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EXPERIENCED VS INEXPERIENCED DISABLED SWIMMERS: TRAINING LOAD AND RECOVERY IN PREPARATION PERIOD

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

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Abstract

The study purpose was to analyse the training load and recovery of experienced and inexperienced swimmers with disabilities.

Materials and methods. The study subjects consisted of seven swimming athletes with disabilities at the provincial level who underwent training camps in preparation for the Indonesia Paralympics Games. The groups of athletes were divided based on their level of training and experience in national championships. For thirteen weeks, the athletes monitored their training load and recovery rate. Borg CR-10 was used to measure the internal training load, while the athlete's recovery rate was measured using Total Quality Recovery (TQR). IBM SPSS Statistics version 22 was used to analyse normality and test differences between the two groups. The Mann-Whitney test was used to test the significance of the RPE Borg CR-10, while the unpaired T-test was used to test the significance of the TQR.

Results. The Borg CR-10 mean for the experienced athlete group was 7.78±0.47, while it was 8.28±0.56 ($p<0.05$) for the inexperienced athlete group. The RPE mean for the experienced athlete group was 18.24±1.47, while it was 18.52±1.57 ($p>0.05$) for the inexperienced athlete group. Furthermore, the Borg RPE shows the training load of experienced athletes of 17.12±1.03, which is lower than the average RPE of inexperienced athletes of 18.21±1.24, and also the TQR average of experienced athletes was of 18.24±1.47, while it was of 18.52 ±1.55 ($p<0.05$) in case of inexperienced athletes.

Conclusions. Experienced para-swimmers had a significantly different training load than inexperienced para-athletes. In addition, the training load of experienced para athletes was also significantly different compared to the recovery rates of experienced and inexperienced para swimmers.

Keywords: monitoring, training, disability, periodisation, swimming, athlete.

Introduction

The balance of training load and recovery is essential for athletes to achieve high performance sustainably (Kellmann et al., 2018). Training load is the cumulative load experienced by an athlete from one or more training sessions over a while. Meanwhile, recovery is an athlete's recovery activity after experiencing a training load so that his condition returns to normal (Schwellnus et al., 2016). Therefore, monitoring the training load and recovery during the training process is essential to achieve balance.

Training load can be known through measurement, either internally or externally. Internal training load-measuring tools include the rating of perceived exertion (RPE), pulse and lactate measurements (McGuigan, 2017). External training load was measured using the Global Positioning System (GPS), time motion analysis, accelerometers and power meters; (Halson, 2014; McGuigan, 2017; McLaren et al., 2016). When compared between the internal and external training loads, a systematic study shows that the internal training load has a stronger relationship with performance than the external training load (Fox, Stanton, Sargent, Wintour, & Scanlan, 2018).

Athletes need sufficient training load to get a stimulus or stimulation for their body to experience the process of increasing physical capacity. Therefore, giving a training load that is too light does not encourage positive adaptation and risks reducing the performance (Bourdon et al., 2017). On the other hand, a training load that is too large is at risk of causing a decrease in performance, overreaching, and an increased risk of illness or injury, and if it occurs for a long time, it will cause overtraining (Hulin et al., 2014).

Concerning training load, the results of the study show that coaches and athletes have different assessments of training load in training sessions (Foster, Heimann et al., 2001; Rodríguez-Marroyo et al., 2014). The risk of an inappropriate training load results in a decrease in physical condition or, on the other hand, even an increase in non-functional overreaching, overtraining, and risk of injury and illness (Doeven et al., 2017; Nässi et al., 2017). For this reason, monitoring can help correct this (McGuigan, 2017).

There is a considerable risk when athletes experience an increase in their training load, resulting in a temporary decrease in physical and mental abilities. Therefore, recovery has a strategic role in accelerating the recovery of physical and mental adaptation to be ready for the next training activity and reducing the risk of injury in the long term (Bishop, Jones, & Woods, 2008). For this reason, a recovery program is needed, both physically and mentally, to assist the process of physical and mental repair and regeneration so that athletes are fully recovered and physically and mentally ready to receive the following training program (Kellman & Beckmann, 2018).

Ideally, to improve performance in the sports coaching process, it is crucial and routine to monitor the training load and recovery. Knowing the training load and recovery data can be used to make decisions to continue or change the training load in the next exercise and maintain or provide a different portion of the recovery to achieve physical and mental balance super-compensation. Research on monitoring training load and recovery has been carried out in various sports (Andrade et al., 2021; Sansone et al., 2020; Tiernan et al., 2020a; Wilke et al., 2020). Likewise, in the sport of swimming (Collette et al., 2018; Pollock et al., 2019). Furthermore, further research on training load (Sinnott-O'Connor et al., 2018) and recovery in persons with disabilities has also been carried out (Rosa et al., 2020). However, there is still no investigation into training load and recovery associated with experienced and inexperienced disabled swimmers. Therefore, this research was conducted to study the comparative conditions of training load and recovery for experienced and inexperienced disabled swimming athletes.

Materials and methods

Study participants

The subjects in this study were all provincial-level disabled swimming athletes who underwent training camps in the preparation phase of training for the Indonesian National Paralympic Week, amounting to seven people. Three swimmers with a swimming history of more than ten years and who have jumped more than once at the National Paralympic Week are listed as experienced athletes, while the less experienced athlete group consists of four swimmers with less than five years of flying hours which never have and poor experience. National Paralympics.

Study organization

For thirteen weeks, athletes monitored their training load and recovery rate. Borg CR-10, with a scale of 0-10, is used as an internal training load measurement tool (Rodríguez-Zamora et al., 2014). In addition, the level of recovery quality was measured using a Total Quality Recovery (TQR) questionnaire with a scale of 0-20 (Kenttä & Hassmén, 1998). Before recording the data at the beginning of the training, all athletes understood the procedure for assessing the rating of perceived exertion based on the perceived subjective training load, recovery education and how to fill out a total quality recovery questionnaire based on the daily recovery pattern. In addition, athletes have also given verbal form consent as a form of approval. This research complies with the Declaration of Helsinki and has been declared ethically acceptable by the health research ethics committee of Airlangga University's School of Medicine No. 266/EC/KEPK/FKUA/2021.

During the training process, athletes were asked to rate their training load for each session consisting of 13 sessions per week. Each athlete is, at the latest, to give a Borg CR-10 assessment 15 minutes after the training session ends (FOSTER et al., 2001). Furthermore, each athlete was asked to honestly answer the training load about the quality of recovery he experienced daily. The Borg CR-10 and TQR data results were analysed, and the average value was calculated weekly for 13 weeks.

Statistical analysis

IBM SPSS Statistics version 22 was used to analyse normality and test differences between the two groups. Shapiro Wilk test for data normality, Mann Whitney test was used to test the significance of the RPE Borg CR-10 for both groups, while the unpair T-test was used to test the TQR significance for groups of experienced and inexperienced athletes, and the Kruskal Wallis test for the RPE Borg CR-10 and TQR group of experienced and inexperienced athletes.

Results

Data about the profiles of para-swimming athletes who are the subjects in this study are presented in Table 1.

Based on table 1, it is known that based on the age aspect, it is known that overall more athletes are under 20 years old than athletes over 20 years old. The dominance of athletes aged less than 20 years was seen in the group of experienced athletes. Overall, the youngest athlete's age is 16 years, while the oldest athlete's age is 47 years. The average age of the experienced athlete group was 27.33±17.04, while the average age of the inexperienced athlete group was 23.50±7.94. Furthermore, in terms of gender, most research subjects are male. It was also evident in both groups. Next, based on the type of disability, it is known that most research subjects experience physical disorders. It is also the same for the inexperienced athlete group, but on the contrary, the experienced athlete group is dominated by visually impaired athletes. It was moving on to the training load data shown in Figure 1.

Based on the data in Figure 1 regarding the comparison of weekly RPE between trained and untrained athletes,

Table 1. Profile of Research Subject

Parameter		Group		Overall Subject of Research
		Experienced	Inexperienced	
Age	<20 years old	66.67%	50%	58.33%
	>20 years old	33.33%	50%	41.67%
Sex	Male	66.67%	75%	70.83%
	Female	33.33%	25%	29.17%
Disability	Physical Impairment	33.33%	100%	66.66%
	Visual Impairment	66.67%	0%	33.34%

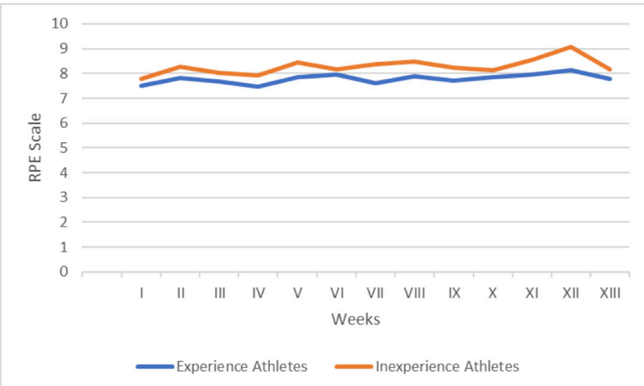

Fig. 1. Comparison of RPE Borg CR-10 Weekly Score Experienced and Inexperienced
Description: average weekly training load value based on Borg CR-10

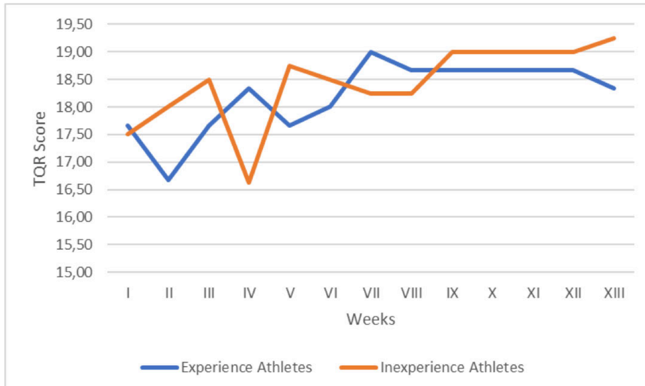

Fig. 2. Comparison of the weekly TQR Score for the Experience and Inexperience groups
Description: average weekly recovery scores based on TQR Kentta 20 Scale

it is known that the untrained athlete group has a higher average weekly RPE value than the trained athlete group. Furthermore, the calculation results show that the average RPE value for 13 weeks for the trained athlete group is 7.78 ± 0.47, while the untrained athlete group is 8.28 ± 0.56. Therefore, it ensures that the untrained group of athletes felt a higher training load during the training process than the trained group. Furthermore, based on the Mann-Whitney test with a significance level of 0.05, it is known that the p-value is 0.000 <0.05, which means that there is a significant difference between the RPE of the experienced and inexperienced athlete groups. Therefore, during 13 weeks of training, it was found that the inexperienced athlete group had a significantly higher training load than the experienced athlete group. Furthermore, the comparison of weekly TQR values between groups of experienced and inexperienced athletes is shown in Figure 2.

Based on the data in Figure 2 regarding the comparison of weekly TQR scores for groups of trained and untrained athletes, it is known that the data for the two groups seem to intersect with a range of values between 16.50-19. Furthermore, the calculation results show that the average TQR value for 13 weeks for the trained athlete group is 18.24±1.47, while the untrained athlete group is 18.52±1.57. Both groups have an excellent average recovery pattern, but the untrained athlete group scores slightly higher than the trained athlete group. Furthermore, an unpaired T-test was conducted to determine the significance level of the difference in the recovery rate between the two groups. The unpaired T-test results with a significance level of 0.05 showed a p-value of 0.265> 0.05. It shows no significant difference in TQR scores between the experienced and non-experienced groups. During 13 weeks of training, it was found that the inexperienced athlete group had a slightly higher recovery rate than the experienced athlete group but not significantly.

Furthermore, to compare the RPE and TQR scores, the RPE CR-10 was converted to Borg on a scale of 6-20. RPE with a Borg scale of 6-20 and a Borg scale of 0-10 have a strong relationship and significance and can be converted to each other (Arney et al., 2019; Hutchinson et al., 2021) and recreationally active participants with paraplegia (PARA. Therefore, to get the data transformation to the Borg scale 06-20, the calculation results of the existing RPE CR-10 are multiplied by 2,21. This data conversion is carried out so that there is a similarity in the pattern of the maximum limit value on the RPE and TQR, which is 20 points. The results of the comparison of RPE and TQR for experienced and inexperienced athletes are presented in Figure 3.

Figures 3 and 4 show that the RPE Borg score of experienced athletes is 17.12 ± 1.03, which looks lower than the RPE Borg of inexperienced athletes with an average of 18.21 ± 1.24, and the TQR of experienced athletes is 18. 24±1.47 and inexperienced at 18.52±1.55. Furthermore, to determine the significance of the difference between the RPE Borg and TQR scores of experienced and inexperienced athletes, the Kruskal Wallis test was carried out with a significance level of 0.05. Therefore, based on the test results, it is known that the p-value is 0.000 <0.05. Therefore, it shows a significant difference between the RPE Borg of the

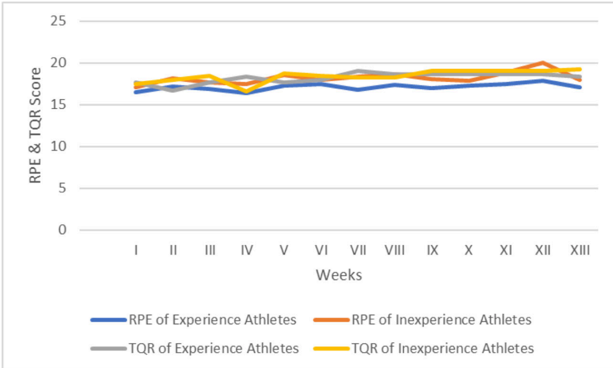

Fig. 3. Comparison of Average Weekly RPE Borg and TQR scores of experienced and inexperienced athletes

Description: Average weekly value of training load based on Borg 6-20 scale and recovery based on TQR Kentta 20 Scale

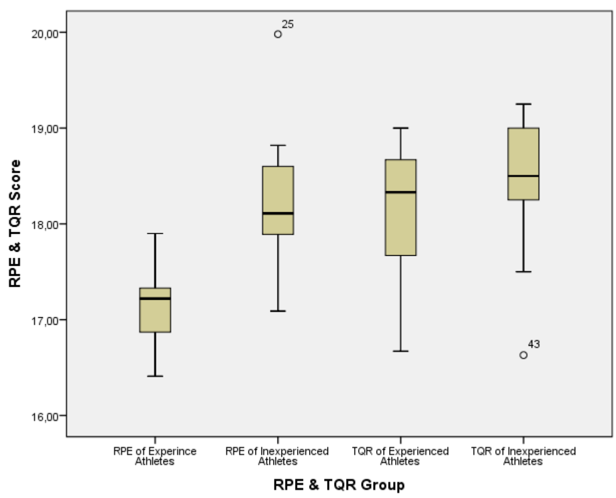

Fig. 4. Comparison of the Average RPE Borg Overall Score and TQR groups of experienced and inexperienced athletes

Description: comparison of the mean±standard deviation of training load and recovery of experienced and inexperienced para athletes

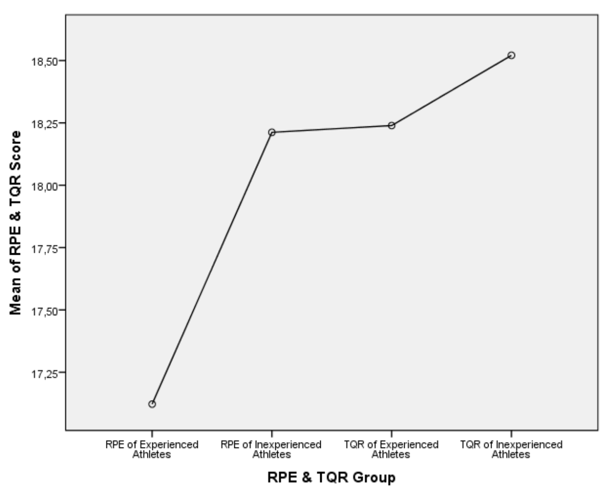

Fig. 5. Comparison of Average RPE and TQR Overall Scores of experienced and inexperienced athletes

Description: comparison of the mean of training load and recovery of experienced and inexperienced para athletes

experienced athlete group compared to the RPE Borg and TQR of the inexperienced athlete group and the TQR of the experienced athlete group. For more detail, the significant difference is shown in Figure 5.

Based on the average score for 13 weeks shown in Figure 5, it is known that the RPE Borg score for the experienced athlete group looks significantly different and is below the Borg RPE and TQR for the inexperienced athlete group the experienced athlete's TQR.

Discussion

Athletes need sufficient training load so that their bodies get the right and progressive stimulation according to the training period so that they can experience an increase in physical capacity from time to time. Measuring the training load of athletes can be done in various ways, counting questionnaires, journal, physiological checking and straight observation (Borresen & Ian Lambert, 2009). One tool that is easy to use is RPE. The use of RPE is based on the consideration that it has high validity and reliability, is inexpensive and is the most widely used as an internal training tool (Halson, 2014; Paulson, Mason, Rhodes, & Goosey-Tolfrey, 2015; Sams et al., 2020). However, the use of RPE in young athletes should also be done with caution because of their lack of reliable ability to measure perceived load and effort (Bourdon et al., 2017). To avoid errors and misperceptions of data entry, all athletes in this study were educated to assess the training load at the beginning of the training period. As a result, there was a shared perception of the limits of the correct range of values according to the load experienced before finally giving an assessment based on the perceived training load.

The findings of this study indicate that in the preparation period, the less experienced athletes had a significantly greater average training load than the group of experienced swimmers. There are several arguments for why inexperienced athletes experience higher training loads. First, it is because experienced athletes have a higher technical quality. The high quality of movement techniques impacts increasing work efficiency so that athletes can mobilise energy efficiently in completing training programs. This is in line with research results which show that technical parameters have a significant effect on swimming results (Strzała & Tyka, 2009). In competitive swimming, stroke technique is one factor that affects energy costs converted into speed (Barbosa, Fernandes, Keskinen, & Vilas-Boas, 2008). In addition, the more excellent the physical ability, the athlete does not feel tired quickly and does not experience a significant decrease in swimming technique. When a swimmer experiences fatigue, there is a reduction in stroke length on both arms, especially in external rotation and joint position on the dominant arm due to fatigue (Matthews, Green, Matthews, & Swanwick, 2017). It is much different compared to the group of inexperienced swimmers. Limitations of physical ability and imperfect swimming techniques cause inexperienced athletes to spend more energy to complete the existing training program with higher levels of fatigue than experienced athletes. This study's results align with the results of several previous studies. The difference in strength performance between beginner and elite athletes is influenced by the quality of the training experience and muscle ability and aerobic endurance (McKendry et al., 2020; Mersmann, Charcharis, Bohm, & Arampatzis, 2017).

Furthermore, the results of research (Ferioli et al., 2018) state that in the periodisation of preparation, professional athletes have greater strength and power than athletes with lower levels. In addition, elite athletes experience lower levels of inflammation and oxidative stress than athletes with lower levels (Al-Muraikhy et al., 2021). It shows that, in general, experienced athletes have the better physical condition than inexperienced athletes.

In the preparation period, when athletes experience a significant and drastic increase in load, this causes the risk of injury (Hulin et al., 2014). In addition, during the preparation period, athletes tend to experience an increase in training load, fatigue, creatine kinase levels and psychological stress (Horta, Bara Filho, Coimbra, Miranda, & Werneck, 2019; Selmi, Ouergui, Castellano, Levitt, & Bouassida, 2020a). Psychophysiological stress can occur in athletes both at the training and competition stages. This stress increase can negatively impact recovery rates and performance (Sinnott-O'Connor et al., 2018). Therefore, the balance between training load and recovery rate is critical for athletes to achieve high performance sustainably (Kellman et al., 2018).

Recovery plays a vital role in the coaching process. The quality of good recovery will impact the balance of the exercise. The body needs the recovery phase to adapt to stress and improve physical and psychological qualities (Romero, Minson, & Halliwill, 2017). Inadequate recovery can lead to decreased performance and increased risk of injury and disease (Tiernan, Lyons, Comyns, Nevill, & Warrington, 2020b). Even in elite athletes, recovery management's essential role is very influential in achieving achievement (Peake, Neubauer, Walsh, & Simpson, 2017).

This study's findings indicate no significant difference in recovery patterns between experienced and inexperienced athletes. Both groups had a reasonable recovery rate with scores above 16 points, and the inexperienced athlete group had a slightly higher average score than the experienced athlete group. It seems to happen because, at the beginning of training, athletes have been educated about the importance of recovery. It is in line with the results of research (Doherty, Madigan, Nevill, Warrington, & Ellis, 2021), which states the need for athletes to receive education about recovery patterns. At the beginning of this training period, athletes are taught various recovery strategies. It is in line with the research results showing that using a combined recovery strategy is more effective than a simple approach to recovery strategy (Crowther, Sealey, Crowe, Edwards, & Halson, 2019; Pimenta et al., 2015). One important sub-section of recovery is adequate sleep. Sleep plays a vital role in athlete performance and recovery (Bonnar, Bartel, Kakoschke, & Lang, 2018). In addition to getting an education about recovery, while athletes stay in the dormitory, a curfew and a collection of cell phones make athletes sleep regularly. This intervention pattern has an impact on the athletes' sleep patterns. It is in line with the research results showing that sleep hygiene education and interventions can positively change athletes' sleep behaviour (Caia, Scott, Halson, & Kelly, 2018; de Mello et al., 2020).

Monitoring training load and recovery is an important thing to do in sports training. By monitoring the training load, the coach can get a picture of information about the response experienced by athletes in connection with the given program (Duggan, Moody, Byrne, Cooper, & Ryan, 2021). In addition, monitoring recovery can also provide an overview of overreaching conditions, the magnitude of recovery needs and the prevention of injury, illness and overtraining (Bourdon et al., 2017). Athletes' training load response and recovery data is a sensitive and valuable monitoring tool for coaches to regulate load balance and recovery rates in achieving increased performance by paying attention to health (Selmi, Ouergui, Castellano, Levitt, & Bouassida, 2020b).

This study's findings indicate a significant difference between the average training load of experienced athletes compared to the training load and recovery of inexperienced athletes and the recovery rate of experienced athletes. This difference in training load occurs because experienced athletes have the higher physical ability and movement efficiency than inexperienced athletes. On the other hand, all groups of athletes had a good recovery pattern thanks to education and control regarding the implementation of recovery during 13 weeks of training to support high performance. An essential result of this study showed that both groups experienced a heavy training load, but a reasonable recovery rate offset this during the training process. Furthermore, the limitations of this study are the limited number of samples and the periodisation of the preparation only. In the future, comparative studies can be carried out with a more significant number of samples in one whole exercise period with a more diverse variety of research subjects.

Conclusions

Differences in the experience level of para-swimming athletes significantly impact the comparison of the amount of training load. However, the recovery pattern that can be adjusted makes the two groups have a recovery rate that tends to be good and does not differ significantly. This study highlights that the significant difference in the simultaneous combination of training load and recovery between the two groups lies in the level of training load efficiency for the experienced para-athlete group compared to other variables. Further studies of these two groups of athletes in a broader variable scale and varying in full training periodisation are needed to provide a more comprehensive picture in the future.

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Conflict of interest

All authors declare no conflicts of interest

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ПОРІВНЯННЯ ДОСВІДЧЕНИХ І НЕДОСВІДЧЕНИХ ПЛАВЦІВ З ІНВАЛІДНІСТЮ: ТРЕНУВАЛЬНЕ НАВАНТАЖЕННЯ ТА ВІДНОВЛЕННЯ В ПІДГОТОВЧИЙ ПЕРІОД

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Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 8 с., 1 табл., 5 рис., 50 джерел.

Метою дослідження було проведення аналізу тренувального навантаження та відновлення досвідчених і недосвідчених плавців з інвалідністю.

Матеріали та методи. Учасниками дослідження були сім спортсменів-плавців з інвалідністю регіонального рівня, які проходили тренувальні збори в рамках підготовки до Паралімпійських ігор в Індонезії. Групи спортсменів були розподілені за рівнем підготовки та досвідом участі в національних чемпіонатах. Протягом тринадцяти тижнів спортсмени відстежували своє тренувальне навантаження та ступінь відновлення. Для вимірювання внутрішнього тренувального навантаження використовували шкалу Борга CR-10, а ступінь відновлення спортсмена вимірювали за допомогою шкали Загального якісного відновлення (TQR). Для аналізу нормальності та перевірки відмінностей між двома групами використовували програмне забезпечення IBM SPSS Statistics версії 22. Для перевірки статистичної значущості показника суб'єктивно сприйманої напруженості (RPE) за шкалою Борга CR-10 використовували критерій Манна-Уітні, а для перевірки статистичної значущості показника шкали Загального якісного відновлення (TQR) використовували двохвибірковий t-критерій Стьюдента для незалежних вибірок.

Результати. Середнє значення показника за шкалою Борга CR-10 для групи досвідчених спортсменів становило 7,78±0,47, тоді як для групи недосвідчених спортсменів воно становило 8,28±0,56 ($p<0,05$). Середнє значення показника суб'єктивно сприйманої напруженості (RPE) у групі досвідчених спортсменів становило 18,24±1,47, а в групі недосвідчених спортсменів воно становило 18,52±1,57 ($p>0,05$). Крім того, показник RPE за шкалою Борга показує, що тренувальне навантаження досвідчених спортсменів становить 17,12±1,03, що є нижчим за середній показник RPE недосвідчених спортсменів 18,21±1,24, а також середній показник шкали Загального якісного відновлення (TQR) для досвідчених спортсменів становить 18,24±1,47, а для недосвідчених — 18,52±1,55 ($p<0,05$).

Висновки. Досвідчені параплавці мали статистично значуще відмінне тренувальне навантаження, ніж недосвідчені параспортсмени. Крім того, тренувальне навантаження досвідчених параспортсменів також статистично значуще відрізнялося порівняно зі ступенями відновлення досвідчених і недосвідчених параплавців.

Ключові слова: відстежування, тренування, інвалідність, періодизація, плавання, спортсмен.

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