyes closed(s)	Control group	20.79±15.89	19.99±14.74	0.211	0.178	0.113
	ZTEx group	21.23±19.73	30.73±21.42			

△△P<0.01, compared with the Control group ; ** P<0.01, compared with pre-exercise.

Table 5: Comparison of psychological questionnaire results pre-exercise and post-exercise.

Variable	Group	Pre-exercise	Post-exercise	p(intergroup)	p(time)	p(interaction)
General self-ef-ficacy	Control group	28.14±4.58	27.23±4.43	0.11	<0.001	<0.001
	ZTEx group	26.52±4.14	32.96±5.24△△**			
PCS	Control group	69.32±5.76	70.08±6.68	0.912	<0.001	<0.001
	ZTEx group	66.44±4.83	72.62±4.88△△**			
MCS	Control group	61.08±5.37	61.46±5.56	0.568	<0.01	<0.01
	ZTEx group	61.21±9.88	63.98±9.57△△**			

△△P<0.01, compared with the Control group ; ** P<0.01, compared with pre-exercise.

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At present, research on intervention for sedentary behavior mostly focuses on factors such as forced sedentary breaks [25,26], electronic reminders [27], and environmental impacts that lead to behavioral changes [28]. However, it is not difficult to find that although such intervention methods have good improvement effects, their overall effectiveness is compromised due to their scalability and operability in real life. Therefore, there is an urgent need for an economic, acceptable, and easy to implement intervention method to provide people with certain behavioral change guidance. Human beings are highly autonomous creatures, and perhaps only individuals who genuinely want to change sedentary behavior and enhance physical activity levels can effectively address the widespread but difficult to easily change lifestyle of sedentary behavior, especially in the existing social environment. The design of ZTEx is easy to integrate into daily life, characterized by no additional time (zero time), money (zero money), and equipment (zero equipment) required. Anyone can complete it at any time (Anytime) and anywhere (Anywhere). ZTEx is very attractive to busy people in daily life and those who think they don't have time to start exercising. Meanwhile, ZTEx is a physical activity behavior that enhances self-regulation of participants through motivational motivation and transforms this behavior into exercise habits by enhancing the motivation for behavior change. This is like the research results of scholars combining cognitive behavioral therapy techniques with motivational interviews to support people in changing various healthy behaviors [29,30]. In this study, we validated the feasibility of ZETx in increasing physical activity levels and reducing sedentary behavior among sedentary college students through two focus group meetings within three months, as well as its potential effectiveness in enhancing their physical and mental health. This is like the small sample study of Agnes Lai et al on-community volunteers [31].

People generally believe that some physical activities (even low-intensity ones) are better than none [32,33], but starting things is difficult because people lack confidence in entering unfamiliar exercise environments, such as the time and cost of entering the gym for exercise, making it difficult for them to take the first step [34]. Do not neglect small things - In this study, ZETx encouraged people to engage in low-intensity strength and endurance training in different settings, like the "gain in progress effect". The advantage of this psychological effect is that it can better meet people's small needs and improve self-efficacy [35]. We have shown through research that ZETx can enhance low-intensity physical activity levels in subjects, reduce sedentary time, and improve physical and mental health. This may be due to ZETx starting from internal motivation and using motivational incentives to encourage people to take the first step, increasing their low-intensity physical activity levels at the beginning of the activity, thereby improving the subjects' self-efficacy and promoting the regulation of their own behavior. Subsequently, people recognized positive changes in certain aspects of their physical health (grip strength, sitting up for 30 seconds) and were willing to maintain this behavior, continuously increasing the frequency of sedentary breaks and low-intensity physical activity duration, reducing sedentary duration, and ultimately improving the quality of life of the subjects. At the same time, the study encourages participants to share their learning and progress with their family and friends, and the support from family and society also helps individuals to start and maintain their exercise plans to a certain extent.

However, this study also has certain limitations. The level of moderate to high-intensity physical activity has not been improved, which may be due to the short intervention time of 3 months, which is not enough to maintain further moderate to high-intensity physical activity. At the same time, some important physical health indicators have not undergone positive changes, which may also be related to the lack of significant improvement in moderate to high-intensity physical activity levels. To improve the overall quality of life and cultivate a good lifestyle, moderate to high-intensity physical activities are essential. Therefore, our research group plans to focus on the transition from low-intensity to moderate to high-intensity physical activities in the next stage of intervention. At the same time, all participants in this study received higher education, and it is unknown whether other populations have the same effect. Therefore, this study will also be conducted as a pilot study. In the future, our research team will increase ZETx interventions for different populations, such as chronic diseases and special populations.

Conclusion

ZTEx as a simple and economical intervention method, can effectively improve the low-intensity physical activity level and reduce sedentary behavior of sedentary college students, cultivate good exercise habits, improve individual physical health and quality of life, further enhance self-efficacy, and provide a prerequisite and foundation for promoting medium to high-intensity physical activity.

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