

Exercise Load Research on Common Ball Skill Practice Way of Volleyball Specialized Course in Colleges and Universities

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Abstract

Teaching of physical education discipline not only requires students to master exercise skills, but also requires students to master teaching techniques of exercise skills. Reasonably arranging exercise load when exercising has significant influences on mastering exercise skills. However, researches on exercise load of common ball skill practice way of volleyball specialized course are still unclear at home and abroad currently. This paper discusses exercise load of common ball skill practice way of volleyball, with the purpose to provide reference basis for teaching design of volleyball specialized course of physical education discipline. This paper mainly adopts the experimental method with students of the volleyball specialized course of 2012 physical education discipline as experimental subject to analyze exercise load of common ball practice way of volleyball. In the experiment, those experiment subjects wear Actigraph instrument to record energy consumption data. Via statistic analysis model on experiment data, it obtains research conclusion as follows: for students of different genders, the same practice way has different exercise loads; practice load of jumping is larger than non-jumping items; similarly, for students of different genders, the same practice means has different practice loads; difference in load may also be caused by psychological factors and skill factors, etc.

Keywords: Volleyball Specialized Course; Ball Skills; Exercise Load Model; Colleges Physical Education

1 Introduction

Physical education discipline bears the heavy load of training high-quality interdisciplinary talents for the society, whether its education contents are reasonable will directly influence the level of sports talents conveyed to the society.

Therefore, physical education discipline of colleges and universities puts forward higher requirements on its the teaching of technical course. Teaching of technical course not only requires students to master exercise skills, but also requires students to master teaching techniques of exercise skills. At the same time, it also needs to reasonably arrange exercise load.

Nowadays, volleyball has become one of main courses of physical education discipline of colleges and universities, and plays the role that cannot be replaced by other exercise items in physical education of colleges and universities. Thus, research on exercise load of common volleyball practice means has certain necessity and importance.

1.1 RESEARCH STATUS OF EXERCISE LOAD

In the development of competitive sports, the fierce confrontation and competition between competitors inevitably require to reasonably arrange exercise load in daily training, and physical education of colleges also requires to reasonably arrange exercise load. What's more, a lot of experts and scholars in the sports circle are engaged in research on basic theory aspects of sports, and numerous research achievements have been published. Exercise load

is constituted of load intensity and load capacity, the former reflects exercise training's stimulation degree on the organism, while the latter reflects the number of practice that exercise load shows in the time limit.

1.2 RESEARCH STATUS OF BALL SKILL PRACTICE MEANS OF VOLLEYBALL

Research on ball skill practice way of volleyball started relatively later, the research contents are mainly focused on important and difficult points of teaching on passing and spiking balls, and there is rarely any research on serving a ball. "Teaching method research of positively passing volleyball" and "Ten methods of positively underhand passing volleyball by both hands" make detailed description on specific method, times and application stage of practice way.

2 Experiment

2.1 EXPERIMENTAL SUBJECT

24 boys and girls students (all of them have passed general course assessment of volleyball) are randomly selected from students of volleyball specialized course of 2012 physical education discipline of a university. To guarantee the scientificity and rationality of the experiment, test is made on the weight and height of these 24 students before experiment to ensure various indexes are within the normal scope. Besides, test is also made on volleyball level of these subjects to ensure the experiment accuracy. In order to ensure these subjects do not have high-intensity exercise

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the day before, these subjects keep an empty stomach before the experiment. For basic situation of these subjects, please refer to Sheet 2.1:

TABLE 1 Basic situation of these subjects

Gender	Height	Weight	BMI(kg/m ²)	Age
Boys (n=14)	181 ± 5.0	72.1 ± 6.5	22 ± 1.7	21 ± 1.0
Girls (n=10)	167.6 ± 3.7	56.9 ± 5.0	20.3 ± 1.8	20.4 ± 1.0

2.2 EXPERIMENT METHOD

2.2.1 Experiment instrument

- (1) Special height and weight meter for physical fitness test of undergraduates, which is used to test height (cm) and weight (kg) of experiment subjects.
- (2) American Actigraph GT3X triple-axis accelerometer, which is used to test physical activities of experiment subjects.
- (3) Actilife 5.10.0 software, which is used for GT3X proofreading, configuration and data processing, etc.
- (4) Weight meter model: M321404 produced by Midwest Yuanda Technology Co., Ltd
- (5) Height meter model: 81M304088 produced by Beijing Midwest Huabo Instrument Co., Ltd
- (6) Stopwatch Goldspink brand

2.2.2 Practice means

Via referring to a large amount of volleyball teaching materials of colleges and universities and consulting volleyball coach, by combining physical fitness conditions of undergraduates, common ball practice methods are selected as shown in Table 2.

TABLE 2 Common ball practice means of volleyball

	Practice means
Positive ball padding techniques by both hands	Padding volleyball by two students
	Self- padding volleyball against the wall
	Self- padding volleyball by moving
	Padding combination
	Padding volleyball between two students
Positive passing techniques by both hands	Throwing volleyball by to people
	Self- passing volleyball against the wall
	Self- passing volleyball by moving
	Combination practice
	Passing between two students
	Passing and padding volleyball by moving
Positive overhand service techniques	Serving volleyball against the wall
	6m serving volleyball continuously
	9m serving volleyball continuously
	Serving volleyball of different areas
	Serving volleyball of different routes
Positive spiking techniques	Spiking against the wall
	Spiking and throwing volleyball

	by two students
	Self- throwing and self- spiking
	6m spiking continuously
	Spiking volleyball of different routes
Blocking techniques	Taking off and blocking on the spot
	Single-step blocking on the spot
	One throwing and one blocking
	Marking through the net

2.2.3 CONTROL ON EXPERIMENT FACTORS

- (1) In view of individual difference between instruments, test is made as the same student wear many instruments for the same exercise, and the result stays the same.
- (2) In view of influence of rest on testing effect, at the stage of pre-experiment, 1min, 2min, 3min, and 4min are respectively chosen when practicing as time intervals, and statistical test is also mad eon the result, which shows no difference exists for various rest times in passing and padding practice, 1min is selected as rest time; 2min, 3min and 4min do not have any difference in passing, blocking and spiking, and 2min is selected as rest time.
- (3) In view of accuracy of experiment data, in the rest time, the subjects are not allowed to increase any other exercises privately, instruments must be taken off, and they must practice as per correct teaching motions in the experiment process.
- (4) In case of interrupt during practice, immediately record the interrupt time and the time of continuing practice, to ensure data accuracy.
- (5) Use 5cm white line to control drop point of ball in the practice means. As for spiking means and serving means, respectively test net height of boys and girls.
- (6) Divide these subjects into 12 groups with two as a group, number every group, reasonably control starting time of every practice means, of which, 4 supergroups for spiking, serving and blocking volleyball, and there are 3 mini-groups in every supergroup, test them in turns, and record it via stopwatch.
- (7) The experiment is made in two times, the first test is for padding and spiking practice means; while the second test is for practice means of passing, serving and blocking volleyball.

2.2.4 Processing and analysis on experiment result

Via conveying data in actigraph by Actilife 5.10.0, as per the difference in time of every practice means, experiment data is sampled. Firstly, tested original data is transferred into data of “1 min” sampling frequency; secondly, eliminate weight’s influence on energy consumption, that is, convert original data into energy consumption of (kg⁻¹*min⁻¹); finally, data result of experiment is calculated as per gender respectively. Screen and sort out data obtained, and make the following analysis:

- (1) One-way analysis of variance is adopted to test whether difference between mean values of various level groups of a dependent variable influenced by a single factor has statistical significance. Factor variance analysis method is adopted in the paper, which takes common practice means of ball skills of volleyball as factor, and

exercise load of practice means of every student as dependent variable, to analyze the influence of different practice means on exercise load, and also sort out the exercise load of every practice means.

(2) Independent-sample T test is to make T test on mean value of mutually independent samples from two normal populations. Independent-sample T test is adopted in the paper, which takes average consumption energy of every practice means as test variable, and gender as group variable to test whether any difference exists in average energy consumption of similar practice means of different genders.

3 Data and Analysis

3.1 CHARACTERISTICS OF VARIOUS EXERCISE LOADS

Table 3. analyzes general exercise load of ball skills of both boys and girls, which shows that exercise load of girls is larger than girls (P<0.01).

TABLE 3 Load comparison sheet of boys and girls

Index	Load of boys(kcal)	Load of girls (kcal)
Total energy	3.142 ± 0.384	6.026 ± 0.589**

Note: express P<0.01

3.1.1 Practice of padding

TABLE 4 Comparison sheet of padding practice load of boys

Index	Self-padding against wall	Self-padding by moving	Padding combination practice	Padding between two students
Throwing padding	**	*	*	*
Self- padding against wall	-	**	*	*
Self- padding by moving	**	-	**	**
Padding combination practice	*	**	-	-

Note: *express P<0.05; **<0.01

TABLE 5 Comparison sheet of padding practice load of girls

Index	Self-padding against wall	Self-padding by moving	Padding combination practice	Padding between two students
Throwing padding	*	**	*	-
Self- padding against wall	-	-	**	*
Self- padding by moving	-	-	**	**
Padding combination practice	**	**	-	*

Note: *express P<0.05; **<0.01

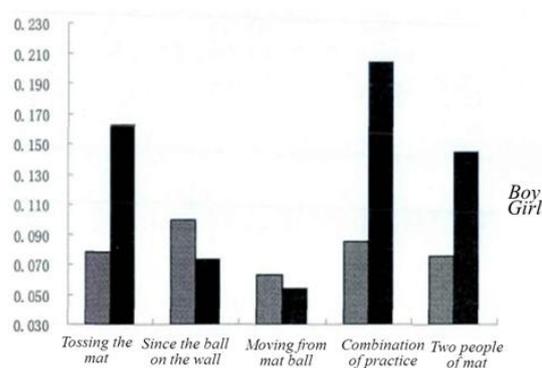


FIGURE 1. Relative energy consumption of padding practice means

It can be seen from Table 4 that, in addition to combination practice and padding between two students, no difference exists for padding practice of boys, and energy consumption of all other means has difference. Via observation by combining with Figure 2, ranking result of padding practice load of boys is: self- padding against wall >padding combination practice and padding between two students>throwing padding of two students > self- padding by moving; combing with Table 5 and Figure 1, it can be seen that ranking result of padding practice load of girls is:

Padding combination practice>padding between two students and throwing padding of two students >self- padding against wall and self- padding by moving, no difference exists for energy consumption of padding between two students and throwing padding of two students, and no difference exists for energy consumption of self- padding against wall and self- padding by moving.

It can be seen from Figure 1 that self- padding against wall and padding combination practice are respectively practice means with the largest energy consumption for boys and girls, while self- padding by moving is the practice means with the least energy consumption for boys and girls. Of them, energy consumption difference for boys and girls in padding combination practice ranks the top. Padding combination practice has the highest requirements on energy consumption difference for boys and girls. Padding combination practice has relatively high requirements on practicer's skill proficiency and control capacity. Thus, it can be inferred from the sheet that the level of padding combination skill for boys is higher than girls.

3.1.2 Passing practice

TABLE 6 Comparison sheet of passing practice load for boys

Index	Self-passing against wall	Self-passing by moving	Passing combination practice	Passing between two students
Throwing passing	*	*	*	*
Self- passing against wall	-	**	*	*
Self- passing by moving	**	-	-	-
Passing combination practice	*	-	-	-

Note: *express P<0.05; **<0.01

TABLE 7 Comparison sheet of passing practice load for girls

Index	Self-passing against wall	Self-passing by moving	Passing combination practice	Passing between two students
Throwing passing	*	*	*	*
Self-passing against wall	-	*	**	*
Self-passing by moving	*	-	**	**
Passing combination practice	**	**	-	-

Note: *express P<0.05; **<0.01

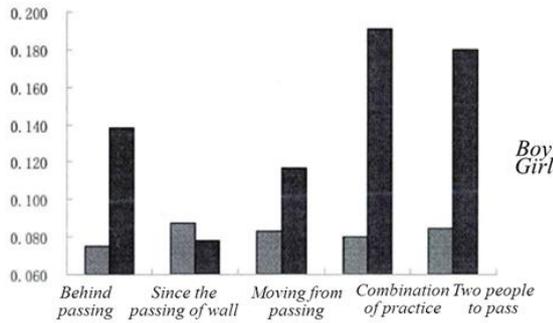


FIGURE 2 Relative energy consumption of common passing practice means

3.1.3 Serving practice

TABLE 8 Comparison sheet of serving practice load for boys

Index	6m serving	9m serving	Ball of different routes	Ball of different areas
Serving against wall	**	*	*	-
6m serving	-	**	**	**
9m serving	**	-	**	**
Serving ball of different routes	**	**	-	*

Note: *express P<0.05; **<0.01

TABLE 9 Comparison sheet of serving practice load for girls

Index	6m serving	9m serving	Ball of different routes	Ball of different areas
Serving against wall	*	**	*	-
6m serving	-	**	**	**
9m serving	**	-	*	**
Serving ball of different routes	**	*	-	*

Note: *express P<0.05; **<0.01

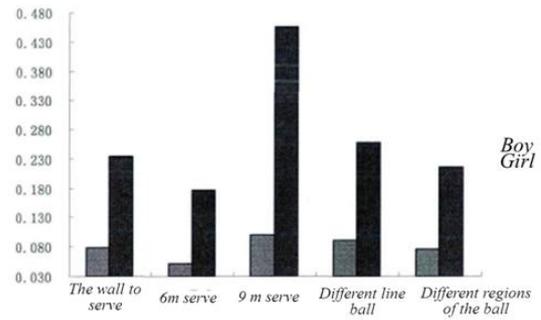


FIGURE 3 Relative energy consumption of common passing practice means

3.1.4 Spiking practice

TABLE 10 Comparison sheet of spiking practice load for boys

Index	Spiking throwing ball	Self-throwing and self-spiking	Spiking between two students	Spiking ball of different routes
Spiking against wall	**	**	*	**
Spiking throwing ball	-	-	**	**
Self-throwing and self-spiking	-	-	**	**
Spiking between two students	**	**	-	**

Note: *express P<0.05; **<0.01

TABLE 11 Comparison sheet of spiking practice load for boys

Index	Spiking throwing ball	Self-throwing and self-spiking	Spiking between two students	Spiking ball of different routes
Spiking against wall	**	**	**	**
Spiking throwing ball	-	**	**	**
Self-throwing and self-spiking	**	-	**	**
Spiking between two students	**	**	-	*

Note: *express P<0.05; **<0.01

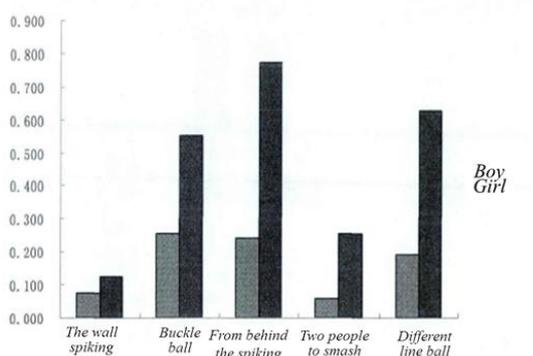


FIGURE 4 Relative energy consumption of common spiking practice means

3.1.5 Blocking practice

Accompanying probability for common blocking means F test for boys is $p=0.435>0.05$, that is, no difference exists in common blocking practice means energy consumption for boys, thus, it will not be discussed here.

TABLE 12 Comparison sheet of blocking practice load for girls

Index	Single-step blocking by moving	One throwing and one blocking	Marking through net
Blocking on the spot	**	**	**
Single-step blocking by moving	-	**	**
One throwing and one blocking	**	-	**

Note: *express $P<0.05$; ** <0.01

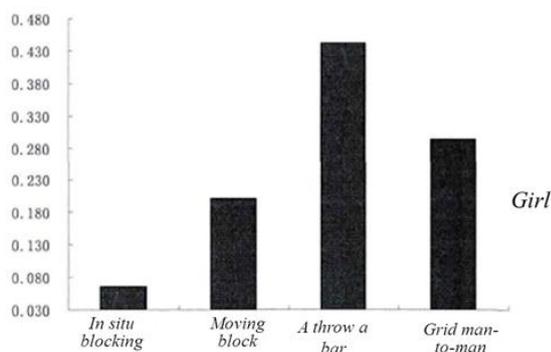


FIGURE 5 Relative energy consumption of common blocking practice means

TABLE 13 Load sheet of various practice means for boys and girls

Index	Relative energy consumption of boys	Relative energy consumption of girls	
Padding	Throwing padding	0.078 ± 0.022	0.162 ± 0.063
	Self- padding against wall	0.099 ± 0.022	0.073 ± 0.017
	Self- padding by moving	0.062 ± 0.018	0.053 ± 0.005
	Combination practice	0.084 ± 0.015	0.204 ± 0.072

Passing	Padding between two students	0.084 ± 0.017	0.144 ± 0.052
	Throwing passing	0.075 ± 0.009	0.137 ± 0.047
	Self- passing against wall	0.087 ± 0.023	0.078 ± 0.024
	Self- passing by moving	0.083 ± 0.015	0.116 ± 0.020
	Combination practice	0.079 ± 0.013	0.190 ± 0.090
Serving	Passing between two students	0.084 ± 0.012	0.179 ± 0.066
	Serving against wall	0.078 ± 0.007	0.233 ± 0.043
	6m serving	0.052 ± 0.014	0.177 ± 0.071
	9m serving	0.095 ± 0.026	0.456 ± 0.060
Spiking	Serving ball of different routes	0.092 ± 0.019	0.258 ± 0.046
	Ball of different areas	0.076 ± 0.014	0.217 ± 0.045
	Spiking against wall	0.073 ± 0.010	0.126 ± 0.023
	Spiking throwing ball	0.253 ± 0.064	0.550 ± 0.039
	Self- throwing and self- spiking	0.241 ± 0.035	0.775 ± 0.087
Blocking	Spiking between two students	0.058 ± 0.014	0.253 ± 0.05
	Ball of different routes	0.192 ± 0.029	0.629 ± 0.050
	Blocking on the spot	0.258 ± 0.039	0.067 ± 0.033
	Single-step blocking by moving	0.325 ± 0.105	0.201 ± 0.047
Blocking	One throwing and one blocking	0.284 ± 0.145	0.443 ± 0.061
	Marking through net	0.273 ± 0.071	0.294 ± 0.074

3.2 LOAD COMPARISON OF VARIOUS PRACTICE MEANS

3.2.1 Comparison as per technical classification

TABLE 14 Load comparison sheet of various practice means for boys and girls

Index	Load of boys	Load of girls
Padding	$0.082 \pm 0.815^*$	0.128 ± 0.039
Passing	$0.082 \pm 0.010^{**}$	0.141 ± 0.042
Serving	$0.072 \pm 0.011^{**}$	0.268 ± 0.031
Spiking	$0.164 \pm 0.022^{**}$	0.467 ± 0.028
Blocking	0.286 ± 0.056	0.251 ± 0.036

Note: *express $P<0.05$; ** <0.01

TABLE 15 Load comparison sheet of various practice means for boys

Index	Passing	Serving	Spiking	Blocking
Padding	-	-	**	**
Passing	-	-	**	**
Serving	-	-	**	**
Spiking	*	**	-	**

Note: *express $P<0.05$; ** <0.01

TABLE 16 Load comparison sheet of various practice means for girls

Index	Passing	Serving	Spiking	Blocking
Padding	-	**	**	**
Passing	-	**	**	**
Serving	**	-	**	**
Spiking	**	**	-	**
Blocking	*	**	**	-

Note: *express P<0.05; **<0.01

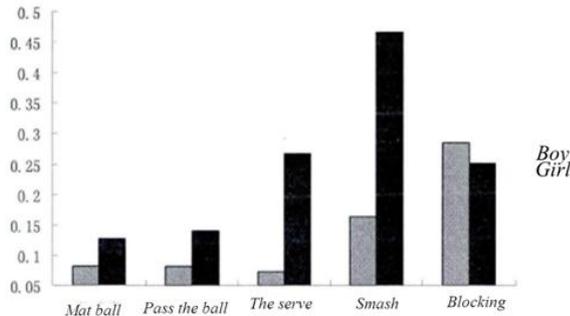


FIGURE 6 Average relative energy consumption of various practice means

3.2.2 Comparison as per practice mode

As per practice mode and supplementary means, it can be divided into throwing practice type of two students, moving type, route type, combination type, practice type against wall, and practice type between two students.

TABLE 17 Load sheet as per practice mode classification

Index	Boys	Girls
Combination	0.084 ± 0.011	0.080 ± 0.012
Route	0.118 ± 0.015	0.124 ± 0.012
Throwing practice	0.136 ± 0.027*	0.163 ± 0.022
Against wall	0.085 ± 0.011**	0.065 ± 0.009
Moving	0.116 ± 0.016**	0.153 ± 0.022
Practice between two students	0.070 ± 0.013	0.061 ± 0.009

Note: *express P<0.05; **<0.01

TABLE 18 Load comparison sheet for boys as per practice mode classification

Index	Route	Throwing practice	Against wall	Moving	Practice between two students
Combination	**	**	-	**	*
Route	-	**	**	-	**
Throwing practice	**	-	**	**	**
Against wall	**	**	-	**	**
Moving	-	**	**	-	**

Note: *express P<0.05; **<0.01

TABLE 19 Load comparison sheet for girls as per practice mode classification

Index	Route	Throwing	Against	Moving	Practice
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	practice	wall		between two students
Combination	**	**	*	**
Route	-	**	**	**
Throwing practice	**	-	**	*
Against wall	**	**	-	**
Moving	**	*	**	-

Note: *express P<0.05; **<0.01

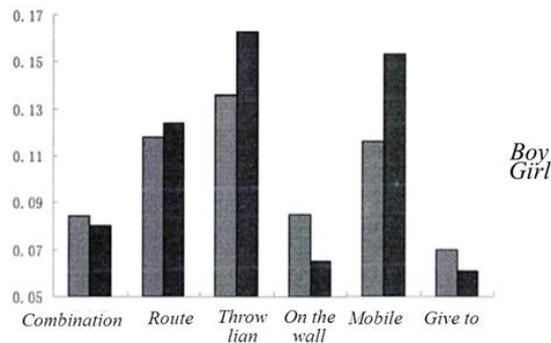


FIGURE 7 Relative energy consumption of different practice modes

It can be seen from Table 18 and Figure 7 that energy consumption of the same practice means for boys and girls is of M distribution, and the largest and least energy consumption means are the same. Thus, for boys and girls, the rule for practice load to change with mode is the same.

3.3 INTENSITY COMPARISON OF VARIOUS PRACTICE MEANS

3.3.1 Comparison as per technical classification

The physiology defines exercise intensity as energy consumption of human body within unit time, in this paper, the unit measuring energy consumption is MET. For the convenience of research in the paper, as per the following formula:

$$\text{Energy (kcal/min)} = \text{MET} * 3.5 * \text{kg} / 200^{30} \quad (1)$$

For conversion between energy consumption and MET, please refer to Table 20 and Table 21.

TABLE 20 Exercise intensity division

Exercise intensity	Small intensity	Medium intensity	Large intensity	Strenuous exercise
Energy consumption	1.5-3	3-6	6-9	>9

TABLE 21 Exercise intensity division of various practice means

Index	Load of boys	Exercise intensity	Load of girls	Exercise intensity
Padding	4.69	Medium intensity	7.31	Large intensity
Passing	4.69	Medium intensity	8.06	Large intensity
Serving	4.11	Medium intensity	15.31	Strenuous exercise
Spiking	9.37	Strenuous exercise	26.69	Strenuous exercise
Blocking	16.34	Strenuous exercise	14.34	Strenuous exercise

It can be seen from Table 21 that various levels of practice means can be divided, volleyball is a controllable large intensity exercise, and the practice time and rest time may vary with each individual. In volleyball teaching, the entire practice intensity can be arranged reasonably as per practice exercise intensity of different classifications.

3.3.2 Comparison as per practice mode

TABLE 22 Exercise intensity division of the same practice mode and practice means

Index	Load of boys	Exercise intensity	Load of girls	Exercise intensity
Padding	4.80	Medium intensity	4.57	Medium intensity
Route	6.74	Large intensity	7.09	Large intensity
Throwing	7.77	Large intensity	8.91	Large intensity
Against wall	4.86	Medium intensity	3.71	Medium intensity
Moving	6.63	Large intensity	8.74	Large intensity
Practice between two students	4.00	Medium intensity	3.49	Medium intensity

It can be seen from comparison in Table 21 and Table 22 that exercise intensity of the same practice mode and practice means are more reasonable than common five practice means.

In order to specify exercise intensity of various practice means, analysis is made on intensity of practice means one by one, and the result is shown in Table 23.

The intensity of practice means for boys is mainly medium, six practice intensities are strenuous exercise, of which, the intensity of spiking throwing ball ranks the top, and self- padding by moving ranks at the bottom. Practice means for girls are mainly large intensity and strenuous intensity exercises, of which , 4 are medium intensity exercises. Of them, the intensity of self-throwing and self-spiking ranks the top, while self- passing by moving ranks at the bottom.

	Index	Load of boys	Intensity degree	Load of girls	Intensity degree
Padding	Throwing padding	4.48	Medium	8.98	Large intensity
	Self- padding against wall	5.66	Medium	4.2	Medium
	Self- padding by moving	3.59	Medium	3.08	Medium
	Combination practice	4.85	Medium	8.6	Large intensity
	Padding between two students	4.85	Medium	7.24	Large intensity
Passing	Throwing passing	4.29	Medium	6.88	Large intensity
	Self- passing against wall	4.99	Medium	4.47	Medium
	Self- passing by moving	4.75	Medium	6.66	Large intensity
	Combination practice	4.56	Medium	7.8	Large intensity
	Passing	4.8	Medium	8.2	Large

	between two students				intensity
	Serving against wall	4.48	Medium	9.3	Strenuous
	6m serving	3.01	Medium	8.1	Large intensity
	9m serving	5.46	Medium	17	Strenuous
	Serving ball of different routes	5.27	Medium	10.7	Strenuous
Spiking	Ball of different areas	4.35	Strenuous	10.4	Strenuous
	Spiking against wall	4.18	Strenuous	7.25	
	Spiking throwing ball	15.4	Medium	21.4	Strenuous
	Self-throwing and self- spiking	14.7	Strenuous	24.3	Strenuous
	Spiking between two students	5.34	Strenuous	9.4	Strenuous
	Ball of different routes	10.9	Strenuous	21.9	Strenuous
Blocking	Blocking on the spot	14.7	Strenuous	8.8	Medium
	Single-step blocking by moving	13.6	Strenuous	11.5	Strenuous
	One throwing and one blocking	14.2	Strenuous	21.3	Strenuous
	Marking through net	12.60	Strenuous	16.80	Strenuous

3.4 ANALYSIS ON FACTORS INFLUENCING EXERCISE LOAD

Excluding the influences of gender and physical factors of the subject on exercise load, different feelings, perceptions, and skill factors of individuals will lead to differences in individual’s exercise load in practice.

4 Conclusion

(1) Means with the largest and least load in various basic skill practice means are shown in Table 24:

TABLE 24 Means with the largest and least load in basic skill practice means

	Index	Boys	Girls
Padding	Largest	Self padding against wall	Padding combination
	Least	Self padding by moving	Self- padding against wall, self- padding against wall
Passing	Largest	Passing against wall, passing by moving, passing between two students	Passing between two students, passing combination
	Least	Throwing passing	Self- passing against wall
Serving	Largest	9m serving	9m serving
	Least	6m serving	6m serving
Spiking	Largest	Self-throwing and self-spiking, spiking	Self- throwing and self- spiking

		throwing ball	
	Least	Spiking between two students	Spiking against wall
Blocking	Largest		One throwing and one blocking
	Least	No difference	Blocking on the spot

- (2) Load brought by the same mode of practice means on students of different genders may also be different. Load brought to boys and girls of combination type, route type, and practice between two students are the same; the load of girls for throwing practice of two students, and practice by moving is larger than boys; in addition to blocking, with the same skill practice, the load of girls is larger than boys. For boys and girls, the rule for practice load to change with mode is the same.
- (3) Under the same practice condition, load of jumping practice is larger than non-jumping practice.
- (4) For practice of the same skills, students of different genders may have different exercise intensities, skill

- practice of boys belongs to large intensity activity, while skill practice of girls belongs to strenuous exercise; for the same practice mode, exercise intensity of boys and girls stays the same, and the intensity lies between medium intensity and large intensity.
- (5) Factors causing difference in practice mode include skill factor and psychological factor. The higher the practicer's space perception is, the exacter their judgment on ball direction, speed and distance will be; the stronger time perception is, the better mastering of exercise rhythm will be; the stronger the exercise perception is, the smoother the motion completion will be; the higher the skill proficiency is, the less the energy consumption will be, the more the skill complexity is, the harder for it to be mastered and the more the energy consumption will be.

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