

## Research Article

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## A Comparative Study of Body Composition and Aerobic Capacity between Water and Land Exercise Walking in Male College Students with Mild Obesity

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This study explores the impact of water and land fitness walking on the body composition and aerobic capacity of mildly obese male college students. Employing a randomized controlled trial, 36 mildly obese male college students were divided into a water group, a land group, and a non-intervention control group. Following a 4-week exercise intervention, dual-energy X-ray absorptiometry and power bicycle tests assessed body composition and aerobic capacity. The results revealed that both the water and land groups significantly enhanced relative maximum oxygen uptake and lactate threshold, with the water group showing greater improvement. Additionally, water fitness walking significantly reduced body composition indicators including body weight, BMI, waist circumference, waist-to-hip ratio, and thigh circumference. However, there were no significant changes in height, chest circumference, muscle mass, and bone density. The research indicates that water fitness walking uniquely enhances aerobic exercise capacity and body composition, offering a scientific foundation for college students to select effective weight loss exercise methods.

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**Received:** July 03, 2024; **Accepted:** July 05, 2024; **Published:** July 17, 2024**Introduction**

As living standards rise and lifestyles change globally, obesity, particularly among college students, has emerged as a serious health challenge. Obesity not only impairs an individual's appearance and psychological well-being, but is also strongly associated with chronic diseases such as cardiovascular disease and type 2 diabetes, significantly elevating health risks [1]. Consequently, exploring scientifically sound and effective weight loss methods is crucial for enhancing the physical health and elevating the quality of life of college students.

Exercise intervention, as a crucial strategy for obesity control, is widely recognized for its effectiveness. Fitness walking, as a low-intensity and easy-to-perform aerobic exercise, is especially favored by obese individuals because of its minimal joint pressure and significant weight loss impact [2, 3]. Water fitness walking, an innovative variation of land-based fitness walking, takes advantage of water's buoyancy, resistance, and heat dissipation to further minimize joint impact and lower the risk of sports injuries [4]. Additionally, it potentially enhances fat burning by increasing energy expenditure, thereby achieving superior weight loss outcomes [5].

This study is designed to offer scientific support for the effectiveness of water and land fitness walking in weight loss and physique improvement among mildly obese male college students by comparing their impacts on body composition and aerobic capacity. Utilizing a randomized controlled trial,

eligible mildly obese male college students from Beijing Sport University were selected as the research subjects for a 4-week exercise intervention. Advanced techniques for body composition measurement and aerobic capacity assessment were utilized to systematically monitor and record the changes in physical indicators of the subjects before and after the experiment.

The significance of this study is twofold: firstly, it reveals the specific roles and mechanisms of water and land fitness walking in alleviating obesity among college students through scientific experimental design and rigorous data analysis; secondly, it offers scientifically-backed weight loss exercise recommendations for college students, guiding them to select more effective and safer exercise methods, thereby enhancing their overall physical health. Additionally, this study will offer fresh perspectives and insights into the field of weight loss through exercise, driving further advancements in related research.

**Research Methodology****Method of Literature Review**

Extensive searches were conducted in databases both domestically and internationally, including the Beijing Sport University library, CNKI, and EBSCO, to gather and analyze research on water fitness walking, land fitness walking, body composition, aerobic capacity, and related areas. Additionally, books on physiology, sports biochemistry, and statistics were consulted, laying a solid theoretical and methodological foundation for the study's design, execution, and data analysis.

### Method of Expert Interview

By interviewing pertinent experts from Beijing Sport University, we clarified the necessary testing methods for this experiment and established testing metrics based on relevant literature. This approach facilitated a more scientific organization of training plans and enabled the timely identification of issues during training. Consultations with experts from Beijing Sport University regarding the experiment's feasibility further refined our training schemes and plans.

### Method of Experimental

#### Experimental Subjects and Grouping

This study selected 36 male college students with mild obesity from Beijing Sport University as subjects, ensuring homogeneity through strict screening criteria (such as body fat percentage, BMI, etc.). The students were randomly divided into three groups: a water group, a land-based group, and a non-intervention control group, with 12 students in each group. Prior to the experiment, all subjects signed an informed consent form and were informed of the purpose, procedures, potential risks, and precautions of the study.

#### Experimental Test Indicators and Methods

**Body Composition Indicators:** The height, weight, BMI, body fat percentage, muscle content, and bone density of the subjects were measured using Dual-energy X-ray Absorptiometry (DXA). The test was conducted with the Lunar iDXA dual-energy X-ray body analyzer, manufactured by GE Healthcare in the United States.



Figure 3.1: Body Composition Test

**Aerobic Work Capacity Indicators:** The relative maximum oxygen uptake ( $VO_{2max}$ ) and lactate threshold (LT) of the subject are assessed using a power bicycle. During the test, the subject is equipped with a respiratory mask, heart rate monitor, among other devices, while data is expertly collected and analyzed using gas analyzers, blood lactate analyzers, among other instruments.



Figure 3.2: Test of Relative Maximum Oxygen Uptake



Figure 3.3: Lactate Threshold Test

#### The Pre-Experiment

A one-week pre-experiment was conducted prior to the formal experiment, primarily to familiarize the subjects with the exercise methods of water walking and land walking, master the correct movement essentials, and determine their respective target heart rate ranges. During the pre-experiment, training on dietary control and safety measures was also conducted to ensure the subjects maintained consistent dietary habits and to reduce the risk of sports injuries throughout the experiment.



Figure 3.4: Pre-Experiment

#### The Formal Experiment

The formal experiment lasts for 4 weeks, with 3 exercise interventions per week, each lasting 30-40 minutes. The training load and intensity of water and land fitness walks are adjusted based on the results of the pre-experiment to ensure that the subjects exercise within the target heart rate range. During the training process, professional coaches provide guidance and supervision to ensure the scientific and safe nature of the training.

#### Method of Mathematical Statistics

After the experiment, the data collected by pretest, post-test and during the experiment were processed using Excel and SPSS. The data from the pre-experiment and post-experiment tests were expressed as mean  $\pm$  standard deviation, and the within-group differences were analyzed using paired sample t-tests, while the between-group differences were analyzed using independent sample t-tests. Significant differences were defined as  $P < 0.05$ , very significant differences were defined as  $P < 0.01$ , and no significant differences were defined as  $P > 0.05$ .

## Research Results

### The Changes in Aerobic Capacity Across Each Group Pre- and Post-Experiment

#### Changes in Relative VO<sub>2</sub>max of Each Group before and after the Experiment

**Table 1.1: Summary of Changes in Relative VO<sub>2</sub> max in Each Group before and after the Experiment**

Group	Relative VO <sub>2</sub> max prior to the experiment (ml/min kg <sup>-1</sup> )	Relative VO <sub>2</sub> max post the experiment (ml/min kg <sup>-1</sup> )	P value
Water Group	37.75±3.66	39.10±7.51	0.039*
Land-based group	37.25±3.48	38.37±6.64	0.047*
Control group	37.17±4.13	37.83±6.29	0.436

**Note:** P<0.05 Indicates a Significant Difference.

Regarding relative VO<sub>2</sub> max, Table 1.1 indicates that, within-group changes reveal that after a 4-week exercise intervention, the relative VO<sub>2</sub>max ( $P<0.05$ ) of participants in both the water and land groups exhibited significant increases compared to their pre- intervention values. However, in the control group, there was no significant change in the relative VO<sub>2</sub>max of the participants ( $P>0.05$ ).

**Table 1.2: Differences in Relative VO<sub>2</sub> max between Groups before and after the Experiment**

Test Indicators	Group Comparison	P value
Relative VO <sub>2</sub> max (ml/min kg <sup>-1</sup> )	Water vs Land-based Group	0.158
	Water vs Control group	0.003**
	Land-based vs Control group	0.02*

**Note:** P<0.05 Indicates Significant Differences, while P<0.01 Indicates a Highly Significant Differences.

Regarding relative VO<sub>2</sub>max, Table 1.2 reveals that the water group exhibits a highly significant difference ( $P<0.01$ ) and the land group shows a significant difference ( $P<0.05$ ) compared to the control group. This indicates that both experimental groups have significant changes compared to the control group after experimental intervention. However, no significant difference is observed between the water and land groups ( $P>0.05$ ).

#### Changes in Lactate Thresholds of each group before and after the Experiment

**Table 1.3: Summary of Changes in Lactate Threshold Values in Each Group before and after the Experiment**

Group	Lactate threshold prior to the experiment (mmol/L)	Lactate threshold post the experiment (mmol/L)	P value
Water Group	2.96±0.12	3.15±0.21	0.032*
Land-based group	2.94±0.09	3.08±0.23	0.043*
Control group	2.87±0.08	2.82±0.21	0.391

**Note:** P<0.05 Indicates a Significant Difference.

Regarding lactate threshold, Table 1.3 indicates that, within-group changes reveal that after a 4-week exercise intervention, the lactate threshold ( $P<0.05$ ) of participants in both the water and land groups exhibited significant decreases compared to their pre- intervention values. However, in the control group, there was no significant change in the lactate threshold of the participants ( $P>0.05$ ).

**Table 1.4: Group Differences in Lactate Threshold before and after the Experiment**

Test indicators	Group comparison	P value
Lactate Threshold(mmol/L)	Water vs Land-based Group	0.132
	Water vs Control group	0.021*
	Land-based vs Control group	0.037*

**Note:** P<0.05 Indicates a Significant Difference.

Regarding lactate threshold, Table 1.4 reveals highly significant differences between the water group and the control group ( $P<0.01$ ), and significant differences between the land group and the control group ( $P<0.05$ ). This suggests that both training groups have undergone notable changes compared to the control group post- intervention. No significant difference is observed between the water group and the land group ( $P>0.05$ ). However, considering the data changes pre- and post-experiment, it is evident that both exercise environments effectively enhance the body's lactate threshold, with the water group showing a superior improvement compared to the land group.

#### The Changes in Body Composition of each group Pre- and Post-Experiment

#### Changes in Height, Weight, and BMI for Each Group before and after the Experiment

**Table 1.5: Summary of Height Changes in Each Group before and after the Experiment**

Group	Height prior to the experiment(m)	Height post the experiment (m)	P value
Water Group	1.76±0.02	1.77±0.03	0.865
Land-based group	1.74±0.03	1.75±0.03	0.843
Control group	1.76±0.03	1.77±0.04	0.854

As indicated in Table 1.5, regarding height, there were no significant differences observed within the water group, land group, and control group after a 4-week exercise intervention when compared to their pre-intervention heights ( $P>0.05$ ).

**Table 1.6 Differences in Height Among Groups before and after the Experiment**

Test indicators	Group comparison	P value
Height(cm)	Water vs Land-based Group	0.816
	Water vs Control group	0.832
	Land-based vs Control group	0.829

As indicated in Table 1.6, regarding height, there is no significant difference in height among the water walking group, land walking group, and the control group ( $P>0.05$ ). This indicates that both water walking and land walking have no significant effect on body height.

**Table 1.7 Summary of Weight Changes in Each Group before and after the Experiment**

Group	Weight prior to the experiment (kg)	Weight post the experiment(kg)	P value
Water Group	88.32±3.97	85.39±3.83	0.032*
Land-based group	87.25±3.41	85.50±3.69	0.047*
Control group	88.87±3.67	89.21±4.28	0.452

**Note:**  $P<0.05$  Indicates a Significant Difference.

As indicated in Table 1.7, there was a significant decrease ( $P<0.05$ ) in the body weight of participants in both the water and land groups after a 4-week exercise intervention, when compared to their pre-intervention values. However, in the control group, there was no significant change ( $P>0.05$ ) in the body weight of the participants.

**Table 1.8: Differences in Weight Among Groups before and after the Experiment**

Test indicators	Group comparison	P value
Weight(kg)	Water vs Land-based Group	0.101
	Water vs Control group	0.008**
	Land-based vs Control group	0.028*

**Note:**  $P<0.05$  Indicates Significant Differences, while  $P<0.01$  Indicates a Highly Significant Differences.

Regarding the body weight, Table 1.8 reveals highly significant differences between the water group and the control group ( $P<0.01$ ), and significant differences between the land group and the control group ( $P<0.05$ ). This suggests that both training groups have undergone notable changes compared to the control group post- intervention. No significant difference is observed between the water group and the land group ( $P>0.05$ ). However, considering the data changes pre- and post-experiment, it is evident that the improvement effect of the water group on body weight is better than that of the land group.

**Table 1.9: Summary of Body's BMI Changes in Each Group before and after the Experiment**

Group	BMI prior to the experiment (kg/m <sup>2</sup> )	BMI post the experiment (kg/m <sup>2</sup> )	P value
Water Group	28.73±2.13	26.83±2.51	0.025*
Land-based group	28.30±2.09	27.28±2.23	0.048*
Control group	28.78±2.58	28.88±2.55	0.702

**Note:**  $P<0.05$  Indicates a Significant Difference.

As indicated in Table 1.9, there was a significant decrease ( $P<0.05$ ) in the body's BMI of participants in both the water and land groups after a 4-week exercise intervention, when compared to their pre-intervention values. However, in the control group, there was no significant change ( $P>0.05$ ) in the body's BMI of the participants.

**Table 1.10: Differences in Body's BMI among Groups before and after the Experiment**

Test indicators	Group comparison	P value
BMI (kg/m <sup>2</sup> )	Water vs Land-based Group	0.267
	Water vs Control group	0.011*
	Land-based vs Control group	0.034*

**Note:**  $P<0.05$  Indicates a Significant Difference.

Regarding the body's BMI, Table 1.10 reveals highly significant differences between the water group and the control group ( $P<0.01$ ), and significant differences between the land group and the control group ( $P<0.05$ ). The results indicate that both training groups have undergone notable changes compared to the control group post- intervention. No significant difference is observed between the water group and the land group ( $P>0.05$ ), considering the data changes pre- and post-experiment, it is evident that both the water group and the land group can effectively improve the body's BMI under both exercise environments. However, the water group has a better effect on improving the body's BMI than the land group.

**Changes in Body Circumference for Each Group before and after the Experiment**

**Table 1.11: Summary of Chest Circumference Changes in Each Group before and after the Experiment**

Group	Chest circumference prior to the experiment(cm)	Chest circumference post the experiment(cm)	P value
Water Group	101.18±6.17	101.43±5.93	0.362
Land-based group	102.50±7.07	102.63±7.14	0.443
Control group	101.87±6.93	101.80±7.03	0.354

As indicated in Table 1.11, regarding the Chest circumference, there were no significant differences observed within the water group, land group, and control group after a 4-week exercise intervention when compared to their pre-intervention Chest circumference ( $P>0.05$ ).

**Table 1.12: Differences in Chest Circumference among Groups before and after the Experiment**

Test indicators	Group comparison	P value
Chest circumference(cm)	Water vs Land-based Group	0.412
	Water vs Control group	0.522
	Land-based vs Control group	0.394

As indicated in Table 1.12, regarding the Chest circumference, there is no significant difference in height among the water walking group, land walking group, and the control group ( $P>0.05$ ). This indicates that both water walking and land walking have no significant effect on Chest circumference.

**Table 1.13: Summary of Waist Circumference Changes in Each Group before and after the Experiment**

Group	Waist circumference prior to the experiment(cm)	Waist circumference post the experiment(cm)	P value
Water Group	94.11±8.13	91.32±7.02	0.001**
Land-based group	95.56±5.98	93.90±5.30	0.048*
Control group	95.36±6.47	95.79±6.28	0.402

**Note:**  $P<0.05$  Indicates Significant Differences, while  $P<0.01$  Indicates a Highly Significant Differences.

Regarding waist circumference, Table 1.13 indicates that, in terms of intra-group changes, after the 4-week exercise intervention, a highly significant difference was observed in the waist circumference of the water group subjects compared to their pre-intervention measurements ( $P<0.01$ ). A significant difference was also noted in the waist circumference of the land group subjects compared to their pre-intervention measurements ( $P<0.05$ ). However, no significant difference was found in the waist circumference of the control group subjects compared to their pre-intervention measurements ( $P>0.05$ ).

**Table 1.14: Differences in Waist Circumference among Groups before and after the Experiment**

Test indicators	Group comparison	P value
Waist circumference(cm)	Water vs Land-based Group	0.043*
	Water vs Control group	0.001**
	Land-based vs Control group	0.053

**Note:**  $P<0.05$  Indicates Significant Differences, while  $P<0.01$  Indicates a Highly Significant Differences.

Regarding the Waist circumference, Table 1.14 reveals significant differences between the water group and the land group ( $P<0.05$ ), highly significant differences between the water group and the control group ( $P<0.01$ ), and no significant differences between the land group and the control group. It is evident that water fitness walking is more effective in reducing waist size compared to land fitness walking.

**Table 1.15: Summary of Thigh Circumference Changes in Each Group before and after the Experiment**

Group	Thigh circumference prior to the experiment(cm)	Thigh circumference post the experiment(cm)	P value
Water Group	55.51±2.98	53.34±2.51	0.027*
Land-based group	55.78±3.12	55.28±3.07	0.183
Control group	55.73±2.58	55.78±2.42	0.725

**Note:**  $P<0.05$  Indicates a Significant Difference.

Regarding thigh circumference, Table 1.15 indicates that, in terms of intra-group changes, after the 4-week exercise intervention, a significant difference was observed in the thigh circumference of the water group subjects compared to their pre-intervention measurements ( $P<0.05$ ), no significant difference was found in the thigh circumference of the land group and control group subjects compared to their pre-intervention measurements ( $P>0.05$ ).

**Table 1.16: Differences in Thigh Circumference among Groups before and after the Experiment**

Test indicators	Group comparison	P value
Thigh circumference(cm)	Water vs Land-based Group	0.012*
	Water vs Control group	0.003**
	Land-based vs Control group	0.073

**Note:**  $P<0.05$  indicates significant differences, while  $P<0.01$  Indicates a Highly Significant Differences.

Regarding the Thigh circumference, Table 1.16 reveals significant differences between the water group and the land group ( $P<0.05$ ), highly significant differences between the water group and the control group ( $P<0.01$ ), and no significant differences between the land group and the control group. It is evident that water fitness walking is more effective in reducing thigh size compared to land fitness walking.

**Table 1.17: Summary of Waist-to-Hip Ratio (WHR) Changes in Each Group before and after the Experiment**

Group	WHR prior to the experiment	WHR post the experiment	P value
Water Group	0.92±0.03	0.87±0.03	0.033*
Land-based group	0.93±0.03	0.90±0.04	0.089
Control group	0.93±0.02	0.93±0.04	0.687

**Note:**  $P<0.05$  indicates a significant difference.

Regarding Waist-to-Hip Ratio (WHR), Table 1.17 indicates that, in terms of intra-group changes, after the 4-week exercise intervention, a significant difference was observed in the WHR of the water group subjects compared to their pre-intervention measurements ( $P<0.05$ ), no significant difference was found in the WHR of the land group and control group subjects compared to their pre-intervention measurements ( $P>0.05$ ).

**Table 1.18: Differences in Waist-to-Hip Ratio (WHR) among Groups before and after the Experiment**

Test indicators	Group comparison	P value
Waist circumference(cm)	Water vs Land-based Group	0.045*
	Water vs Control group	0.001**
	Land-based vs Control group	0.067

**Note:**  $P<0.05$  Indicates Significant Differences, while  $P<0.01$  Indicates a Highly Significant Differences.

Regarding the WHR, Table 1.18 reveals significant differences between the water group and the land group ( $P<0.05$ ), highly significant differences between the water group and the control group ( $P<0.01$ ), and no significant differences between the land group and the control group. It is evident that water fitness walking is more effective on improving the waist-to-hip ratio compared to land fitness walking.

### Changes in Body Fat Percentage, Muscle Content, and Bone Density for Each Group before and after the Experiment

**Table 1.19: Summary of Body fat Percentage (BFP) Changes in Each Group before and after the Experiment**

Group	BFP prior to the experiment(%)	BFP post the experiment(%)	P value
Water Group	28.26±2.47	25.28±2.22	0.016*
Land-based group	28.56±2.78	26.63±2.13	0.047*
Control group	28.62±2.68	28.93±2.89	0.676

**Note:**  $P<0.05$  Indicates a Significant Difference.

Regarding BFP, Table 1.19 indicates that, within-group changes reveal that after a 4-week exercise intervention, the Body fat percentage of participants in both the water and land groups ( $P<0.05$ ) exhibited significant decreases compared to their pre-intervention values. However, in the control group, there was no significant change in the Body fat percentage of the participants ( $P>0.05$ ).

**Table 1.20: Differences in BFP among Groups before and after the Experiment**

Test indicators	Group comparison	P value
Body fat Percentage (%)	Water vs Land-based Group	0.121
	Water vs Control group	0.003**
	Land-based vs Control group	0.012*

**Note:**  $P<0.05$  Indicates Significant Differences, while  $P<0.01$  Indicates a Highly Significant Differences.

Regarding the BFP, Table 1.20 reveals highly significant differences between the water group and the control group ( $P<0.01$ ), and significant differences between the land group and the control group ( $P<0.05$ ). The results indicate that both training groups have undergone notable changes compared to the control group post- intervention. No significant difference is observed between the water group and the land group ( $P>0.05$ ), considering the data changes pre- and post-experiment, it is evident that both the water group and the land group can effectively improve the BFP under both exercise environments. However, the water group has a better effect on improving the BFP than the land group.

**Table 1.21: Summary of Muscle Content Changes in Each Group before and after the Experiment**

Group	Muscle content prior to the experiment(kg)	Muscle content post the experiment(kg)	P value
Water Group	47.66±4.55	48.56±3.87	0.205
Land-based group	46.88±5.01	47.40±4.74	0.335
Control group	47.93±6.47	47.87±6.28	0.602

As indicated in Table 1.21, regarding Muscle content, there were no significant differences observed within the water group, land group, and control group after a 4- week exercise intervention when compared to their pre-intervention Muscle content ( $P>0.05$ ).

**Table 1.22: Differences in Muscle Content among Groups before and after the Experiment**

Test indicators	Group comparison	P value
Muscle content(kg)	Water vs Land-based Group	0.622
	Water vs Control group	0.313
	Land-based vs Control group	0.398

As indicated in Table 1.22, regarding Muscle content, there is no significant difference in Muscle content among the water walking group, land walking group, and the control group ( $P>0.05$ ). This indicates that both water walking and land walking have no significant effect on Muscle content.

**Table 1.23: Summary of Bone Density Changes in Each Group before and after the Experiment**

Group	Bone density prior to the experiment (g/cm <sup>3</sup> )	Bone density after the experiment (g/cm <sup>3</sup> )	P value
Water Group	1.11±0.05	1.14±0.04	0.253
Land-based group	1.16±0.07	1.18±0.06	0.276
Control group	1.14±0.04	1.14±0.03	0.857

As indicated in Table 1.23, regarding Bone density, there were no significant differences observed within the water group, land group, and control group after a 4- week exercise intervention when compared to their pre-intervention Bone density ( $P>0.05$ ).

**Table 1.24: Differences in Bone Density among Groups before and after the Experiment**

Test indicators	Group comparison	P value
Bone density(g/cm <sup>3</sup> )	Water vs Land-based Group	0.623
	Water vs Control group	0.341
	Land-based vs Control group	0.373

As indicated in Table 1.24, regarding Bone density, there is no significant difference in Bone density among the water walking group, land walking group, and the control group ( $P>0.05$ ). This indicates that both water walking and land walking have no significant effect on Bone density.

### Changes in Body Fat Percentage of Specific Body Parts for Each Group before and after the Experiment

**Table 1.25: Summary of Upper Body Fat Percentage Changes in Each Group before and after the Experiment**

Group	Upper body fat percentage prior to the experiment(%)	Upper body fat percentage post the experiment(%)	P value
Water Group	1.11±0.05	1.14±0.04	0.253
Land-based group	1.16±0.07	1.18±0.06	0.276
Control group	25.52±2.37	25.63±2.58	0.528

As indicated in Table 1.25, regarding the Upper body fat percentage, there were no significant differences observed within the water group, land group, and control group after a 4-week exercise intervention when compared to their pre-intervention Upper body fat percentage ( $P>0.05$ ).

**Table 1.26: Differences in Upper Body Fat Percentage among Groups before and after the Experiment**

Test indicators	Group comparison	P value
Upper body fat Percentage(%)	Water vs Land-based Group	0.412
	Water vs Control group	0.087
	Land-based vs Control group	0.090

As indicated in Table 1.26, regarding Upper body fat percentage, there is no significant difference in Upper body fat percentage among the water walking group, land walking group, and the control group ( $P>0.05$ ). This indicates that both water walking and land walking have no significant effect on Upper body fat percentage.

**Table 1.27: Summary of Thigh Body Fat Percentage Changes in Each Group before and after the Experiment**

Group	Thigh body fat percentage prior to the experiment(%)	Thigh body fat percentage post the experiment(%)	P value
Water Group	24.86±2.55	22.56±2.87	0.032*
Land-based group	24.93±2.01	23.60±2.74	0.046*
Control group	24.94±2.47	25.03±2.28	0.702

**Note:**  $P<0.05$  Indicates a Significant Difference.

As indicated in Table 1.27, there was a significant decrease ( $P<0.05$ ) in the Thigh body fat percentage of participants in both the water and land groups after a 4-week exercise intervention, when compared to their pre-intervention values. However, in the control group, there was no significant change ( $P>0.05$ ) in the Thigh body fat percentage of the participants.

**Table 1.28: Differences in Thigh Body Fat Percentage among Groups before and after the Experiment**

Test indicators	Group comparison	P value
Thigh body fat percentage (%)	Water vs Land-based Group	0.298
	Water vs Control group	0.028*
	Land-based vs Control group	0.042*

**Note:**  $P<0.05$  Indicates a Significant Difference.

Regarding the Thigh body fat percentage, Table 1.28 reveals highly significant differences between the water group and the control group ( $P<0.01$ ), and significant differences between the land group and the control group ( $P<0.05$ ). The results indicate that both training groups have undergone notable changes compared to the control group post-intervention. No significant difference is observed between the water group and the land group ( $P>0.05$ ), considering the data changes pre- and post-experiment, it is evident that both the water group and the land group can effectively improve the Thigh body fat percentage under both exercise environments. However, the water group has a better effect on improving the Thigh body fat percentage than the land group.

**Table 1.29: Summary of Trunk Body Fat Percentage Changes in Each Group before and after the Experiment**

Group	Trunk body fat percentage prior to the experiment(%)	Trunk body fat percentage post the experiment(%)	P value
Water Group	31.15±2.89	28.12±3.08	0.005**
Land-based group	31.07±3.07	28.89±3.23	0.037*
Control group	31.14±3.04	31.20±3.12	0.657

**Note:**  $P<0.05$  Indicates Significant Differences, while  $P<0.01$  Indicates a Highly Significant Differences.

Regarding the Trunk body fat percentage, Table 1.29 indicates that, in terms of intra-group changes, after the 4-week exercise intervention, a highly significant difference was observed in the Trunk body fat percentage of the water group subjects compared to their pre-intervention measurements ( $P<0.01$ ). A significant difference was also noted in the Trunk body fat percentage of the land group subjects compared to their pre-intervention measurements ( $P<0.05$ ). However, no significant difference was found in the Trunk body fat percentage of the control group subjects compared to their pre-intervention measurements ( $P>0.05$ ).

**Table 1.30: Differences in Trunk Body Fat Percentage among Groups before and after the Experiment**

Test Indicators	Group Comparison	P value
Thigh body fat percentage (%)	Water vs Land-based Group	0.045*
	Water vs Control group	0.001**
	Land-based vs Control group	0.025*

**Note:**  $P<0.05$  Indicates Significant Differences, while  $P<0.01$  Indicates a Highly Significant Differences.

Regarding the Trunk body fat percentage, Table 1.30 reveals highly significant differences between the water group and the control group ( $P<0.01$ ), and significant differences between the land group and the control group ( $P<0.05$ ). The results indicate that both training groups have undergone notable changes compared to the control group post-intervention. No significant difference is observed between the water group and the land group ( $P>0.05$ ), considering the data changes pre- and post-experiment, it is evident that both the water group and the land group can effectively improve the Trunk body fat percentage under both exercise environments. However, the water group has a better effect on improving the Trunk body fat percentage than the land group.

**Table 1.31: Summary of Android Body Fat Percentage Changes in Each Group before and after the Experiment**

Group	Android body fat percentage prior to the experiment(%)	Android body fat percentage post the experiment(%)	P value
Water Group	32.88±3.86	29.25±3.08	0.002**
Land-based group	32.68±4.07	29.96±3.23	0.032*
Control group	32.79±4.04	32.89±3.12	0.689

**Note:**  $P<0.05$  Indicates Significant Differences, while  $P<0.01$  Indicates a Highly Significant Differences.

Regarding the Android body fat percentage, Table 1.29 indicates that, in terms of intra-group changes, after the 4-week exercise intervention, a highly significant difference was observed in the Trunk body fat percentage of the water group subjects compared to their pre-intervention measurements ( $P<0.01$ ). A significant difference was also noted in the Android body fat percentage of the land group subjects compared to their pre-intervention measurements ( $P<0.05$ ). However, no significant difference was found in the Android body fat percentage of the control group subjects compared to their pre-intervention measurements ( $P>0.05$ ).

**Table 1.32: Differences in Android Body Fat Percentage among Groups before and after the Experiment**

Test indicators	Group comparison	P value
Android body fat percentage (%)	Water vs Land-based Group	0.038*
	Water vs Control group	0.000**
	Land-based vs Control group	0.025*

**Note:**  $P<0.05$  Indicates Significant Differences, while  $P<0.01$  Indicates a Highly Significant Differences.

Regarding the Android body fat percentage, Table 1.32 reveal significant differences between the water group and the land group ( $P<0.05$ ), highly significant differences between the water group and the control group ( $P<0.01$ ), and significant differences between the land group and the control group ( $P<0.05$ ).

**Table 1.33: Summary of Gynoid Body Fat Percentage Changes in Each Group before and after the Experiment**

Group	Gynoid body fat percentage prior to the experiment(%)	Gynoid body fat percentage post the experiment(%)	P value
Water Group	25.79±2.56	24.12±3.08	0.253
Land-based group	25.86±2.89	24.54±3.23	0.276
Control group	25.94±3.17	26.02±3.12	0.257

As indicated in Table 1.33, regarding the Gynoid body fat percentage, there were no significant differences observed within the water group, land group, and control group after a 4-week exercise intervention when compared to their pre-intervention Upper body fat percentage( $P>0.05$ ).

**Table 1.34: Differences in Gynoid Body Fat Percentage among Groups before and after the Experiment**

Test indicators	Group comparison	P value
Gynoid Body Fat Percentage (%)	Water vs Land-based Group	0.089
	Water vs Control group	0.043*
	Land-based vs Control group	0.046*

**Note:**  $P<0.05$  Indicates A Significant Difference.

Regarding the Gynoid body fat percentage, Table 1.34 reveals highly significant differences between the water group and the control group ( $P<0.01$ ), and significant differences between the land group and the control group ( $P<0.05$ ). The results indicate that both training groups have undergone notable changes compared to the control group post-intervention. No significant difference is observed between the water group and the land group ( $P>0.05$ ), considering the data changes pre- and post-experiment, it is evident that both the water group and the land group can effectively improve the Gynoid body fat percentage under both exercise environments. However, the water group has a better effect on improving the Gynoid body fat percentage than the land group.

## Discussion and Analysis

### Analysis of the Effects of Exercise in Two Different Environments on Aerobic Capacity

#### Analysis of the effects of exercise in two different environments on Relative Maximal Oxygen Uptake ( $VO_2$ max)

Maximal oxygen uptake ( $VO_2$  max) represents the maximum volume of oxygen absorbed in a given time when the body's respiratory training capacity peaks [6]. Numerous studies indicate that the prevalence of cardiovascular diseases and pulmonary ventilation dysfunction is significantly higher in obese individuals compared to those of normal weight. The cardiopulmonary function levels in obese individuals are inversely related to metabolic indicators associated with cardiovascular diseases [7]. Obesity can cause a decline in cardiopulmonary function, raising the risk of cardiovascular diseases and overall mortality [8]. Therefore, cardiopulmonary function is a critical indicator of overall health. The increase in relative maximum oxygen uptake is a primary manifestation of enhanced cardiopulmonary function [9]. Conti discovered that, when comparing land fitness walking to water fitness walking, the latter demonstrated a comparable effect on enhancing maximum oxygen uptake ( $VO_2$  max) [10]. The findings of this study align with previous research, showing

that over a four-week period, both the water and land groups significantly increased the subjects' relative maximum oxygen uptake. The water group demonstrated a marginally superior effect in enhancing this level compared to the land group. The reason may be that during moderate to high-intensity aerobic exercise leading to exhaustion, the onset of exercise fatigue is primarily due to respiratory muscle limitations in ventilation, leading to inadequate oxygen supply. Consequently, the body augments respiratory muscle strength by enhancing their adaptability to exercise, thereby increasing ventilation, ensuring adequate oxygen supply, and subsequently postponing the onset of exercise fatigue. The heart not only pumps blood but also functions as an endocrine organ. It secretes a hormone known as atrial natriuretic peptide, which primarily promotes sodium excretion, diuresis, vasodilation, and reduction in sympathetic nervous tension. The secretion of atrial natriuretic peptide is closely linked to the volume of blood returned to the heart. Breathing patterns during water sports differ from those on land. The adoption of deep and prolonged abdominal breathing in water sports facilitates the removal of liver congestion, enhances blood flow within the abdominal cavity, improves visceral organ function, and increases the work performed by respiratory muscles, thereby enhancing overall respiratory function [11]. Pulmonary ventilation capacity is enhanced; moreover, the negative intrathoracic pressure dilates the atria and vena cava, facilitating venous blood return, increasing cardiac output, enhancing atrial natriuretic peptide secretion, lowering heart rate, and consequently elevating cardiopulmonary function [12]. Therefore, fitness walking in water or on land can effectively improve the subjects' relative maximum oxygen uptake.

#### **Analysis of the Impact of Exercise in Two Environments on Lactate Threshold**

The Lactate Threshold (LT) represents the critical juncture where the body shifts from aerobic to anaerobic metabolism during progressively increased exercise stress, manifesting as a nonlinear increase at an inflection point [13]. Additionally, the lactate threshold serves as a safety limit in fitness training. Some scholars have posited that variations in heart rate and blood lactate levels are governed by various mechanisms, yet the majority concurs on the substantial correlation between the two, Heart rate monitoring is also quite straightforward [14]. Therefore, in practice, the heart rate corresponding to the lactate threshold is generally used to monitor exercise intensity, aiming for a scientific, effective, and safe approach.

Shen Pengfei discovered that after a 10-week training intervention involving water fitness running and land fitness running, both methods significantly increased the lactate threshold in 40 obese male college students. However, water fitness running demonstrated a greater impact on enhancing the lactate threshold levels compared to land fitness running [15]. In a study comparing deep-water running with shallow-water running, Town discovered that exercising in shallow water triggers a higher metabolic response. He posits that the more muscles involved in exercise, the greater the activation of muscle fibers, and the enhanced capacity for muscle oxygen utilization [16]. The concentration of blood lactate is dependent on the number of muscle fibers utilized in skeletal muscle [17]. The study results indicate that, following a 4-week experimental intervention, both the water group and the land group significantly enhanced the lactate threshold of the participants. The water group demonstrated a marginally superior effect in elevating the lactate threshold levels compared to the land group. This difference can likely be attributed, on one hand, to the greater density of water compared to air, which

subjects athletes to increased resistance and challenges stability during water-based exercises. Conversely, land-based exercises allow for foot placement on the ground, facilitating better body stability. On the other hand, the oxygen utilization capacity of the body during exercise primarily occurs in skeletal muscles. The contraction patterns of muscles differ between water and land-based exercises. In water, muscle contractions are primarily centripetal, necessitating the involvement of more muscles in the movement. Therefore, when compared to land-based fitness walking, water fitness walking can significantly improve the body's lactate threshold.

#### **Analysis of the Effects of Exercise in Two Different Environments on Body Composition**

#### **Analysis of the Effects of Exercise in Two Different Environments on Body Height**

Human height is primarily influenced by familial genetics, nutritional intake, physical exercise, physiological health, and external environmental factors [18]. Human height growth demonstrates distinct developmental features across various stages. Research indicates that human height growth undergoes two significant peaks. The first peak occurs during infancy, while the second peak for males occurs between the ages of 14 and 16, and for females between the ages of 12 and 14 [19]. Over the next five years, there will be a continued increase in height, primarily due to the growth of spinal bones, with the closure process extending until the age of 23-26 [20]. Therefore, prior to the completion of ossification, engaging in appropriate physical exercise can enhance the supply of blood and nutrients to the bones, foster bone growth, and fully leverage the body's growth potential.

The results of this study indicate that after a 4-week experimental intervention, there was no significant change in the height of participants in either the water group or the land group. Consequently, it is evident that fitness walking exercises in either environment do not promote the growth of body height.

#### **Analysis of the Impact of Exercise in Two Different Environments on Body Weight and BMI**

Physical exercise can increase the energy consumption of the body, and is one of the most effective and sustainable ways to improve or prevent obesity and enhance the body's adaptability [21]. Aerobic exercise can help obese individuals lose weight and decrease their obesity index [22]. Consistently engaging in aerobic exercise over the long term can improve the body's utilization of fat, Enhance the rate of fat mobilization and increase the activity of the rate-limiting enzymes involved in this process [23, 24]. Weight and BMI are significant indicators for assessing obesity and the effectiveness of weight loss [25]. The World Health Organization considers Body Mass Index (BMI) a critical measure for assessing human body fitness and overall health. It serves as a reliable marker for both protein-energy malnutrition and obesity [26]. Based on the World Health Organization's (WHO) reference standards for body mass index (BMI) among Asians, a BMI less than 18.5 is considered underweight,  $18.5 \leq \text{BMI} < 23.9$  is considered normal,  $24 \leq \text{BMI} < 27.9$  is considered overweight, and  $\text{BMI} \geq 28$  is considered obese. In this study, the target heart rate for exercise intensity was set at the rate corresponding to a fitness walk of 6.0 km/h in the land group. Given that water pressure aids the heart in its pumping action, the heart's workload is less in water than on land. Additionally, the temperature of water is lower than body temperature, which in turn lessens the strain on the circulatory system. These two factors enhance heart efficiency. To counteract the influence of water on the cardiovascular response

post-exercise, participants need to subtract 10% from their land-based target heart rate to establish their appropriate pool-based target heart rate range. Thus, the target heart rate for the water group is derived by subtracting 10% from that of the land group. The study results revealed that, following a 4-week experimental intervention, both the water group and the land group exhibited significant improvements in the subjects' body weight and BMI. Based on the unique physical properties of water, exercising in water results in a greater calorie loss compared to land-based activities, and walking in water involves overcoming a higher level of resistance. Consequently, at the same level of training intensity and volume, water fitness walking proves more effective in reducing the body weight of mildly obese male college students.

### **Analysis of the Effects of Exercise in Two Different Environments on Chest, Waist, Thigh Circumferences, and Waist-to-Hip Ratio**

Chest circumference measures the size of the ribcage and indicates muscle development. Essentially, it mirrors the overall body shape and the growth of respiratory organs, serving as a critical indicator of growth and development. Thigh circumference is taken at the fullest part of the inner thigh, or horizontally around the thigh from the hip crease [27]. Waist circumference serves as an indirect indicator of body fat status, reflecting the thickness and nutritional status of subcutaneous fat in the abdomen. The size of waist circumference not only characterizes body shape but also maintains an appropriate ratio between the waist and hips, which is crucial for health and longevity. The waist-to-hip ratio, calculated as the waist circumference divided by the hip circumference, is closely associated with human health and certain diseases. The study results revealed that after a 4-week experimental intervention, no significant changes were observed in the chest circumferences of both the water and land groups. The water group exhibited a highly significant change in waist circumference, significant changes in waist-to-hip ratio and thigh circumference. The land group showed significant changes in waist circumference, but no significant changes were observed in waist-to-hip ratio and thigh circumference. The lack of significant improvement in chest circumference may be attributed to the fact that the aquatic fitness walking exercises were conducted at a depth of 1.2 meters. Subjects of medium to high heights experienced no significant changes in chest circumference, while a few shorter subjects demonstrated some improvement in chest circumference due to the water's influence. Additionally, due to the nature of fitness walking, it primarily targets leg muscles, upper limb muscles, and core muscle groups, among others. Consequently, the effect on chest circumference is minimal. A key distinction between exercise-based weight loss and other approaches lies in their impact on body composition. While other weight loss methods often lead to a reduction in lean body mass alongside the loss of body fat, exercise-based weight loss uniquely promotes an increase in lean body mass despite the reduction in body fat. Water fitness walking can notably reduce fat around the waist and hips. This effect is likely attributed to the higher density of water compared to air, which creates a greater resistance to overcome during underwater exercise. Consequently, the hip muscles must exert more force, leading to a reduction in fat accumulation in the hips and an increase in muscle strength. This results in either maintaining the hip circumference or achieving a minor increase, while the waist circumference and waist-to-hip ratio decrease. Fitness walking in water yields a superior weight loss effect compared to fitness walking on land. This could be attributed to the impact of water temperature, duration of water exercise, and the body's adaptability on energy expenditure during water-based activities. Additionally, due to the unique properties of the aqueous

environment, the force exerted by water on the human body during exercise results in a significantly higher caloric expenditure in water compared to land-based activities.

### **Analysis of the Impact of Exercise in Two Different Environments on Body Fat Percentage**

Fat is essential for sustaining life functions. The level of body fat is influenced by factors including diet, exercise, metabolism, health status, age, and gender [28]. In recent years, as obesity research has advanced, it has become apparent that regional fat distribution is a critical factor influencing both obesity and overall health. The distribution of body fat serves as a significant indicator for predicting the adverse cardiovascular and metabolic impacts of obesity, independent of overall fat levels [29]. Currently, the most scientifically accepted measure of obesity is body fat percentage. Nicholas discovered that both land-based and water-based fitness walking significantly enhance the body composition of participants [30]. From a physiological perspective, the exercise prescription designed in this experiment is classified as aerobic. During the initial phase of aerobic exercise, the concentration of free fatty acids is low, with the body primarily fueled by sugar. As the duration of exercise extends, the body continuously experiences the intensification of exercise's stimulus, leading to sympathetic nerve activation and the subsequent increase in the secretion of hormones such as glucocorticoids, adrenaline, and catecholamines. This heightened activity of rate-limiting enzymes pertinent to fat hydrolysis and metabolism further enhances the breakdown and oxidation of fat for energy production [31]. The results of this study showed that both the water group and the land group significantly improved the body fat percentage of the experimental subjects through a 4-week exercise intervention. The total body fat mass decreases, aligning with the findings of Ballor and Keesey. Engaging in fitness walking effectively accelerates fat decomposition and reduces body fat content [32].

In the human Android region, visceral fat is more prevalent, while the Gynoid region primarily consists of subcutaneous fat. In terms of fat in the trunk area, both water fitness walking and land fitness walking effectively decrease the fat content, with a significant reduction in waist circumference. Consequently, both activities can significantly mitigate the risk of cardiovascular diseases [33]. Owing to the unique physical properties of the aquatic environment, obese individuals can significantly diminish the ground reaction forces encountered in terrestrial exercises, thereby lowering the risk of sports-related injuries and enhancing their enthusiasm for training [34]. Because the water temperature is lower than the body temperature, water dissipates heat 26 times more effectively than air. Because the water temperature is lower than body temperature, more body heat is lost through water conduction during exercise, leading to increased energy consumption and decreased accumulation of body fat. In conclusion, water fitness walking is more effective than land fitness walking in reducing body fat.

### **Analysis of the Impact of Exercise in Two Different Environments on Muscle Content**

Lean body mass, also termed "fat-free mass", denotes the weight of all bodily components excluding fat, with muscle being the primary constituent. Research indicates that, after the age of 25, without engaging in physical exercise, the body's muscles will decrease by 1% annually, consequently leading to a decline in health [35]. Muscles adapt to exercise, manifesting as changes in both muscle volume and mass. Factors influencing these changes include the intensity, frequency, and rhythm of the exercise. Consequently, physical exercise can influence overall health and lean body mass

within a relatively short timeframe [36]. The prevailing theory of aerobic exercise suggests it can result in a reduction of lean body mass, yet it also increases intramuscular capillary mass, prompting the body to adapt to the exercise regimen. The findings of this study indicate that after a 4-week experimental exercise program, no significant changes were observed in the muscle content of participants in both the water and land groups. This can likely be attributed to the short duration and moderate intensity of the exercise protocol in the present study.

### Analysis of the Impact of Exercise on Bone Mineral Density in Two Different Environments

Bone mineral density (BMD) is a critical indicator of bone quality, providing insights into the extent of osteoporosis and effectively predicting the risk of fractures. Recent studies by scholars indicate that fat accumulation in the human body elevates the risk of osteoporosis, resulting in reduced bone mineral content and density. Peak bone mass is closely associated with body fat content [37]. During aerobic exercise intervention for obese individuals, weight loss frequently correlates with an increase in bone density [38]. The results of this study indicate that, following a 4-week exercise intervention, there was no significant change in bone density for participants in either the water group or the land group. Frost posits that bone loading is a critical determinant of bone mass and strength. This concept of bone loading extends beyond the mere body weight to include the force exerted by skeletal muscles on the bones. It is likely that there exists a threshold for the load applied by skeletal muscles, and only when this load surpasses the threshold does it trigger bone remodeling and the expression of related genes, increased bone function [39]. Therefore, the discrepancy between the research results and previous studies may be due to the combined effects of exercise intensity and volume not reaching the expression of relevant genes in bone tissue.

### Conclusion

Four weeks of water and land fitness walking can effectively enhance the aerobic exercise capacity of mildly obese male college students. There was a significant difference pre- and post-experiment, with the training effect of water fitness walking being more pronounced.

Four weeks of water fitness walking and land fitness walking can reduce the weight of mildly obese male college students, with significant differences before and after the experiment, but the training effect of water fitness walking is better.

Four weeks of aquatic fitness walking training significantly outperforms its terrestrial counterpart in reducing waist circumference, waist-to-hip ratio, and thigh circumference among mildly obese male college students, showing substantial differences pre- and post-experiment.

The impact of 4-week aquatic and terrestrial fitness walking training on height, chest circumference, muscle mass, and bone density remains unclear, with no significant differences observed pre- and post-experiment.

### References

1. Friedrich Rust M, Schoelzel F, Maier S, Seeger F, Rey J, et al. (2017) Severity of coronary artery disease is associated with non-alcoholic fatty liver disease: A single-blinded prospective mono-center study. *PLoS One* 26: e0186720.
2. Lee IM, Buchner DM (2008) The importance of walking to public health. *Med Sci Sports Exerc* 40: 512-518.
3. Shen Dijun (2016) Research on the impact of power walking on college students' physical health. *Youth Sports* 04: 117-118.
4. Ishida Kenji (2011) Underwater Exercise for Joint Disease. *Japanese Journal of Joint Diseases* 30: 95-100.
5. Lu Jialin, Sun Yu, Gao Kai (2021) Experimental study on the effect of aquatic and land aerobics on weight loss in obese college students [C]//Physical Training Branch of China Sports Science Society, National School Sports Federation (Swimming Project). Collection of Abstracts of the Third International Aquatic Sports Forum - Special Report 2021: 2.
6. Sun Qingzhu, Hao Wenting, Hong Feng (2011) Sports Measurement and Evaluation, 2nd edition. Beijing: Higher Education Press <https://www.amazon.com/College-Textbook-Physical-Measurement-Evaluation/dp/7040297019>.
7. Wang Xinbo (2014) Comparative study on the fat-reducing effects of high-intensity intermittent exercise and aerobic exercise. *Jilin Institute of Physical Education* <https://www.front-sci.com/journal/article?doi=10.32629/jher.v2i6.570>.
8. Suriano Katie, Jacqueline Curran, Susan M Byrne, Timothy W Jones, Elizabeth A Davis (2010) Fatness, fitness, and increased cardiovascular risk in young children. *The Journal of pediatrics* 157: 552-558.
9. Astrand PO, Rodahl K, Dahl HA, Sigmund B Stromme (2003) Textbook of work physiology: physiological bases of exercise. *Human kinetics* <https://lib.ugent.be/en/catalog/rug01:000881322>.
10. Conti A, Minganti C, Magini V, Felici F (2015) Cardiorespiratory of land and water walking on a non-motorized treadmill. *J Sports Med Phys Fitness* 55: 179-184.
11. Frangolias Despina Daisy, E C Rhodes, J E Taunton, A N Belcastro, K D Coutts (2000) Metabolic responses to prolonged work during treadmill and water immersion running. *Journal of Science and Medicine in Sport* 3: 476-492.
12. Meng Lin (2008) Study on the effects of water aerobics on body composition and some physiological indicators of obese middle-aged women. *Northeast Normal University* <https://en.nenu.edu.cn/info/1002/1924.htm#>.
13. Foster C, Crowe MP, Holum D, Sandvig S, Schrage M, et al. (1995) The bloodless lactate profile. *Med Sci Sports Exerc* 27: 927-933.
14. Xiao Guoqiang (1998) Research on aerobic training and anaerobic training in exercise and energy metabolism. Beijing: People's Sports Publishing House 6: 20-27.
15. Shen Pengfei (2021) Effects of land and water fitness running on the aerobic capacity and fat loss of obese male college students in general universities. *Hunan Normal University* 2021: 002119.
16. Town GP, Bradley SS (1991) Maximal metabolic responses of deep and shallow water running in trained runners. *Med Sci Sports Exerc* 23: 238-241.
17. Chu KS, Rhodes EC (2001) Physiological and cardiovascular changes associated with deep water running in the young. Possible implications for the elderly. *Sports Med* 31: 33-46.
18. Mushtaq MU, Gull S, Mushtaq K, Abdullah HM, Khurshid U, et al. (2012) Height, weight and BMI percentiles and nutritional status relative to the international growth references among Pakistani school- aged children. *BMC Pediatr* 12: 31.
19. Chinese Students' Physique and Health Research Group (1997) Chinese Students' Physique and Health Research. Beijing: People's Education Press 1997: 156-158.
20. Zhu Dalian (2008) Physiology. Shanghai: Fudan University Press <https://www.researchgate.net/scientific-contributions/Dalian-Zhu-16356876>.
21. Chen J, Guo Y, Gui Y, Xu D (2018) Physical exercise, gut, gut microbiota, and atherosclerotic cardiovascular diseases.

- Lipids Health Dis 17: 17.
22. Harsha DW, Bray GA (1996) Body composition and childhood obesity. *Endocrinol Metab Clin North Am* 25: 871-885.
  23. Liu Shanyun, Li Ruichen, Jia Qi (1998) Effects of aerobic exercise on hyperlipidemia and lipoprotein metabolism in mice. *Chinese Journal of Applied Physiology* 1998: 67-68.
  24. Yu Sumei (2001) Biological analysis of obesity and aerobic exercise weight loss (review). *Journal of Beijing Sport University* 2001: 62-63.
  25. Guo Yin, Chen Peijie, Chen Wenhe (2011) Effects of 4-week aerobic exercise on body shape, blood lipids and blood insulin in obese children and adolescents. *Chinese Journal of Sports Medicine* 30: 426-431.
  26. Nuttall FQ (2015) Body Mass Index: Obesity, BMI, and Health: A Critical Review. *Nutr Today* 50: 117-128.
  27. National Institutes of Health (1995) National Heart, Lung, and Blood Institute[C]/Global Initiative for Asthma Management and Prevention. NHLBI/WHO Workshop Report. National Institutes of Health, National Heart Lung, and Blood Institute <https://ginasthma.org/wp-content/uploads/2019/01/1995-GINA.pdf>.
  28. Koenen M, Hill MA, Cohen P, Sowers JR (2021) Obesity, Adipose Tissue and Vascular Dysfunction. *Circ Res* 128: 951-968.
  29. Tulloch Reid MK, Hanson RL, Sebring NG, Reynolds JC, Premkumar A, et al. (2004) Both subcutaneous and visceral adipose tissue correlate highly with insulin resistance in african americans. *Obes Res* 12: 1352-1359.
  30. Greene NP, Lambert BS, Greene ES, Aaron F Carbuhn, John S Green, et al. (2009) Comparative efficacy of water and land treadmill training for overweight or obese adults. *Med Sci Sports Exerc* 41: 1808-1815.
  31. Hamer M (2006) The anti-hypertensive effects of exercise. *Sports medicine* 36: 109-116.
  32. Ballor DL, Keeseey RE (1991) A meta-analysis of the factors affecting exercise-induced changes in body mass, fat mass and fat-free mass in males and females. *Int J Obes* 15: 717-726.
  33. Després JP (1993) Abdominal obesity as important component of insulin-resistance syndrome. *Nutrition* 9: 452-459.
  34. Jefferis BJ, Sartini C, Lee IM, Minkyoungh Choi, Antoinette Amuzu, et al. (2014) Adherence to physical activity guidelines in older adults, using objectively measured physical activity in a population-based study. *BMC public health* 14: 1-9.
  35. Paavo V (2004) Komi (Finland), ed.; Ma Tie, Gao Dongming, translators and reviewers. *Power and rapid force in sports*. Beijing: People's Sports Publishing House 208.
  36. Shen Jianwei, Ruan Boren (2008) *Basic Theory of Physical Fitness*. Beijing: People's Sports Publishing House 199.
  37. Weiler HA, Janzen L, Green K, Grabowski J, Seshia MM, et al. (2000) Percent body fat and bone mass in healthy Canadian females 10 to 19 years of age. *Bone* 27: 203-207.
  38. Gao Huan (2013) Effects of hypoxia and high-altitude endurance training on body composition, resting metabolism and exercise capacity of overweight and obese adolescents. *Shanghai Institute of Physical Education* 2013: 156.
  39. Frost HM (1997) On our age-related bone loss: insights from a new paradigm. *J Bone Miner Res* 12: 1539-1546.

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