Coaching Applications

The Unintended Consequences of Tension in the Abdominal and Lumbar Musculature on Swimmers' Ventilatory and Metabolic Indices

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Abstract

Swimming performance is governed by the ability of the body to consume oxygen for energy production, and for most events increase the resistance on the propulsive surfaces, and decrease resistance on the non-propulsive surfaces of the body. It has been proposed that the abdominal and erector spinae muscles contract during swimming to decrease form resistance or drag on the swimmers' body to increase speed. We hypothesized that contracting these muscle groups would negatively impact pulmonary functions and increase oxygen consumption. Significantly lower pulmonary functions and higher resting oxygen consumption were observed while the abdominal and erector spinae muscles were contracted. We propose that contracting the abdominal and erector spinae muscles could cause decrements in crawl stroke swimming performance.

Introduction

There are many amateur sports theorists who generate ideas to improve swimming performances. These ideas often appear to come from uninformed ideas about science and the unintended consequences of their recommendations are not considered. We found that the participants in this study could indeed pull their stomach in tight and put their body in a rigid straight position suggested by Skinner (11). Compression suits Smith (12) have been shown to compress the body and have demonstrated a reduction in passive drag making the idea of this body position more attractive in light of the illegalization of the compressive suits.

There were many unintended consequences observed when the swimmers' bodies were put into the contracted condition described in this paper. These included decrements in the ability of the participants to ventilate their lungs. Ventilation is important in oxygen consumption as well of getting rid of carbon dioxide to control the acid base environment. This position also increased oxygen consumption from contraction of the musculature required to maintain this position and as shown in the literature review causes a redistribution of blood flow away from the exercising muscles.

Methods

We compared the ventilation volumes measured in the contracted condition and the non-contracted condition to normal values. The swimmers in this study showed greater ventilatory capacities than what were expected from the normal population. Under NC the swimmers' vital capacity was 109% of what one would expect from an age, height and weight matched group, while when the abdominal muscles were contracted the swimmers' vital capacities were 89% of the expected value. This value of 89% is similar to what one might see in an asthmatic population. Hence, a swimmer holding his or her trunk in this contracted condition could experience decrements in performance.

This position was prescribed not only to decrease resistance but to enhance the ability of the body to roll. However, research on body roll shows that body roll is strongly related to the center of buoyancy or the lungs. So, losing volumes of air from the lungs will decrease the buoyant force and reduce the ability of the body to roll in coordination with the arms and legs. Prins (2007) demonstrated that body roll does not produce a resultant force like turning the body to swing a bat because there is no ground reaction transmitted from the ground through the body and to the hand. In addition too much rolling can result in increased frontal resistance and a lateral spread of the feet. Hence this body position is again not useful in propulsion in addition to its detrimental effects on ventilatory and metabolic factors.

Discussion

What do these statistics mean? First the P or probability value of $P<.0167$ means that if this study were repeated 100 times the probability of getting the same results would occur 98.983 times out of 100 or (100 minus .0166). Because these variables were significantly correlated or related to one another they had to be tested against a very high standard. Instead of testing the probability at the .05 level, meaning the observed differences would occur 95 times out of 100, we tested them at .05 divided by 3 or .0166 and the differences were still significant. The Omega Square value indicated the amount of change in the variance of the score distribution in the control test changed as a result of the experimental condition. Hence we would expect to see these changes in the amount shown by each Omega square value. So if an Omega square value is .80 that means that the magnitude of the difference will be observed 80 percent of the time if the experiment were repeated 100 times. There were other types of statistical analyses that could have been used in this study, but these met the standard for publication in peer reviewed articles. This article has been previously reviewed by the Scientific Committee for the conference on Medicine and Biomechanics of Swimming. It has been revised for coaches and has again been reviewed for the Journal of Swimming Research.

Conclusion

Why should coaches read scientific articles? First, they show how the data was collected and analyzed. Secondly, they are reviewed by peers, and in the case of JSR, they are reviewed by coaches. Articles in professional periodicals deal with systems of belief about swimming, but there is not a requirement for confirmation of these beliefs through the collection of data. This is how a coach can determine whether findings or articles have validity as determined through data collection and statistical confirmation by the author and is approved by a group of impartial reviewers. It is hoped this process will develop information that will give swimming coaches an opportunity to use evidence based practices in their training programs. These findings will contribute to a coaches' ability to instruct their swimmers based on scientific evidence.