DO BODYSUITS FROM DIFFERENT MANUFACTURERS AID A SWIMMER’S BUOYANCY?

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INTRODUCTION

The new full-body swimsuits that became popular during the 2000 Olympic Games appear to provide swimmers with an advantage over conventional suits as evidenced by the sudden popularity of bodysuits and the onslaught of recent world records set in these suits. The reasons for such an advantage are unclear, however. Perhaps the suit material provides a reduction in frictional resistance (surface drag) compared to conventional suits or bare skin. Many swimmers claim that they feel that these suits allow them to “ride higher in the water” implying increased buoyancy. Previous research has looked at buoyancy characteristics and how they affect swimmers (Cordain & Kopriva, 1991; McLean & Hinrichs, 1998, 2000; Toussaint et al., 1989; Yanai, 2001). Cordain and Kopriva (1991) demonstrated a 3-5% time drop with a reduction in body density of 0.027 g/ml while wearing neoprene wetsuits. Toussaint et al. (1989) suggest that this is due to increased buoyancy and less frontal area in the water. Toussaint et al. (2002) observed a non-significant 2% drag reduction due to a full-body swimsuit, and two recent studies demonstrated no buoyant effects of the Fastskin™ (Benjanuvatra et al., 2002; Roberts et al., 2003).

The purpose of this study was to measure the buoyant forces and center of buoyancy locations of competitive swimmers wearing full bodysuits compared to conventional lycra suits and to see if the buoyant effects change with time in the water.

METHODS

Bodysuits were obtained from five different manufacturers. Of the many designs available, we tested the most popular variety from each manufacturer—those that covered full legs and torso but not the arms (or in one case only to the elbow). Thirty competitive swimmers (14 men, 16 women, ages 18-36) were used as subjects. Informed consent was received from each subject prior to testing. Each subject’s center of mass (CM) was located relative to the malleolus in a prone body position with the arms fully extended above the head (hereafter referred to as the streamline position) using a two-dimensional reaction board (Hay, 1993). The distance between malleolus and the bottom of the foot was used to express all distances relative to the bottom of the heel. The center of buoyancy (CB) was determined using procedures similar to those we have followed in previous studies (McLean & Hinrichs, 1998, 2000). During these tests the subjects assumed a prone position underwater while being suspended by two tethers each attached through force gauges to a wooden beam placed above the water. They were asked to get into position as quickly as possible, and hold that position for a few seconds while we measured the forces in the tethers. The subjects then stayed attached, but with their heads above water, until they were tested again at one-minute intervals. This was done for the conventional suit first and then for each of the five bodysuits in random order.
RESULTS AND DISCUSSION

We found a significantly greater buoyant force (as a % of body weight) in women than men for all suits (p<.05) (Figure 1). We also found smaller CB-CM distances in women compared to men for all suits. These results are consistent with our previous data on conventional suits (McLean & Hinrichs, 1998, 2000). Bodysuits from three of the five manufacturers provided a significant increase in buoyant force compared to conventional suits. One additional suit had a non-significant trend in this direction. The increases in force were approximately 0.1 to 0.3% of body weight at minute 1 and tended to decrease over time. At minute 4 this effect had all but disappeared. While there were trends for all suits, we found only one suit that provided a significant reduction in the CB-CM distance compared to the conventional suit. Overall, the bodysuits had the greatest “buoyant effects” on the men. This may be because men have a higher body density and their legs tend to sink more than women’s (McLean & Hinrichs, 1998, 2000).

![Buoyant Force of Several Full-Body Swimsuits](image)

**Figure 1:** The suits provided a buoyant force that was reduced over time. Suits 1-3 provided significantly greater buoyant force than the conventional lycra suit.

SUMMARY

FINA rule SW 10.7 states “No swimmer shall be permitted to use or wear any device that may aid his speed, buoyancy or endurance during a competition…” It is this rule that makes wetsuits illegal. Why are bodysuits being treated differently than wetsuits? Our results show that at least three of these bodysuits do indeed aid in a swimmer’s buoyancy compared to conventional suits. Perhaps this rule should be changed or else these suits should be disallowed.

REFERENCES

FINA. (http://www.fina.org/swimrules_10.html)

ACKNOWLEDGEMENTS

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