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ORIGINAL

REAL-TIME ATHLETE STATUS FEEDBACK AND GUIDANCE BASED ON SMART WEARABLE DEVICES

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ABSTRACT

Physical training for basketball players is important for improving the overall economic level of athletes. Smart wearable devices can enable coaches and athletes to plan and adjust training more scientifically and accurately by monitoring and recording athletes' physiological data and sports performance in real time. In this study, two sports physiological indexes, heart rate and blood oxygen saturation, were monitored and recorded by Xiaomi sports band 7 for basketball players, and a comparative study was conducted on the physical training process of adolescent female basketball players. The experiment proves that the real-time heart rate and blood oxygen saturation parameters provided by Xiaomi sports band 7 can reflect the athlete's body's adaptation to the training content in real time, and the coaches can better grasp the athlete's physical fitness level and improve the training effect by adjusting the training intensity.

KEYWORDS: smart wearable devices; feedback; guidance; physical training

1. INTRODUCTION

Wearable devices are becoming more and more widely used in sports with the rapid development of IoT and artificial intelligence technologies (Chen, Han, Zhang, You, & Zheng, 2023; Chen, Li, et al., 2023; Li & Cao, 2021). They not only provide athletes with real-time data and feedback, but also play an important role in training, technical improvement, and injury prevention. Wearable devices can monitor an athlete's heart rate, steps, speed, distance and other data and record them to help athletes understand their training. Certain wearable devices can alert the user when abnormalities are detected

or send a signal for help in an emergency, improving training safety (Agyingi, Wiandt, & Ngwa, 2017). In the field of competitive sports training, smart wearable devices promote a data-driven training process by monitoring and recording athletes' physiological data and athletic performance in real time. Coaches and athletes can make more scientific and precise training planning and adjustments based on this data. Not only that, coaches are able to wear the specific data collected by the wearable devices for each individual to develop training plans for each athlete to provide personalized training guidance and provide targeted feedback. At the same time, during the training process, coaches monitor and analyze the athletes' movement trajectory and technical performance to help athletes improve their technical movements and raise their competitive level. In addition, wearable devices can monitor athletes' physical condition, such as posture and fatigue level, which helps prevent athletic injuries. Also, during the rehabilitation phase, these devices can provide guidance and monitoring to accelerate the recovery process (Albert Chakona, 2022).

Basketball as a sport with intense confrontation, in basketball games, athletes often need to carry out a large number of intense confrontation and repeated running, which is a great physical consumption of athletes. In order to improve the physical performance of athletes, it is necessary to strengthen the physical training of athletes in basketball training, and actively take effective measures to enhance physical performance and improve the effect of basketball training. Excellent physical fitness quality is the key for excellent athletes to score strongly in the confrontation, and is also the core of excellent athletes' technical performance ability and tactical execution ability, scientific and reasonable training can make physical fitness enhancement twice as effective with half the effort. Morrison et al (Morrison et al., 2022) proposed an analysis of the characteristics of physical fitness of basketball players, extracted the physical characteristics of elite basketball players and introduced a large number of tests, and came to the conclusion that the characteristics of physical fitness have a great impact on the physical training of basketball . Feito et al (Feito, Heinrich, Butcher, & Poston, 2018) pointed out that high-intensity functional training is a kind of multifunctional, multi-joint movement exercise, which can adjust the human body's level of health, and compared with the traditional way of physical training, high-intensity functional training can better stimulate the muscular strength and endurance, and improve the human body's metabolism and cardiorespiratory adaptability.

Traditional physical training relies on the coaches' subjective judgment of training intensity and exercise load, and it is questionable whether the training effect reaches the athletes' optimal competitive state. In recent years, with the synergistic development of science and technology and training, the combination of electronic equipment and sports training is becoming more and more close, coaches through scientific and technological equipment to

accurately monitor the physical state of the athlete, can scientifically determine the degree of fatigue and suitable training state to control the training process. Nunes et al (Nunes et al., 2014) pointed out that athletes can be physically and mentally fatigued by high-intensity basketball exercise during training and competition, which may even affect their performance ability during the season. In order to enable athletes to perform well throughout the basketball season, it is important that they have a good understanding of their physical and mental health. In order to maintain optimal training and competition level of athletes throughout the basketball season, it is possible to manage the fatigue system of athletes and intervene using exercise monitoring. Seshadri et al (Seshadri et al., 2019) suggested that athletes prefer to use wearable sensors to monitor training and recovery in order to keep track of their health and maximize their athletic performance.

As a convenient wearable electronic device, the sports bracelet integrates various functions such as health management, sports monitoring, and smart reminders, among which by tracking athletes' sports data such as steps, speed, running distance, heart rate, etc., it can help coaches better understand the physical condition of each athlete and the training effect, so as to carry out personalized guidance and adjust the training plan. At the same time, the sports bracelet can also provide real-time feedback to help athletes control the training intensity and achieve the best state. Sports bracelets can help manage physical training, improve training results, and help prevent over-training and injuries in basketball physical training.

Figure 1: Xiaomi Sport Band 7

In this study, Xiaomi Sport Band 7 (Figure 1) was used to monitor and record the two sports physiological indexes of heart rate and oxygen saturation of basketball players, so as to scientifically and reasonably control the training process, with a view to obtaining better physical fitness qualities of the athletes.

2. Objects of study

In this paper, the impact of sports bracelet monitoring on the physical training effect of high school girls' basketball players as the object of study, a high school in Zhengzhou, high school girls' basketball team 10 athletes as the experimental object, using simple random sampling method is divided into two groups of players, one group for the experimental group, one group for the control group, each group of 5 players, the athlete's basic information is shown in Tables 1, 2:

Table 1: Basic information of students in the experimental group (n=5)

NO.	HEIGHT (CM)	WEIGHT (KG)	AGE	TRAINING YEARS
1	179	76	17	5
2	166	55	15	3
3	171	67	17	3
4	175	64	16	3
5	167	51	15	3

Table 2: Basic information of students in the control group (n=5)

NO.	HEIGHT (CM)	WEIGHT (KG)	AGE	TRAINING YEARS
1	169	71	17	6
2	171	62	16	3
3	166	56	16	4
4	178	78	15	3
5	171	62	17	3

As shown in Table 3, by statistically analyzing the height, weight, age, and years of training of the two groups of athletes, the P-values of the comparison of the two groups of experimental subjects were obtained as 0.943, 0.636, 0.738, 0.583, and all the four categories of data were greater than 0.05, so it can be concluded that there is no significant difference between the two groups of experimental subjects, and it meets the requirements of the experiment.

Table 3: Analysis of basic information of experimental subjects

GROUP	EXPERIMENTAL GROUP M±SD	CONTROL GROUP M±SD	F	T	P
HEIGHT(CM)	171.6±5.46	171±4.42	0.125	-0.069	0.943
WEIGHT(KG)	62.6±9.91	65.8±8.67	0.026	-0.488	0.636
AGE	16±1	16.2±0.84	0.330	-0.343	0.738
TRAINING YEARS	3.4±0.89	3.8±1.3	0.612	-0.566	0.583

Note: *M is the mean, SD is the standard deviation; F is the ratio of two means, P>0.05 means no significant difference, P<0.05 means significant difference*.

3. Methodology

In this study, 10 athletes from a middle school girls' basketball team in Zhengzhou were divided into an experimental group and a control group by simple random sampling method. The experimental group wore Xiaomi sports bracelets7 to monitor the changes in the three main physiological indicators of resting heart rate, immediate heart rate and oxygen saturation in different training programs during physical training, and to regulate the amount and intensity of training in this way. By organizing and analyzing the test scores of the two groups before, during and after the experiment, we explored the influence of sports bracelet monitoring on the physical training effect of high school girls' basketball.

3.1 Time and place of experiment

From October 13, 2021 to December 17, 2021, the indicators of 10 subjects were tested and trained in the basketball gymnasium, track and field, and strength room of a middle school in Zhengzhou.

3.2 Experimental controls

(1) Before physical training, the experimental group uniformly wore a Xiaomi sports band 7 on the left wrist. Before each physical training session, the athletes were warmed up sufficiently to ensure that their physical condition was ready for training.

(2) The experimental group used Xiaomi sports band 7 to monitor their resting heart rate, immediate heart rate and blood oxygen saturation, and adjusted the load and interval time of the training content strictly according to the monitoring situation, while the control group trained according to the traditional training methods.

(3) The experiment was conducted for a total of 10 weeks, three times a week, with two groups at the same time. The two groups strictly followed the training program, and in addition to the experimental training, the athletes of the two groups also practiced basketball skills and tactics at other times.

(4) Due to the epidemic, the school was closed, and the third test of the experiment was organized and conducted through the school's coaching staff, with students in the experimental group recording their own data on individual physiological indicators and sending them to themselves.

3.3 Experimental procedures

1) Before the experiment: the basic information of 10 athletes was recorded, including name, height, weight, age, and years of training. In order to ensure that there is no significant difference between the experimental subjects,

this study was conducted on October 13, 2021 for the pre-experimental testing of five test indexes: 15m×17 times of return running, weighted deep squat, PRO agility test, and one-step upward longitudinal jump in situ to touch the height.

(2) The fifth week of the experiment: after the end of the first phase (adaptation phase) and the second phase (accumulation phase) of the experiment, the study was conducted on November 14th to test the five test indexes of the experiment, namely, 15m × 17 repetitive running, weighted squatting, PRO agility test, and one-step longitudinal jump and touching the height in the same place.

(3) The tenth week of the experiment: at the end of the third stage (advanced stage) and the fourth stage (intensive stage) of the experiment, the study was conducted on December 17th to conduct the post-experimental test of the five test indexes of 15m×17 repetitive running, weighted deep squatting, PRO agility test, and one-step upward longitudinal jump in situ to touch the height.

3.4 Experimental indicators

Through inquiring the related literature about the physical fitness of basketball players at home and abroad, taking the "Chinese Basketball Association Basketball Player Technical and Physical Fitness Test and Evaluation Manual" as the standard, combining the domestic and international literature and interview data, the experimental test indexes were determined, as shown in the following Table 4:

Table 4: Experimental test indexes

TEST CONTENT	TEST METRICS
MOVING SPEED AND SPEED ENDURANCE TEST	The 15m×17 times return run
MUSCLE STRENGTH ENDURANCE TEST	Weighted squat test index
SENSITIVE COORDINATION TEST	PRO Agile Test Metrics
LOWER EXTREMITY EXPLOSIVE STRENGTH TESTS	In-Place Step-Up Vertical Jump Touch Test

Note: *The experimental test indexes are from the Youth Men's and Women's Basketball Edition of the Chinese Basketball Association Basketball Players' Technical and Physical Fitness Test and Evaluation Manual.*

3.5 Experimental training program

Weekly physical training is arranged on Monday, Wednesday and Saturday at 17:00 p.m., and each training session lasts 90 minutes, and the training volume and intensity of training are adjusted according to the athletes' physical condition during the training period. Figure 2 shows the physical

training process of the experimental group and the control group. The two groups of subjects warmed up in a uniform way, and the warm-up time was 20 minutes, including jogging and flexibility stretching. Before the formal training, the heart rate and oxygen saturation of the experimental group were monitored, and the heart rate was maintained at 110-120 beats per minute, and the oxygen saturation was maintained at 95%-99%, and the action training could be started, and the heart rate and oxygen saturation were monitored again at the end of each action, and the interval between groups was carried out after reaching the prescribed physiological index interval; If the prescribed physiologic index interval is not reached, repeat the last exercise until the prescribed physiologic index interval is reached; If the prescribed physiological index interval is exceeded, the interval time will be extended. At the end of the interval time, heart rate and oxygen saturation were observed again, and the training was resumed to a trainable state; if not, the training was resumed to a trainable state and the interval was continued. After completing the required number of groups in each group, the training of the next movement was started, and the training process of each movement was consistent. The control group performed training and intervals according to the load and interval time established in the training program.

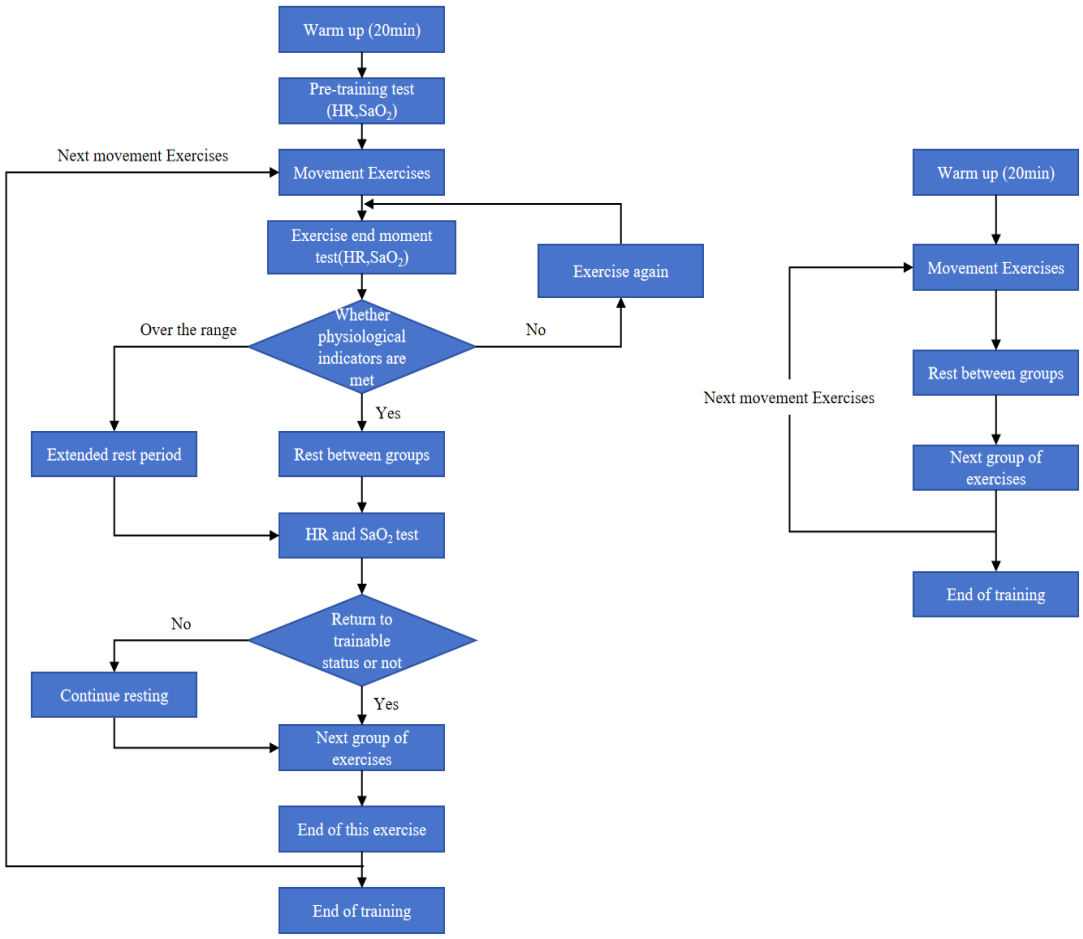

Figure 2: Flow chart of physical training in the experimental and control groups

The main contents of the physical training program arrangement include core strength, upper body strength, lower body strength, coordination and sensitivity, speed endurance, the specific training sequence is:

First, pre-training warm-up, arranged in the track and field or basketball court jogging; Second, flexibility stretching, athletes perform in situ or marching preparation activities; Three, coordinated agility training on the basketball court, where auxiliary equipment such as marking buckets, agility ladders and hurdle racks will be used; Fourth, strength training in the strength room, following the "from top to bottom, from large muscle groups to small muscle groups" training principles; Fifth, flexibility and relaxation exercises, a group of two people stretching each other; sixth, the end of training, finishing equipment.

3.6 Mathematical statistics

All data organization and statistical analysis in this study were done on SPSS26.0 statistical software and Excel sheet. In the course of the study, the test data obtained from the members of the experimental and control groups before, during and after the experiment were screened and transformed, and the statistical analysis in SPSS26.0 was used to compare whether there were any differences between the two groups of experimental subjects.

Independent samples t-test was used to analyze the data of the seven test indicators between the groups (Pan, 2024). Paired samples T-test was used to analyze the data of the seven test indicators within the group to analyze whether there is any difference; inductive processing, statistical analysis, assessing whether the data are significant or not, and providing mathematical support for this study.

4. Experimental results and analysis

4.1 Changes and analysis of maximum heart rate in experimental group

Figure 3 shows the maximum values of heart rate during 30 physical training sessions recorded by the five subjects in the experimental group during the 10 weeks of the experiment. As can be seen from the figure, the maximum values of heart rate during physical training of the five subjects in the experimental group were in the range of 140-180 beats/min, which is in line with the range of the optimal heart rate for 15-17 year olds (Umetani, Singer, McCraty, & Atkinson, 1998).

The characteristics of heart rate changes in each phase of training were similar, and the overall situation showed a kind of overlap. During the 30 times of physical training, the highest heart rate values of the five subjects showed an increasing trend, which shows that with the increase of training volume and the difficulty of training intensity, the heart rate of the athletes also increased,

and the training effect was very obvious. No. X1, X2, X3, X4, X5 in the process of physical training heart rate maximum value of the maximum and minimum value of the difference between 35, 32, 30, 30, 28 times / min, the overall difference between 7 times / min, which can be seen in the reliability of the experimental program and is applicable to each of the experimental subjects.

During the whole experiment, there was no situation that the life and health of the experimental subjects were jeopardized by the high heart rate, and no major athletic injuries occurred.

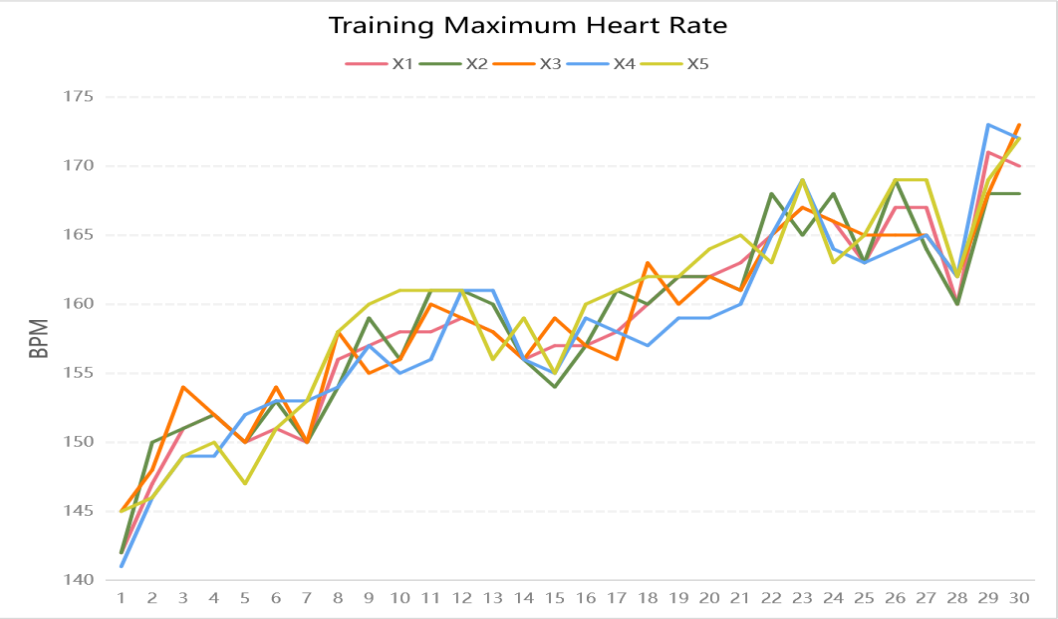

Figure 3: Changes in Training Heart Rate Maximum Indicators During the Monitoring Phase

4.2 Changes and analysis of oximetry indicators

Figure 4 shows the immediate oxygen saturation at the end of 30 physical training sessions of five subjects in the experimental group during the 10 weeks of the experiment. As can be seen from the figure, the immediate oxygen saturation at the end of physical training of the five subjects in the experimental group ranged from 80% to 99%, with some cases of insufficient oxygen supply and oxygen saturation values in the range of 90% to 95%, and a small number of cases of hypoxemia and oxygen saturation values lower than 90% (Caille & Squara, 2006).

The five subjects in the experimental group had an uneven range of changes in oxygen saturation at the immediate end of physical training. Numbers X1, X2, X3, X4, and X5 had values of oxygen saturation in the range of 90%-95% at the end of physical training 10, 10, 6, 3, and 1 times, respectively, with a minimum value of 90%, and in addition, numbers X1 and X2 had values of oxygen saturation lower than 90% at the end of physical training on three

occasions each. The possibility of hypoxemia was ruled out by questioning and further examination, and the subjects had a slight breath-holding sensation at the end of the training, but the oxygen saturation quickly returned to normal values after rest.

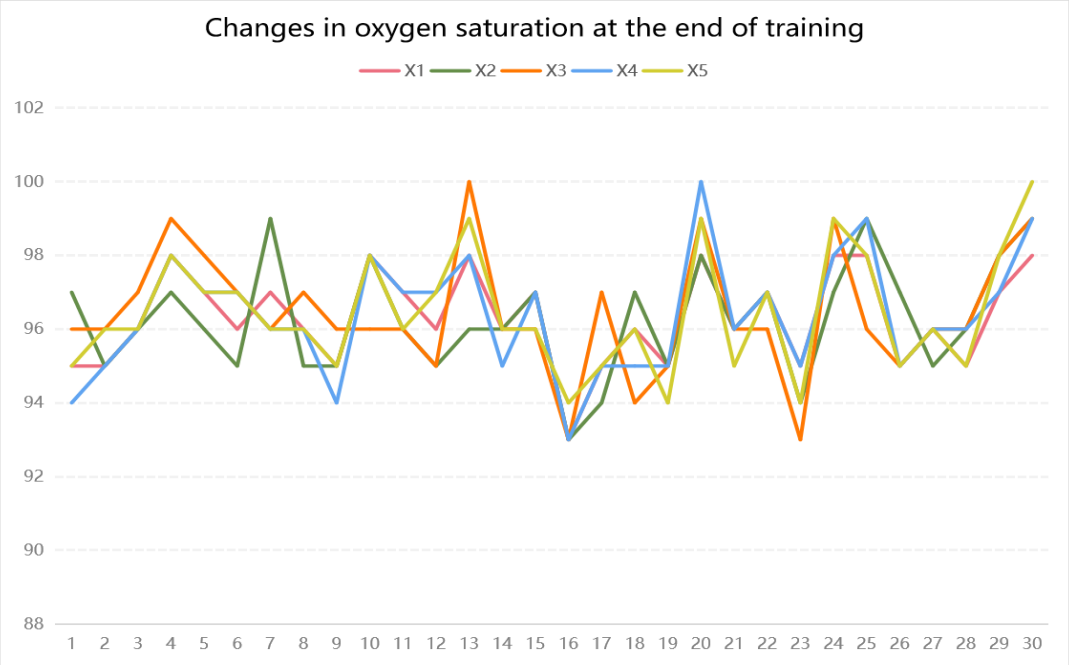

Figure 4: Changes in oxygen saturation at the end of the monitoring phase of training

4.3 Moving speed and speed endurance test results and analysis

4.3.1 The results and analysis of 15m return run test indexes

The 15m×17 times return run means that the straight line distance between the two sides of the basketball court is 15 meters, and the athletes need to go back and forth between the two sides of the border, counting 2 times, and a total of 17 times.

During the test, the athletes will be tested twice, with a two-minute break between groups, and the average of the two scores will be the final result; in order to ensure the accuracy of the test results, the 10 athletes will be divided into two groups of five people each.

By analyzing the characteristics of basketball as a full-court game, we know that basketball players need to go back and forth several times in a game, which shows that 15m×17 times of running back and forth is very important in basketball as a sport. The following are the test index data of the experimental group and the control group before, during and after the experiment, where X represents the experimental group and Y represents the control group, D1 is the number of the three tests before the experiment started, D2 is the number

of the three tests in the middle of the experiment, and D3 is the number of the three tests at the end of the experiment, which are shown in Table 5 below:

Table 5: Results of 15m×17 times of return running test (s)

EXPERIMENTAL GROUP (X)N=5	TEST RESULTS(D)			CONTRAL GROUP (Y)N=5	TEST RESULTS(D)		
NO.	D1	D2	D3	No.	D1	D2	D3
X1	71.23	69.98	68.86	Y1	65.74	65.37	63.25
X2	67.89	65.43	63.94	Y2	67.38	65.32	66.17
X3	65.37	63.94	62.21	Y3	63.97	63.18	61.24
X4	65.34	63.83	63.17	Y4	73.26	71.12	73.87
X5	68.20	65.75	64.39	Y5	67.14	65.41	66.04
M±SD	67.61±2.43	65.79±2.50	64.51±2.57	M±SD	67.50±3.50	66.08±2.97	66.11±4.80

From the above table, the overall mean values of the experimental group before, during and after the experiment were 67.61, 65.79 and 64.51 respectively, and analyzing the overall effect, the third test of the experimental group shortened the time by 3.10 seconds compared to the first test; The overall mean values for the control group before, during and after the experiment were 67.50, 66.08 and 66.11 respectively, and the change in values before and after the experiment was shortened by 1.42 seconds. The following table summarizes the results of the significance tests for the experimental group, the control group, and the two groups before, during, and after the experiment, as shown in Table 6 below:

Table 6: Test results of 15m×17 times return run test (95% confidence interval of difference score)

	AVERAGE	SD	LOWER LIMIT	LIMIT	T	SIG. (BILATERAL)
XD1-XD2	1.820	0.587	1.090	2.549	6.930	0.002
XD2-XD3	1.272	0.407	0.766	1.777	6.988	0.002
XD1-XD3	3.092	0.810	2.085	4.098	8.530	0.001
YD1-YD2	1.418	0.794	0.431	2.404	3.992	0.016
YD2-YD3	-0.034	2.057	-2.588	2.520	-0.037	0.972
YD1-YD3	1.384	1.334	-0.272	3.040	2.319	0.081
XD1-YD1	0.108	1.905	-4.284	4500	0.057	0.956
XD2-YD2	-0.294	1.736	-4.297	3.709	-0.169	0.870
XD3-YD3	-1.600	2.433	-7.212	4.012	-0.657	0.529

As can be seen from the above table, the P-value of the first test experimental group and control group (XD1-YD1) is 0.956, and there is no

significant difference. In terms of the significance test results of the experimental group in the pre-experimental, mid-experimental and post-experimental two-by-two comparisons of the test data, the P-value of the three significance tests of the test results of the early experimental period compared with the mid-experimental period (XD1-XD2), the mid-experimental period compared with the late experimental period (XD2-XD3) and the pre-experimental period compared with the late experimental period (XD1-XD3) were 0.002, 0.002 and 0.001, respectively. That is, the test results of the experimental group were highly significant at the 0.01 level ($P < 0.01$) in all the three tests of 15m×17 repetitions. As for the significance test results of the control group in the two-by-two comparison of the test data in the pre-experimental and mid-experimental periods, the P-values of the three significance test results of the test results of the pre-experimental period compared to the mid-experimental period (YD1-YD2), the mid-experimental period compared to the late-experimental period (YD2-XD3), and the pre-experimental period compared to the late-experimental period (YD1-YD3) were 0.016, 0.972, and 0.081, respectively. That is, there are significant differences and changes ($P < 0.05$) in the test results of pre-experimental compared to mid-experimental in the three tests of 15m×17 folding runs in the control group, indicating that there are no significant differences in the test results of mid-experimental compared to late-experimental and pre-experimental compared to late-experimental.

The test results of the three data tests of the experimental group comparing the control group were 0.956, 0.870 and 0.529, respectively, indicating that the difference in the data changes was not significant, but the values gradually decreased, indicating that the comparison of the test data of the two groups of experimental subjects gradually approached to have differences. Therefore, the implementation of precision monitoring in this study has a significant effect on the improvement of the 15m×17 times of return running performance of the subject group, and further indicates that the ability of the subject group in basketball in terms of movement speed and speed endurance has been significantly improved.

4.4 Muscle strength endurance test results and analysis

4.4.1 Weighted squat test index results and analysis

In the weighted squat index test, each player in turn, to ensure the safety of the athletes and the standardization of the action, the final performance record to "weight (kg) × times ÷ body weight (kg)" coefficient as the result. Weighted bench press is an important test index that reflects the strength of the upper limbs of the athletes, upper limb muscular endurance has a vital role in basketball, basketball dribbling, shooting and other basic skills and athletes upper limb strength of the relationship between the inextricably linked，as

shown in Table 7 below:

Table 7: Weighted squat test results

EXPERIMENTAL GROUP (X)N=5	TEST RESULTS(D)			CONTRAL GROUP (Y)N=5	TEST RESULTS(D)		
NO.	D1	D2	D3	No.	D1	D2	D3
X1	7.33	7.69	8.31	Y1	7.53	7.73	7.85
X2	7.47	8.11	8.75	Y2	7.32	7.43	7.51
X3	7.67	8.28	8.88	Y3	8.11	8.64	8.97
X4	8.12	8.27	9.03	Y4	7.38	7.23	7.48
X5	7.25	7.56	8.23	Y5	7.69	7.95	7.73
M±SD	7.57 ± 0.35	7.98 ± 0.34	8.64 ± 0.35	M±SD	7.61 ± 0.32	7.80 ± 0.55	7.90 ± 0.61

As we know from the above table, the overall mean values of the experimental group before, during and after the experiment are 7.57, 7.98 and 8.64 respectively, and the third test of the experimental group increases 1.07 compared with the first test; the overall mean values of the control group before, during and after the experiment are 7.61, 7.80 and 7.90 respectively, and the post-test increases 0.29 compared with the beginning of the experiment, which is a relatively small change in value. In order to further explore the data information, the following are the significance test results for the changes of the relevant data of the experimental group and the control group before, during and after the experiment, as shown in Table 8 below:

Table 8: Weighted squat test data test results (95% confidence interval of difference score)

	AVERAGE	SD	LOWER LIMIT	LIMIT	T	SIG. (BILATERAL)
XD1-XD2	-0.414	0.207	-0.672	-0.155	-4.452	0.011
XD2-XD3	-0.658	0.062	-0.735	-0.580	-23.500	0.000
XD1-XD3	-1.072	0.162	-1.273	-0.870	-14.761	0.000
YD1-YD2	-0.190	0.246	-0.495	0.115	-1.725	0.160
YD2-YD3	-0.112	0.210	-0.373	0.149	-1.188	0.301
YD1-YD3	-0.302	0.329	-0.710	0.106	-2.051	0.110
XD1-YD1	-0.038	0.210	-0.522	0.446	-0.181	0.861
XD2-YD2	0.186	0.286	-0.475	0.847	0.648	0.535
XD3-YD3	0.732	0.316	0.002	1.461	2.313	0.049

From the analysis of the above data processing results, the P-value of the data test results between the experimental group and the control group (XD1 - YD1) before the beginning of the experiment is equal to 0.861, and there is no difference in the initial state of the two groups in line with the basic conditions of the experimental study. In terms of the significance test results of

the test data of the experimental group in the pre-experimental, mid-experimental and post-experimental two-by-two comparisons, the P-value of the three significance test results of the test results of the experimental group at the beginning of the experiment compared to the experimental mid-experiment (XD1 - XD2), experimental mid-experiment compared to experimental late-experiment (XD2-XD3), and the experimental pre-experiment compared to experimental late-experiment (XD1 - XD3) are 0.011, 0.000 and 0.000 respectively. That is, in the three tests of weighted deep squat in the experimental group, there was a significant difference and change in the test results of the pre-experiment compared to the mid-experiment ($P < 0.05$), and there was a highly significant difference and change in the test results of the two tests of the mid-experiment compared to the late-experiment and the pre-experiment compared to the late-experiment ($P < 0.01$).As for the significance test results of the control group in the two-two comparison test data in the pre-mid and late experimental periods, the P values of the three significance test results of the test results in the pre-mid experimental period compared to the mid experimental period (YD1-YD2), the mid-mid experimental period compared to the late experimental period (YD2-XD3), and the pre-mid experimental period compared to the late experimental period (YD1-YD3) were 0.160, 0.301, and 0.110, respectively. That is, there is no significant difference between the test results of the control group in the three tests of weighted deep squat in the pre-experimental versus mid-experimental, mid-experimental versus late-experimental and pre-experimental versus late-experimental. The test results of three times data of experimental group comparing with control group were 0.861, 0.535 and 0.049 respectively, which indicated that there was no significant difference in the data change of the first and second test between experimental group and control group, but there was a significant difference in the data change of the third test comparing ($P < 0.05$). The above data analysis also further confirms that the exercise bracelet adopted in this study to accurately monitor the volume and intensity of training can effectively improve the quality of muscular strength endurance of the subject group, and also indicates that the implementation of accurate monitoring is conducive to improving and enhancing the lower limb muscular strength endurance of the subjects.

4.5 Sensitive Coordination Test Results and Analysis

4.5.1 PRO Agile Test Metrics Results and Analysis

The PRO Agility Test is when an athlete runs a full course in a prescribed running sequence. Athletes are tested in sequence and each athlete can be tested twice to record the best performance. Also as a test indicator of the quality of sensitive coordination, the PRO agility test is shorter than the T-run distance, and therefore requires a faster reaction speed. This study selected this index as the test index of the ability of sensitivity and coordination qualities,

and also got the unanimous approval of the experts, specific experimental and control groups before and after the experiment of the relevant data testing and processing results are shown in the following table 9:

Table 9: PRO Agility Test Results (s)

EXPERIMENTAL GROUP (X)N=5	TEST RESULTS(D)			CONTRAL GROUP (Y)N=5	TEST RESULTS(D)		
NO.	D1	D2	D3	No.	D1	D2	D3
X1	5.87	5.78	5.41	Y1	6.15	5.96	5.99
X2	6.23	6.01	5.97	Y2	5.93	5.90	5.77
X3	5.96	5.70	5.15	Y3	5.82	5.80	5.74
X4	6.53	6.25	5.59	Y4	6.6	6.65	6.55
X5	6.07	5.85	5.30	Y5	6.31	6.11	5.87
M±SD	6.13 ± 0.26	5.92 ± 0.22	5.48 ± 0.32	M±SD	6.16 ± 0.31	6.08 ± 0.34	5.98 ± 0.33

As known from the above table, the overall mean values of the experimental group before, during and after the experiment were 6.13, 5.92 and 5.48 seconds, respectively, and the overall mean value of the third test was quantitatively improved by 0.65 seconds relative to the first test; the overall mean values of the control group before, during and after the experiment were 6.16, 6.08 and 5.98 seconds for the three tests, respectively, and were improved by 0.18 seconds after the experiment compared to the beginning of the experiment, with a relatively small change in the values of the before and after the experiment. The change in the values before and after the experiment is relatively small. In order to further deepen the understanding of the specific influence of the sports bracelet monitoring on this index before and after the experiment and the degree of influence, the relevant data test results are shown in the following Table 10:

Table 10: PRO Agile Test Data Verification Results (95% confidence interval of difference score)

	AVERAGE	SD	LOWER LIMIT	LIMIT	T	SIG. (BILATERAL)
XD1-XD2	0.214	0.074	0.122	0.305	6.464	0.003
XD2-XD3	0.434	0.243	0.131	0.736	3.984	0.016
XD1-XD3	0.648	0.279	0.301	0.994	5.186	0.007
YD1-YD2	0.078	0.111	-0.060	0.216	1.568	0.192
YD2-YD3	0.100	0.098	-0.022	0.222	2.265	0.086
YD1-YD3	0.178	0.154	-0.013	0.369	2.579	0.061
XD1-YD1	-0.030	0.180	-0.447	0.387	-0.166	0.872
XD2-YD2	-0.166	0.179	-0.578	0.246	-0.927	0.381
XD3-YD3	-0.500	0.204	-0.971	-0.028	-2.444	0.040

From the analysis of the above-mentioned data significance test results: at the beginning of the experiment between the experimental group and the control group significance test results P-value equal to 0.872, indicating that at the beginning of the experiment there is no significant difference between the two groups, the initial state level in line with the requirements of the study of the experimental grouping.

As for the significance test results of the experimental group comparing the test data between the two groups at the beginning and the middle and the end of the experiment, the P-values of the three significance tests of the test results at the beginning of the experiment comparing the middle of the experiment (XD1-XD2), the middle of the experiment comparing the end of the experiment (XD2-XD3), and the beginning of the experiment comparing the end of the experiment (XD1-XD3) are 0.003, 0.016, and 0.007, respectively.

That is, in the three tests of PRO agility test for the experimental group, there is a highly significant difference and change in the test results of pre-experiment versus mid-experiment and pre-experiment versus late-experiment ($P < 0.01$), and there is a significant difference and change in the test results of mid-experiment versus late-experiment ($P < 0.05$).

Regarding the significance test results of the control group in the two-by-two comparison of test data in the pre-mid and late experimental periods, the P-values of the three significance test results of the test results of the pre-mid compared to the mid-experimental period (YD1-YD2), the mid-experimental period compared to the late-experimental period (YD2-XD3), and the pre-mid compared to the late-experimental period (YD1-YD3) were 0.192, 0.086, and 0.061, respectively.

That is, there is no significant differential change in the test results of the control group in the three tests of PRO agility test, pre-experimental versus mid-experimental, mid-experimental versus late-experimental and pre-experimental versus late-experimental. The test results of the experimental group compared to the control group in the three tests of the data were 0.872, 0.381 and 0.040 respectively, which means that the test results of the first and second test data of the experimental group and the control group did not have significant differences and changes but the values were substantially close to the significant changes, which appeared in the results of the data of the third test ($P < 0.05$).

Summarizing the results of the data analysis, it can be seen that the precise monitoring of the training volume and intensity used in this study has a significant effect in improving and enhancing the PRO agility test ability of the subject group, and also confirms that through the intervention of the experimental training program, the subjects have been effectively promoted

and improved in the quality of agility coordination.

4.6 Lower Extremity Explosive Strength Test Results and Analysis

4.6.1 In-Place Step-Up Vertical Jump Touch Test Results and Analysis

In the index of in situ step-up vertical jump touch test, each athlete can try to jump twice and take the highest score. According to previous studies and the practice of basketball, the quality of jumping power is one of the relatively important physical qualities of basketball players. One-step vertical jump touch height in situ is an important index for the lower limb explosive strength quality test, which is not only a necessary index for the early selection of basketball players, but also an important index for the evaluation of players' physical quality.

Therefore, this study chooses this index for testing, and to a certain extent, it can also indirectly reflect the influence of sports bracelet monitoring on the effect of basketball physical training. The following are the results of the three indicator tests before, during and after the experiment, as shown in Table 11 below:

Table 11: In-Place Step-Up Vertical Jump Touch Test Results (meters)

EXPERIMENTAL GROUP (X)N=5	**TEST RESULTS(D)**			**CONTRAL GROUP (Y)N=5**	**TEST RESULTS(D)**		
NO.	D1	D2	D3	No.	D1	D2	D3
X1	2.72	2.70	2.73	Y1	2.62	2.62	2.63
X2	2.59	2.57	2.62	Y2	2.59	2.59	2.62
X3	2.58	2.56	2.61	Y3	2.58	2.57	2.58
X4	2.62	2.63	2.65	Y4	2.70	2.72	2.71
X5	2.52	2.55	2.55	Y5	2.56	2.57	2.57
M±SD	2.60 ± 0.07	2.60 ± 0.06	2.63 ± 0.07	M±SD	2.61 ± 0.05	2.61 ± 0.06	2.62 ± 0.06

As we know from the above table, the overall mean values of the experimental group before, during and after the experiment were 2.60, 2.60 and 2.63 meters, respectively, and the overall height of the longitudinal jump increased by 3 centimeters before the experiment compared with that after the experiment; and the overall mean values of the control group for the three times of the test were 2.61, 2.61 and 2.62 meters, respectively, and the overall height of the longitudinal jump increased by 1 centerimetre before the experiment compared with that after the experiment, which basically remained unchanged. In order to more clearly observe the specific effects and changes before and after the experiment, the results of the above data were examined, and the following is a summary of the results of the t-test of the above data, which is

shown in Table 12 below:

Table 12: In-Place Step-Up Vertical Jump Touch Test Data Inspection Result sm (95% confidence interval of difference score)

	AVERAGE	SD	LOWER LIMIT	LIMIT	T	SIG. (BILATERAL)
XD1-XD2	0.004	0.023	-0.024	0.032	0.389	0.717
XD2-XD3	-0.030	0.021	-0.056	-0.003	-3.162	0.034
XD1-XD3	-0.026	0.008	-0.037	-0.014	-6.500	0.003
YD1-YD2	-0.004	0.011	-0.018	0.010	-0.784	0.477
YD2-YD3	-0.008	0.014	-0.026	0.010	-1.206	0.294
YD1-YD3	-0.012	0.010	-0.025	0.001	-2.449	0.070
XD1-YD1	-0.004	0.040	-0.098	0.090	-0.098	0.925
XD2-YD2	-0.012	0.039	-0.103	0.079	-0.302	0.770
XD3-YD3	0.010	0.038	-0.078	0.098	0.260	0.801

From the analysis of the t-test results of the experimental group and the control group in the first test results at the beginning of the experiment, P=0.925, i.e., there is no significant difference between the experimental group and the control group subject groups in the ability of touching the height of the one-step upward longitudinal jump in situ.

As for the significance test results of the test data of the experimental group in the two-by-two comparison before and after the experiment, the P-values of the three significance test results of the test results of the early stage of the experiment comparing the middle stage of the experiment (XD1-XD2), the middle stage of the experiment comparing the late stage of the experiment (XD2-XD3), and the pre-experimental stage of the experiment comparing the late stage of the experiment (XD1-XD3) were 0.717, 0.034, and 0.003, respectively. That is, in the three tests of the experimental group in the in situ step-up longitudinal jump to touch the height, there is no significant difference in the test results of the pre-experiment compared to the mid-experiment, there is a significant difference and change in the test results of the mid-experiment compared to the late-experiment ($P < 0.05$), and there is a highly significant difference and change in the test results of the pre-experiment compared to the late-experiment ($P < 0.01$).

With regard to the significance test results of the control group in the two-by-two comparison of test data in the pre-mid and late experimental periods, the P values of the three significance test results of the test results of the pre-mid experimental period compared to the mid experimental period (YD1-YD2), the mid experimental period compared to the late experimental period (YD2-XD3), and the pre-mid experimental period compared to the late experimental period (YD1-YD3) were 0.477, 0.294, and 0.070, respectively. That is, there is

no significant differential change in the test results of pre-experimental versus mid-experimental, pre-experimental versus late-experimental and mid-experimental versus late-experimental in the three tests of the control groups in-situ one-step longitudinal jump to touch height.

The results of the three tests of the experimental group versus the control group were 0.925, 0.770 and 0.801 respectively, indicating that the variability of the data changes was not significant. From the results of the above data analysis, it can be learned that the accurate monitoring of the amount and intensity of physical training through the sports bracelet can effectively improve the ability of the subject group to touch the height of the in situ vertical jump, so that the bouncing ability of the subject group can be effectively improved.

5. Conclusion

This paper verifies through experiments that, under the continuous monitoring of wearable devices, athletes and coaches can better grasp the training intensity and training effect, can more accurately control the training process, effectively improve the training effect, and at the same time, can reduce the incidence of athletic injuries. Based on the research in this paper, the following suggestions are made.

(1) Basketball teaching and training process should not only emphasize the training of basketball skills and tactics, but also strengthen the physical fitness of basketball players. Therefore, it is recommended that coaches pay enough attention to the scientific, systematic and standardized basketball physical training, and take into account the training of basketball physical training while focusing on technical and tactical teaching.

(2) The improvement of athletes' special physical quality cannot be separated from the training of daily physical training, coaches can accurately monitor the changes in the values of athletes' resting heart rate, instant heart rate and blood oxygen saturation during the training process through the sports bracelet, so as to timely adjust the amount and intensity of physical training.

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