

Swiftness movement evaluation criteria in women's rowing

Volodymyr Bogush¹
Sergiy Getmantsev²
Konstantin Bogatyirev¹
Yuriy Kulakov²
Olga Kuvaldina¹
Yevgen Yatsunskiy¹

¹Admiral Makarov National University of Shipbuilding, Mykolayiv, Ukraine

²Sukhomlynskiy Mykolayiv National University, Mykolayiv, Ukraine

Purpose: to develop criteria for assessing the speed capabilities of the rate of movement, time and speed of one movement, the frequency of movements that ensure the performance of motor actions in certain conditions of a specific period of time.

Material & Methods: the girls, students of the Higher School of Physical Culture and university students, specializing in rowing, various age groups and sports qualification were surveyed, all 73 athletes. According to the method of measuring the effect of the training action developed by us, we studied the speed capabilities that characterize the manifestation of the quality of swiftness. On a special stand athletes made hand movements from the target to target. In the first period of the test, with a duration of 15 seconds, the athletes were to gain maximum speed; in the second period, with a duration of 60 s, it was necessary to maintain the achieved speed – distance velocity was investigated; in the third period – 15 seconds, speed endurance was determined – the athletes were supposed to perform the motor task with the maximum speed. The rate, time and speed of single movement, the frequency of movements were determined, and sensorimotor responses to sound and light stimuli were studied in modeling the conditions of training and competitive activity.

Result: formation and improvement of motor abilities in specific age ranges is caused by high rates of development of morphological and functional indicators in sensitive periods. Obtained results characterize the individual psycho-physiological characteristics of the athlete's body in the context of modeling sports activities, show a different reaction in the observed age groups, a different level of sports qualification, which makes it possible to make adjustments in improving the speed abilities and effectively manage the training process.

Conclusion: based on a comparative analysis of the studies that carried out, criteria were developed for assessing the physical quality of swiftness and its components (rate, time and speed of single movement, the frequency of movements). The proposed technique for investigating the effect of a training action can be applied for the purposeful study and development of physical quality of swiftness in the training process, as well as to determine the prospects of athletes and use as one of the constituent parts of the selection methodology at various stages of improving sports training and perfecting the level of sports qualifications.

Keywords: rate, time and speed of one movement, the frequency of movements, time of sensorimotor reactions to sound and light stimuli.

Introduction

The effectiveness of work aimed at the development of various high-speed qualities depends not only on the methodology and organization of the pedagogical process, but also on the individual rates of development of this quality. With the directed development of high-speed quality in the period of accelerated development, the pedagogical effect is much higher than in the period of slow growth. Therefore, it is expedient to carry out directed development of speed abilities in children in those age periods when their most intensive growth is observed [4; 6].

Swiftness is a complex physical quality of a person – it is the ability of a person to perform a motor action in the minimum period for these conditions with a certain frequency and impetuosity. The physiological basis of swiftness is the lability of the neuromuscular apparatus, and the importance of the swiftness of mobility of the nervous processes [9].

Swiftness – physical quality, which is very diverse and specific

manifested in various motor actions of person. The swiftness of the motor reaction is expressed, which is expressed by the time from the moment when the person saw the light or heard the sound signal, before the movement, and also – swiftness of movement, that is speed with which there is a signal switching off. Between these forms there is no close relationship: a person can have a very fast reaction and at the same time a relatively slow speed of movements and vice versa [5].

The swiftness of movement is primarily determined by the appropriate nervous activity, causing tension and relaxation of the muscles, directing and coordinating movements. It largely depends on the perfection of sports equipment, strength and elasticity of muscles, mobility in the joints, consistency of the activity of muscle-antagonists at the maximum frequency of alternation of processes of excitation and inhibition, the degree of possession of technical methods, and in continuous work – from the athlete's endurance [7; 8].

Swiftness is manifested in the ability to overcome a certain distance in the shortest period of time, as well as in the impul-

siveness, sharpness of single or repeated movements. Between these forms of manifestation of speed there is a connection, but there is no direct dependence.

Speed abilities are individual features that determine the level of motor abilities of a person associated with the success of any motor activity. Ability – it is a function with a peculiar form of manifestation, with different for each individual makings, one of which are genetically conditioned typological features of the manifestation of the properties of the nervous system, very little and with great difficulty changing under the influence of living and working conditions. At the same time, such individual characteristics as maximum oxygen consumption, high mobility of nervous processes, and speed of thinking or trunk length are reflected in the resultant side of activity. At certain age periods, especially favorable for the development of certain motor qualities, it is necessary to carry out work aimed at the development of high-speed qualities, strength, speed, endurance and other motor abilities of children, which gives the most visible effect [1; 8].

The use of high-speed and speed-strength exercises in school age is determined by indicators of morphofunctional development of children, which characterize the sufficiently high capabilities of their body, the close relationship between the formation of functional systems and physical preparedness [2; 9].

Improving the swiftness of movement, increasing the speed of implementation of integral motor acts are closely related to the enhancement of the functional capabilities of the athlete's organism, which determine the speed characteristics in various forms of motor activity [4; 7].

The physiological mechanism of manifestation of swiftness, associated with the speed characteristics of the nervous processes, is realized as a multifunctional property of the central nervous system and peripheral neuromuscular apparatus [8; 9].

Purpose of the study: to develop criteria for assessing the speed capabilities of the rate of movement, time and speed of one movement, the frequency of movements that ensure the performance of motor actions in certain conditions of a specific period of time.

Material and Methods of the research

Surveyed women of different ages, students of the Higher School of Physical Education and students of universities specializing in rowing. First group (young) – age 13–14 years, 27 people, 2 sports category; Second group (medium) – 15–16 years, 25 people, 2 and 1 sports category; third group (senior) – 17–18 years, 21 people, first-rank sportsmen and candidates for master of sports. According to the method of measuring the effect of the training action developed by us, we studied the speed capabilities that characterize the manifestation of swiftness quality. On a special stand athletes made hand movements from the target to the target. In the first period of the test, with a duration of 15 s, the athletes were to gain maximum speed; in the second period, with a duration of 60 s, it was necessary to maintain the achieved speed – distance velocity was investigated; in the third period – 15 s, speed endurance was studied – the athletes were supposed to perform the motor task with the maximum speed. Sensory

motor responses to sound and light stimuli were also studied. In detail, the research methodology was published in the "Slobozhanskyi herald of science and sport", 2015, No. 4(48), pp. 15–20 [3].

Results of the research and their discussion

The conducted observations (Table 1) showed that the time of sensorimotor reaction to a sound stimulus in athletes aged 13–14 years was more by 0,012 s or 6,06% compared to 15–16-year-olds and 0,024 s or 11,43%, compared to 17–18-year-olds; sensorimotor response time to the light stimulus in the younger group was greater by 0,042 s or 19,35% than in the middle group and by 0,056 s or 27,59% than in the older group. The time of sensorimotor reactions decreased, therefore, the response to sound and light stimuli improved with increasing age and sports qualification.

When determining the effect of the training action in the first period of 13–14 years, the rate was less by 3,7 movements (16,59%) than at 15–16 years, and by 4,7 movements (21,08%) than at the age of 17–18 years; last group showed an increase in the tempo from the previous one by one movement (3,85%). The difference in the deviation from the average was 13–14 years at the most 3.7 movements (16,59%) and minimally 4,3 movements (23,89%); in 15–16 years the best result is more for 11 movements – 42,31% and the worst – for 7 movements less – 36,84%; in 17–18 years the indicator is more than the average for 4 movements – 14.81% and less for 5 movements – 22,72%. The number of movements from the youngest to the older age group increases, however, deviations from the average are noted, more pronounced in 15–16 years, the difference was 79,15%, and at 13–14 years – 40,48% and 17–18 years – 37,53%. These results characterize the unequal reaction of athletes of all ages, especially at the age of 15–16, as well as a different level of athletic preparedness for all athletes, especially at 13–14 and 17–18 years.

The time of one movement in girls aged 13–14 was greater by 0,096 s (16,67%) than at 15–16 years, and by 0.117 s (21,08%) than at 17–18 years. The difference between the senior and middle groups was 0,021 s (3,78%). Deviation in the younger group from the average was in the direction of improving the result – by 0,095 s (16,46%) and deterioration - by 0,161 s (23,96%), at 15–16 years the best result was 0,171 s (42,22%) And the worst – on 0,129 s (22,39%), in 17–18 years the best result was at 0,072 s (14,91%) and the worst result – by 0,126 s (22,70%). The time of one movement from the younger age group to the older one decreases, which characterizes the improvement of one of the speed indicators. Deviations from the average indicator are more pronounced in 15–16 years, the difference was 65,61%, at 13–14 years – 40,42%, at 17–18 years – 37,61%.

The speed of one movement in the first group was less than in the second group by 0,074 m·s⁻¹ (16,59%) and by 0,094 m·s⁻¹ (21,07%) than in the third group, in the second group compared to third less on 0,020 m·s⁻¹ (3,85%). At 13–14 years, the maximum speed was observed at 0,074 m·s⁻¹ (16,59%) more than the average, the minimum speed is less than the average for 0,086 m·s⁻¹ (23,89%). The best result of the first group was the same with the average of the second group. In athletes aged 15–16 years, the highest speed exceeded the average by 0,221 m·s⁻¹ (42,5%), minimum speed was less

Table 1
Indicators of physical quality of swiftness (women's, rowing)

| Indicators | Age | | | | | | | | | | |
|--------------------------------------|--|--|---------------------------|-----------------|---------------------------|---------------------------|-----------------|-------------------------|-------------------------|---------------|-------------|
| | 13–14 year-olds | | | 15–16 year-olds | | | 17–18 year-olds | | | | |
| | M±m | M _{max} | M _{min} | M±m | M _{max} | M _{min} | M±m | M _{max} | M _{min} | | |
| Effect of training action | First period | rate (number of movements) | 22,3±0,99 | 26 | 18 | 26,0±1,25 | 37 | 19 | 27,0±1,26 | 31 | 22 |
| | | time of one movement (s) | 0,672 | 0,577 | 0,833 | 0,576 | 0,405 | 0,705 | 0,555 | 0,483 | 0,681 |
| | | speed of one movement (m·s ⁻¹) | 0,446 | 0,520 | 0,360 | 0,520 | 0,741 | 0,425 | 0,540 | 0,621 | 0,441 |
| | | frequency of movement | 1,48 | 1,73 | 1,20 | 1,73 | 2,47 | 1,27 | 1,80 | 2,07 | 1,47 |
| | Second period | rate (number of movements) | 102,5±5,82 (25,5±1,45) | 135 (33,75) | 88 (22) | 116,0±2,23 (29,0±0,55) | 128 (32) | 92 (23) | 120,0±6,73 (30±1,68) | 148 (37) | 100 (25) |
| | | time of one movement (s) | 0,585 | 0,445 | 0,682 | 0,517 | 0,469 | 0,652 | 0,500 | 0,405 | 0,600 |
| | | speed of one movement (m·s ⁻¹) | 0,512 | 0,674 | 0,439 | 0,580 | 0,639 | 0,475 | 0,600 | 0,741 | 0,500 |
| | | frequency of movement | 1,71 | 2,25 | 1,47 | 1,93 | 2,13 | 1,53 | 2,0 | 2,47 | 1,67 |
| | Third period | rate (number of movements) | 27,4±0,61 | 35 | 22 | 30,5±1,39 | 44 | 24 | 31,8±1,26 | 36 | 27 |
| | | time of one movement (s) | 0,547 | 0,429 | 0,682 | 0,491 | 0,341 | 0,625 | 0,471 | 0,417 | 0,556 |
| | | speed of one movement (m·s ⁻¹) | 0,548 | 0,699 | 0,439 | 0,610 | 0,879 | 0,480 | 0,636 | 0,719 | 0,559 |
| | | frequency of movement | 1,82 | 2,33 | 1,47 | 2,03 | 2,93 | 1,6 | 2,12 | 2,4 | 1,80 |
| Summary | rate (number of movements) | 152,0±3,06 (25,3±1,01) | 196 (32,6) | 131 (21,8) | 172,0±7,52 (28,6±1,25) | 244 (40,6) | 136 (22,6) | 178±6,17 (29,6±1,02) | 217 (35,8) | 173 (24,8) | |
| | time of one movement (s) | 0,592 | 0,460 | 0,687 | 0,523 | 0,369 | 0,662 | 0,505 | 0,415 | 0,612 | |
| | speed of one movement (m·s ⁻¹) | 0,506 | 0,652 | 0,437 | 0,573 | 0,753 | 0,453 | 0,594 | 0,723 | 0,500 | |
| | frequency of movement | 1,69 | 2,17 | 1,45 | 1,91 | 2,51 | 1,51 | 1,97 | 2,41 | 1,65 | |
| Time of sensorimotor reaction | | | | | | | | | | | |
| | Sound | 0,210±0,044 | 0,199 | 0,222 | 0,198±0,006 | 0,152 | 0,239 | 0,186±0,005 | 0,159 | 0,198 | |
| | Light | 0,259±0,017 | 0,200 | 0,340 | 0,217±0,005 | 0,167 | 0,247 | 0,203±0,011 | 0,165 | 0,248 | |

than the average speed by 0,095 m·s⁻¹ (22,35%). For rowers at 17–18 years, the maximum speed was greater than the average by 0,081 m·s⁻¹ (15,01%), and minimum speed is less than the average speed 0,99 m·s⁻¹ (22,45%). Deviations from the average index of the highest 64,85% in 15–16 years, significantly less in 17–18 years, which amounted to 37,46% and slightly less than 40,22% in 13–14 years.

The frequency of movement of the surveyed athletes increased with age. In the 15–16 years was more by 0,25 Hz (16,89%), and at 17–18 years by 0,32 Hz (21,62%) than at 13–14 years, at 17–18 years of age this figure was higher than in 15–16 years 0,07 Hz (4,05%). In the younger group, the maximum frequency of movements was greater than the average value by 0,25 Hz (16,89%), the minimum – less than the average 0,28 Hz (23,33%). In the middle group, the highest frequency of movements at 0,74 Hz (42,77%) exceeded the average, the smallest frequency of movement at 0,46 Hz (36,22%) was less than the average value. In the senior group, the best indicator was greater than the average value by 0,27 Hz (15,01%), and the worst – less than the average

0,33 Hz (22,45%). Deviations from the average indicator were 40,22% in the first group, 78,99% in the second group, and in the third group – 37,46%.

In the second period of the study of the effect of training action, the rate of athletes at 13–14 years was less than in 15–16 years for 3,5 movements (13,73%) and even less than in 17–18 years – 4,5 movements (17,65%). In the older group, the rate was greater than in the middle group, for one movement (3,45%). The deviation from the average of 13–14 years was according to the maximum indicator – 8,25 movements (35,35%), the minimum indicator – 3,5 movements (15,91%); in 15–16 years for the best result – 3 movements (10,34%), for the worst – 6 movements (26,09%); in 17–18 years, according to the highest score – 7 movements (23,33%), at the lowest – 5 movements (20%). The difference in the rate between the maximum and minimum values compared with the average results was observed in 13–14 years – 48,26%, in 15–16 years – 36,43%, in 17–18 years – 43,33%.

The time of one movement in the first group was greater than

in the second group by 0,068 s (13,15%) and more than in the third, by 0,085 s (17%), and in the second group more than in the third group by 0,017 s (3,4%). In the first group, the best result differed from the average by 0,14 s (31,46%), the worst – by 0,097 s (16,58%). In the second group, the best time was less than the average for 0,048 s (10,23%) and the worst time is more than the average for 0,135 s (26,11%). In the third group, the best time for one movement is less than the average for 0,095 s (23,46%), the worst time is more than the average for 0,100 s (20%). The difference in the time index of one movement between the maximum and minimum values was in 13–14 years 48,04%, 15–16 years – 36,34%, 17–18 years – 43,46%.

The average speed of one movement in the group of female athletes aged 17–18 was more by 0,020 m·s⁻¹ (3,45%) than in 15–16-year-olds, and by 0,088 m·s⁻¹ (17,19%), than in 13–14-year-olds. In the younger age group, the maximum speed was greater than the average by 0,162 m·s⁻¹ (31,64%), and the minimum speed was less by 0,073 m·s⁻¹ (16,63%); in the middle group, the maximum speed exceeded the average by 0,059 m·s⁻¹ (10,23%), and the minimum was less than the average on 0,105 m·s⁻¹ (22,11%); In the older group, the maximum speed was determined more than the average speed by 0,141 m·s⁻¹ (23,5%), and the minimum – less than the average 0,100 m·s⁻¹ (20%). The difference in the rate of one movement between the maximum and minimum results was in 13–14 years – 48,27%, 15–16 years – 32,34%, in 17–18 years – 43,5%.

The frequency of movements in 13–14 years was compared with a 15–16-year less at 0,22 Hz (12,87%) and 17–18-year 0,29 Hz (16,96%), the last group by this indicator exceeds previous on 0,07 Hz (3,63%). In the first group, the maximum frequency of movements was determined more than the average value by 0,54 Hz (31,58%), the minimum – less than the average 0,24 Hz (16,32%). In the second group, the best result was greater than the average of 0,2 Hz (10,36%) and the worst – less than the average 0,4 Hz (26,14%). In the third group, the maximum indicator was greater than the average value by 0,47 Hz (23,5%), the minimum – less than the average by 0,33 Hz (19,76%). Fluctuations between the best and worst indicators were in 13–14 years – 47,9%, in 15–16 years – 36,5%, in 17–18 years – 43,26%.

In the third period of the test of determining the effect of the training action, when comparing the three age groups, the lowest rate was observed at 13–14 years, at 15–16 years it was increased by 3,1 movements (11,31%), in 17–18 – on 4,4 movements (16,06%) and compared with 15–16-year-olds – on 1,3 movements (4,26%). The maximum rate of 13–14 years was above the average by 7,6 movements (27,74%), and the minimum – less than the average by 5,4 movements (24,55%). In the 15–16 years the best indicator was determined above the average by 13,5 movements (44,26%), the worst – below the average by 6,5 movements (27,08%). In 17–18 years the maximum index exceeded the average by 4,2 movements (13,21%), and the minimum was below the average by 4,8 movements (17,78%). There was a difference in the fluctuations s between the maximum and minimum values in 13–14 years – 52,29%, in 15–16 years – 71,34%, in 17–18 years – 30,99%.

The time of one movement was 13–14 years more than at 15–16 years by 0,56 s (11,41%), at 17–18 years – by 0,076 years

(16,14%), in the older group compared to average this indicator decreased by 0,02 s (4,25%). In the first group, the best result differed from the average by 0,118 s (27,51%) and the worst by 0,135 s (24,68%), in the second group the difference in the best time from the mean was 0,15 s (43,99%) and the worst – 0,134 s (27,29%), in the third group, respectively – 0,054 s (12,95%) and 0,085 (18,05%). The difference in the time index of one movement between the maximum and minimum results was noted in 13–14 years – 52,19%, in 15–16 years – 71,28%, in 17–18 years – 31,0%.

Speed of one movement in the 13–14 years was less than in the 15–16 years by 0,062 m·s⁻¹ (11,31%) and less than in the 17–18 years by 0,088 m·s⁻¹ (16,09%), and in the middle group it is less than in the senior group on 0,026 m·s⁻¹ (4,26%). In the first group, the maximum speed exceeded the average by 0,15 m·s⁻¹ (27,55%), and the minimum was less than the average 0,109 m·s⁻¹ (24,83%). In the second group, the fastest speed was 0,269 m·s⁻¹ (44,09%) above the average and the lowest – below the average by 0,13 m·s⁻¹ (27,08%). In the third group, the best speed is greater than the average by 0,083 m·s⁻¹ (13,05%) and the worst speed is less than the average on 0,077 m·s⁻¹ (13,77%).

Frequency of movement in female athletes in 13–14 years was less than in 15–16 years at 0,21 Hz (11,54%), at 17–18 years – at 0,30 Hz (16,48%), and in 15–16 years less than in the 17–18 years, on 0,09 Hz (4,43%).

In the first group, the maximum frequency of movements was greater than the average value by 0,51 Hz (28,02%) and the minimum frequency was less than the average by 0,35 Hz (23,81%); in the second group, respectively – by 0,90 Hz (44,33%) and 0,43 Hz (26,87%), in the third group the best result is more than the average for 0,28 Hz (13,21%) and worst – was less than the average on 0,32 Hz (17,79%). Differences between the maximum and minimum results for the frequency of movements were in 13–14 years 51,83%, in 15–16 years – 71,20%, in 17–18 years – 31,0%.

On the total score of the test for determining the effect of the training action, the following data were obtained. At 13–14 years, the rate was less than 15–16 years, 3,3 movements (13,04%), and less than in the 17–18 years by 4,3 movements (6,99%), and in 15–16 years less than in 17–18 years, for 1 movement (3,49%). In the first group, the best result was above the average by 7,3 movements (28,85%) and the worst – below the average by 3,5 movements (16,06%); in the second group the maximum index is more than the average for 12 movements (41,96%) and the minimum – less than the average for 6 movements (26,55%); in the third group, the highest result exceeded the average by 6,2 movements (20,95%) and the smallest was less than the average by 4,8 movements (19,35%). Difference in the total result of the rate between the maximum and minimum values in comparison with the average indicator was determined in 13–14 years – 44,91%, in 15–16 years – 68,51%, in 17–18 years – 40,3%.

The time of one movement in the first group was more than in the second group by 0,069 s (13,19%) and than in the third by 0,087 s (17,23%), and in the second one more than in the third – на 0,018 s (3,56%). At 13–14 years, deviations from the average value were for the better, i.e., the decrease in the time of one movement by 0,132 s (28,69%) and the increase in time by 0,095 s (16,05%), at 15–16 years The best

result differed from the average – by 0,154 s (41,73%) and the worst – by 0,139 s (26,58%), at 17–18 years respectively – by 0,009 s (21,69%) and 0,107% s (21,19%). The difference in the time of one movement from the mean value over the maximum and minimum indicators was noted in 13–14 years 44,74% in 15–16 years – 68,31%, in 17–18 years – 42,88%.

The speed of one movement among female athletes in 13–14 years less than in 15–16 years, by 0,067 m·s⁻¹ (13,24%) and, by 17–18 years – by 0,088 m·s⁻¹ (17,39%), and 15–16 years less than in the 17–18 years, on 0,021 m·s⁻¹ (3,67%). In the younger age group, the total maximum speed is greater than the average by 0,126 m·s⁻¹ (28,85%), the minimum is less by 0,069 m·s⁻¹ (15,79%); in the middle group, respectively – 0,244 m·s⁻¹ (42,58%) and 0,120 (26,49%); in the senior group the best result is greater than the average by 0,129 m·s⁻¹ (21,72%), the worst – 0,094 m·s⁻¹ (18,81%). The deviation of the speed of one movement in total for the best and the worst indicator was in 13–14 years – 44,64%, in 15–16 years – 69,07%, in 17–18 years – 40,53%.

The frequency of movements in the sum of the three stages of the test was 13–14 years less than at 15–16 years, 0,22 Hz (13,01%) and, at 17–18 years, at 0,28 Hz (16,57%), and 15–16 years less than in the 17–18 years, on 0,06 Hz (3,14%). In the first group, the maximum indicator is 0,48 Hz higher than the average (28,41%), minimum indicator is less by 0,24 Hz (16,55%); in the second group, the best result exceeds the average by 0,80 Hz (41,88%), worst – less than the average by 0,40 Hz (26,49%); in the third group, the indicators studied were correspondingly – 0,44 Hz (22,34 %) and 0,32 Hz (19,39%). Deviations from the average value are determined in total in 13–14 years – 44,96%, in 15–16 years – 68,37%, in 17–18 years – 41,73%.

The obtained results characterize the individual characteristics of female athletes in the simulation of sports activities; show a different reaction in the observed age groups and, consequently, a different level of sports qualification.

Based on a comparative analysis of the studies, criteria were developed for assessing the physical quality of the speed and its components (the rate, time and speed of a one movement, the frequency of movements) to determine the prospects of athletes and use as part of the selection methodology at various stages of improving sports training and improving the level of sports qualifications.

Table 2 presents the criteria for assessing the physical quality of the swiftness of female athletes aged 13–14 years engaged in rowing. Obtained results of the conducted researches characterize the level of the functional and physical state of the examined female athletes. The average time of sensorimotor reaction to sound is determined by the evaluation “good”, the best time is almost “excellent” (less than 0,001 s), in the light of the average time – “satisfactory”, the best figure – somewhat higher (0,008 s) parameters “excellent” assessment, worst is less by 0,055 s from the “satisfactory”.

In the test of measuring the effect of the training action in the first period, the tempo by the average indicator is rated “good”, but at the lower level of the evaluation, the maximum is “excellent”, the minimum is lower (for one movement). The time of one movement is marked at the level – on the average “good”, the best indicator is “excellent”, the worst – “satisfactory”. The speed of one movement was on the average at the level of “good”, the maximum speed – “excellent”, the minimum – “satisfactory”, but only 0,01 m·s⁻¹ exceeded the lower limit. The frequency of movements was assessed as an average “good”, the best result was “excellent”, and the worst was

Table 2
Criteria for assessing the physical quality of swiftness (girls 13–14 years old, rowing)

| Indicators | Evaluation | Rate | Time | Speed | Frequency | |
|--------------------------------------|-------------------|-----------------------|-------------------------|----------------------|-------------|-----------|
| | | (Number of movements) | (s) | (m·s ⁻¹) | (Hz) | |
| Effect of training action | First period | satisfactory | 19–21 | 0,850–0,750 | 0,350–0,430 | 1,20–1,45 |
| | | good | 22–24 | 0,749–0,650 | 0,431–0,510 | 1,46–1,71 |
| | | excellent | 25–27 | 0,649–0,550 | 0,511–0,590 | 1,72–1,97 |
| | Second period | satisfactory | 80–90 (20–22,5) | 0,750–0,650 | 0,430–0,510 | 1,45–1,70 |
| | | good | 91–101 (22,75–25,25) | 0,649–0,550 | 0,511–0,590 | 1,71–1,96 |
| | | excellent | 102–112 (25,5–28) | 0,549–0,450 | 0,591–0,670 | 1,97–2,22 |
| | Third period | satisfactory | 22–24 | 0,650–0,550 | 0,435–0,515 | 1,50–1,75 |
| | | good | 25–27 | 0,549–0,450 | 0,516–0,595 | 1,76–2,01 |
| | | excellent | 28–30 | 0,449–0,350 | 0,596–0,675 | 2,02–2,27 |
| | Summary | satisfactory | 140–150 (23,3–25) | 0,700–0,600 | 0,400–0,480 | 1,40–1,65 |
| | | good | 151–162 (25,2–27) | 0,599–0,500 | 0,481–0,560 | 1,66–1,91 |
| | | excellent | 163–174 (27,1–29) | 0,499–0,400 | 0,561–0,640 | 1,92–2,17 |
| Time of sensorimotor reaction | | | | | | |
| | Evaluation | Sound (s) | | Light (s) | | |
| | satisfactory | 0,230–0,215 | | 0,255–0,240 | | |
| | good | 0,214–0,199 | | 0,239–0,224 | | |
| | excellent | 0,198–0,183 | | 0,223–0,208 | | |

“satisfactory” at the lower boundary level.

In the second period of the test, female athletes maintain an average rate of movement on “excellent”, maximum – more than the best estimate for 5,75 movements (20,54%), minimum – “satisfactory”. The time of one movement is determined by the “good” rating, the best result is 0,005 (1,12%) higher than the “excellent” rating, the worst is “satisfactory”. The speed of one movement is on average “good”, the maximum result is “excellent”, the minimum is “satisfactory”. The frequency of movements is on the average “good”, the best result is “excellent”, the worst is “satisfactory”.

In the third test period, the rate of 0,4 movement (1,48%) exceeded the rating “good”, maximum for 5 movements (16,67%) more parameters – “excellent”, minimum – “satisfactory”. The time of one movement was determined on the average by “good”, the best figure is “excellent”, the worst result is less “satisfactory” by 0,032 s (24,68%). The average speed of one movement is “good”, the maximum is 0,024 m·s⁻¹ (3,56%) is more “excellent”, the minimum is “satisfactory”. The average frequency of movements is a “good” estimate, the maximum is 0,006 Hz (2,64%) higher than the rating parameters “excellent”, the minimum frequency is 0,03 Hz (3,81%) less than the lower “satisfactory”.

According to the total indicator of the study of the effect of training action in female athletes aged 13–14 years, the rate of movement on average – the score is “good”, maximum – 3,6 movements (12,41%) more than “excellent”, at least 1,5 movement (6,89%) is less than the lower level of the assessment “satisfactory”. Time of one movement is “good”, the best is “excellent”, worst is “satisfactory”. Speed of one movement was, on the average, evaluated as “good”, the maximum indicator for 0,012 m·s⁻¹ (1,88%) Above the proposed assess-

ment boundary is “excellent”, the minimum is “satisfactory”. Average frequency of movements is at the level of “good”, the maximum – “excellent”, the minimum – “satisfactory”.

The obtained research results characterize, on the average, a sufficiently high level of development of swiftness physical quality; however, large differences between the maximum and minimum indices indicate the heterogeneous composition of the group for special and general physical readiness.

The obtained results of the research of female athletes 15–16 age years engaged in rowing, made it possible to develop criteria for assessing the physical quality of the swiftness and some of its components, which are presented in the Table 3.

Following assessments were made in our studies: the time of sensorimotor reaction to sound is “good” on the average, the best result is 0,028 s (18,42%) higher than the upper bound of the rating “excellent”, the worst is 0,014 s (6,22%) less than the lower boundaries of the assessment are “satisfactory”; sensorimotor response time to light is “good” on the average, the best result is 0,021 s (12,57%) higher than the rating parameters “excellent”, the worst indicator is less than the “satisfactory” score for 0,012 s (5,11%).

In the test of the effect of the training action in the first period, the evaluation criteria were determined: the average rate is “good”, the maximum result is greater than the “excellent” score for 7 movements (23,33%), minimum – lower assessment “satisfactory” 3 movement (15,79%); time of one movement – on average the score is “good”, the best result is “excellent”, the worst is “satisfactory”; The speed of one movement on average is “good”, the maximum result is more “excellent” 0,071 m·s⁻¹ (10,59%), minimum – slightly less than “satisfactory”; frequency of movements is on the aver-

Table 3
Criteria for assessing the physical quality of swiftness (girls 15–16 years old, rowing)

| Indicators | Evaluation | Rate | Time | Speed | Frequency | |
|--------------------------------------|-------------------|-----------------------|--------------------------|----------------------|-------------|-----------|
| | | (Number of movements) | (s) | (m·s ⁻¹) | (Hz) | |
| Effect of training action | First period | satisfactory | 22–24 | 0,750–0,650 | 0,430–0,510 | 1,30–1,55 |
| | | good | 25–27 | 0,649–0,550 | 0,511–0,590 | 1,56–1,81 |
| | | excellent | 28–30 | 0,549–0,450 | 0,591–0,670 | 1,82–2,07 |
| | Second period | satisfactory | 90–100 (22,5–25) | 0,700–0,600 | 0,435–0,515 | 1,50–1,75 |
| | | good | 101–111 (25,25–27,75) | 0,599–0,500 | 0,516–0,595 | 1,76–2,01 |
| | | excellent | 112–122 (28–30,5) | 0,499–0,400 | 0,596–0,675 | 2,02–2,27 |
| | Third period | satisfactory | 25–27 | 0,650–0,550 | 0,450–0,530 | 1,55–1,80 |
| | | good | 28–30 | 0,549–0,450 | 0,531–0,610 | 1,81–2,06 |
| | | excellent | 31–33 | 0,449–0,350 | 0,611–0,690 | 2,07–2,32 |
| | Summary | satisfactory | 150–160 (25–26,7) | 0,700–0,600 | 0,440–0,520 | 1,50–1,75 |
| | | good | 161–172 (26,8–28,7) | 0,599–0,500 | 0,521–0,600 | 1,76–2,01 |
| | | excellent | 173–184 (28,2–30,7) | 0,499–0,400 | 0,601–0,680 | 2,02–2,27 |
| Time of sensorimotor reaction | | | | | | |
| | Evaluation | Sound (s) | | Light (s) | | |
| | satisfactory | 0,225–0,210 | | 0,235–0,220 | | |
| | good | 0,211–0,196 | | 0,219–0,204 | | |
| | excellent | 0,195–0,180 | | 0,203–0,188 | | |

age “good”, the best result exceeds the rating “excellent” by 0,4 Hz (19,32%), the worst one – by 0,03 Hz (2,36%) less than the “satisfactory”.

In the second period of the test the average rate was at the level of “excellent”, maximum – 1,5 movement (4,91%) more “excellent”, the minimum – “satisfactory”; time of one movement is on the average “good”, the best indicator is “excellent”, the worst is “satisfactory”; speed of one movement was estimated on average as “good”, maximum – “excellent”, minimum – “satisfactory”; frequency of movements was on the average – “good”, the best result – “excellent”, the worst – “satisfactory”. In the third period of the test, the tempo of the movements was noted at the level of the upper bound of the “good” score, the maximum – by 11 movements (33,33%) higher than the “excellent” score, the minimum – “satisfactory”; time of one movement was estimated on the average – “good”, the best figure – exceeds “excellent” by 0,059 s (17,30%), speed of one movement – on average, the score is “excellent”, maximum – more “excellent” for 0,199 m·s⁻¹ (29,26%), minimum – “satisfactory”; frequency of movements is on the average “good”, the best indicator exceeds the rating “excellent” by 0,61 Hz (26,29%), the minimum – “satisfactory”.

Total indicator of the measurement of the effect of the training action of female athletes 15–16 years age, specializing in rowing, characterized the following results: the rate of movements – “good”, maximum – more than “excellent” for 9,9 movements (32,25%); time of one movement is on the average “good”, the best indicator is more than “excellent” at 0,031 s (8,4%), the worst – “satisfactory”; speed of one movement – on the average “good”, maximum – exceeds the rating “excellent” on 0,073 m·s⁻¹ (10,74%), minimum – “satisfactory”; frequency of movements is on the average “good”, the best result is more than “excellent” at 0,60 Hz (31,41%),

the worst is “satisfactory”.

Based on the conducted research, it was noted that there are large differences between the mean values and the maximum and minimum indices, which determines the unequal level of physical and functional preparedness of the female athletes of this group, with a general average level determined by the “good”.

These criteria for assessing the physical quality of the swiftness of female athletes 17–18 years age, specializing in rowing, are presented in Table 4. In our studies in the first period of the measurement of the effect of a training action, the rate of movement was determined on the average by the evaluation “good”, the maximum – “excellent”, the minimum – for one movement (4,55%) smaller evaluation as “satisfactory”; time of one movement on the average – “good”, the best indicator – “excellent”, the worst – “satisfactory”; speed of one movement on the average is “good”; maximum – “excellent”, minimal – on 0,009 m·s⁻¹ (2,04%) smaller evaluation as “satisfactory”; Frequency of movements – on the average “good”, best indicator – “excellent”, worst – “satisfactory”. In the second period following evaluation test were observed: the average rate – “good”, the maximum – up to 4 motion (12,12%) “excellent”, the minimum – at least one movement (4,0%) than the “satisfactory”; time of one movement on the average – “good”, the best – “excellent”, the worst – “satisfactory”; The speed of one movement on average is “good”, the maximum on 0,046 m·s⁻¹ (6,62%) is greater than “excellent”, minimum is “satisfactory”; frequency of movements on the average is “good”, the best indicator is 0,10 Hz (4,22%) more than “excellent”, the worst – “satisfactory”. In the third period of the test, the indices were estimated: the rate of movement was 0,2% slower (0,63%) than “excellent”, maximum – 2 movements (5,89%) higher than “excellent”, minimum – “sat-

Table 4
Criteria for assessing the physical quality of swiftness (girls 15–16 years old, rowing)

| Indicators | Evaluation | Rate | Time | Speed | Frequency | |
|--------------------------------------|-------------------|-----------------------|--------------------------|----------------------|-------------|-----------|
| | | (Number of movements) | (s) | (m·s ⁻¹) | (Hz) | |
| Effect of training action | First period | satisfactory | 23–25 | 0,730–0,630 | 0,450–0,530 | 1,40–1,65 |
| | | good | 26–28 | 0,689–0,530 | 0,531–0,610 | 1,66–1,91 |
| | | excellent | 29–31 | 0,529–0,430 | 0,611–0,790 | 1,92–2,15 |
| | Second period | satisfactory | 100–110 (25–27,5) | 0,680–0,580 | 0,455–0,535 | 1,60–1,85 |
| | | good | 111–121 (27,75–30,25) | 0,579–0,480 | 0,536–0,615 | 1,86–2,11 |
| | | excellent | 122–132 (30,5–33) | 0,479–0,380 | 0,616–0,695 | 2,12–2,37 |
| | Third period | satisfactory | 26–28 | 0,630–0,530 | 0,470–0,550 | 1,65–1,90 |
| | | good | 29–31 | 0,529–0,430 | 0,551–0,630 | 1,91–2,16 |
| | | excellent | 32–34 | 0,429–0,330 | 0,631–0,710 | 2,17–2,42 |
| | Summary | satisfactory | 155–165 (25,8–27,5) | 0,680–0,580 | 0,460–0,540 | 1,55–1,80 |
| | | good | 166–176 (27,7–29,3) | 0,579–0,480 | 0,541–0,620 | 1,81–2,06 |
| | | excellent | 177–187 (29,5–31,2) | 0,479–0,380 | 0,621–0,700 | 2,07–2,32 |
| Time of sensorimotor reaction | | | | | | |
| | Evaluation | Sound (s) | Light (s) | | | |
| | satisfactory | 0,125–0,200 | 0,230–0,215 | | | |
| | good | 0,199–0,184 | 0,214–0,199 | | | |
| | excellent | 0,183–0,168 | 0,198–0,183 | | | |

isfactorily”; time of one movement is on the average “good”, the best time is “excellent”, the worst is “satisfactory”; speed of one movement on the average is “good”, the maximum is “excellent”; frequency of movements on average – “good”, maximum – “excellent”, minimal – “satisfactory”. Totally, for three periods, the average rate was rated “excellent”, the maximum rate for 4,6 movements (14,74%) exceeded the score “excellent”, the minimum for one movement (4,03%) was less than “satisfactory”; time of one movement on the average – “good”, the best indicator – “excellent”, the worst – “satisfactory”; speed of one movement on average is “good”, the maximum on $0,023 \text{ m}\cdot\text{s}^{-1}$ (3,29%) is greater than “excellent”, minimum is “satisfactory”; frequency of movements on the average is “good”, the best score is 0,09 Hz (3,88%), higher than the upper bound of the rating “excellent”, the worst is “satisfactory”.

Results of the research determine a fairly uniform level of female athletes of this group in terms of indicators that characterize the physical quality of swiftness.

Increase in the speed of voluntary movements is due to the training of swiftness in the overall movement, as well as the analytical improvement of the factors determining the maximum speed of movement during the performance of exercises. Common tendency is the desire to exceed the maximum speed when performing exercises.

A simple motor reaction is determined by its two main components: latent (delayed), due to delays accumulating at all levels of organization of motor actions in the central nervous system (latent time of a simple motor reaction practically does not lend itself to training, it is not connected with sporting skill and can not be taken as a characteristic of the speed of a person); motor, due to the improvement of which, basically, and

the reduction of the response time.

Conclusions

To improve the motor qualities and form the speed of movements, the most favorable conditions have studied age periods. Under the influence of training, there are changes in the tempo, time, speed, frequency of movements, the time of sensorimotor reactions to sound and light stimuli.

Indicators of the physical quality of the swiftness characterize the individual psycho-physiological characteristics of the athlete's body, which makes it possible to make adjustments in improving the speed abilities and effectively manage the training process.

Based on a comparative analysis of the studies, criteria were developed for assessing the physical quality of the swiftness and its components (rate, time and speed of a single movement, frequency of movements) to determine the prospects of athletes and use as part of the selection methodology at various stages of improving sports training and improving the level of sports qualifications.

Prospects for further research. This work is a logical continuation of a series of studies related to the study of the functional state and physical qualities of rowers, differing in gender, age, sports qualification and specialization in order to create an effective integrated methodology for assessing the prospects and selection of rowing and other sports.

It is proposed to identify other functional and psycho-physiological indicators along with the study of traditional features in predicting sports abilities, which can significantly change under the influence of training.

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Information about the Authors

Volodymyr Bogush: *PhD (Medicine); Admiral Makarov National University of Shipbuilding: Geroev Stalingrada str. 9, Mykolayiv, 54025, Ukraine.*

ORCID.ORG/0000-0002-7178-6165

E-mail: toops@ukr.net

Sergiy Getmantsev: *PhD (Biology); V. Sukhomlynskiy Mykolayiv National University: Nikolskaya str. 24, Mykolayiv, 54030, Ukraine.*

ORCID.ORG/0000-0003-1829-9832

E-mail: s.v.getmantsev@rambler.ru

Konstantin Bogatyrev: *Doctor of Science (Economy), Professor; Admiral Makarov National University of Shipbuilding: Geroev Stalingrada str. 9, Mykolayiv, 54025, Ukraine.*

ORCID.ORG/0000-0003-0963-8417

E-mail: toops@ukr.net

Yuriy Kulakov: *V. Sukhomlynskiy Mykolayiv National University: Nikolskaya str. 24, Mykolayiv, 54030, Ukraine.*

ORCID.ORG/0000-0002-3651-0438

E-mail: KulakoV_MNU@ukr.net

Olga Kuvaldina: *PhD (Physical Education and Sport); Admiral Makarov National University of Shipbuilding: Geroev Stalingrada str. 9, Mykolayiv, 54025, Ukraine.*

ORCID.ORG/0000-0002-3402-2369

E-mail: olga.kuvaldina@nuos.edu.ua

Yevgen Yatsunskyi: *Admiral Makarov National University of Shipbuilding: Geroev Stalingrada str. 9, Mykolayiv, 54025, Ukraine.*

ORCID.ORG/0000-0001-7450-252X

E-mail: lily0210837@gmail.com