Chapter V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The purpose of this study was to investigate the relationship of anthropometric, behavioural and physiological factors to crawl stroke swimming learning and to find out the combined contribution of anthropometric, physiological and all the anthropometric, behavioural and physiological variables taken collectively, besides developing a multiple regression equation for the prediction of success in learning front crawl stroke swimming.

The subject for the study were 100 male students selected randomly out of 132 swimming beginners, by using a table of random numbers.\textsuperscript{1} They represented various schools of Greater Gwalior and had enrolled themselves for learning swimming in the Summer Swimming

\textsuperscript{1}Steel and Torrie, Principles and Procedures of Statistics, pp.428-431.
Course, 1985 being run at the Lakshmibai National College of Physical Education, Gwalior.

The dependent variable was the crawl stroke swimming learning ability which was determined by calculating a sum of the composite scores of the speed of swimming front crawl stroke over a distance of 50 metres, and the subjective rating of the crawl stroke technique done on a 10-point scale by 5 experts on the expiry of 10 weeks teaching programme.

The independent variables selected for the study were anthropometric, behavioural and physiological variables. The anthropometric variables included: weight standing height, foot length, foreleg length, thigh length, leg length, trunk length, forearm length, upperarm length, arm length, head circumference, shoulder width, upper arm girth, thigh girth, calf girth, leg length/trunk length, foreleg length/thigh length, and forearm length/upperarm length. The behavioural variables included: level of aspiration, intelligence, and concentration. The physiological variables included: body fat percentage, body density, vital capacity, aerobic capacity, power, arm and shoulder strength, abdomen strength, leg strength, average ankle flexibility,
trunk-hip flexibility, and shoulder flexibility.

The anthropometric measurements were taken by using weighing machine, spreading caliper, flexible steel tape and wall scale. Amongst behavioural variables the level of aspiration was assessed by using the test prepared by H.M. Singh and G. Tiwari.² For testing intelligence the Verbal Intelligence Test (Hindi Version) by R.K. Ojhan and K. Ray Choudhary³ was used. Concentration ability of the subjects was measured by using Electrical Mirror Drawing apparatus. Amongst physiological variables percentage of body fat was measured with the help of skinfold measurements recorded at four sites i.e. triceps, back, hip and stomach. The sum of these four readings was converted into percent fat by using the regression equation of Yuhasz.⁴

²Singh and Tiwari, Manual for Level of Aspiration.

³Ojha and Choudhary, Manual for Verbal Intelligence Test.

Body density was obtained by comparing the percent body fat to a ready reckoner prepared by Keys and Brozek.\textsuperscript{5} Vital capacity was measured by using a dry spirometer, aerobic capacity by Cooper's 12 Minute Run/Walk Test, power by Sargent jump, arm and shoulder strength by pull up test, abdomen strength by bent knee sit ups, and leg strength by using a leg dynamometer. Average flexibility of right and left ankles was measured by using a goniometer, trunk-hip flexibility by Wells and Dillon sit and reach test, and shoulder flexibility by raising the arms from the floor in a prone lying position on a flat surface.

The data on anthropometric, behavioural and physiological variables was collected during the week prior to the beginning of regular swimming classes. All tests were administered in the Human Performance Laboratory, Gymnasium, Track and Field and at the Swimming Pool of Lakshmi Bai National College of Physical Education, Gwalior. Tester's competence, reliability of tests and reliability of subjects were established by test-retest method and the reliability co-efficients were found to be satisfactorily high.

\textsuperscript{5}Keys and Brozek, "Body Fat in Adult Man," cited by Ibid., p.44.
The data were analysed by using the Pearson's Product Moment Correlation for assessing the relationship between crawl stroke swimming learning scores and each of the independent variables. The combined effect of anthropometric, behavioural and physiological variables on swimming learning was obtained by computing Multiple correlation. Step down regression method was used to identify the most contributing independent variables to crawl stroke swimming learning. In order to predict the crawl stroke swimming learning ability on the basis of most contributing anthropometric, physiological, and all variables combined, Regression Equations were developed. Level of significance for testing the hypothesis was set at .05.

Analysis of data revealed significant relationship of crawl stroke swimming learning ability to each of the following anthropometric, behavioural and physiological variables: weight \( r = 0.530 \), standing height \( r = 0.485 \), foot length \( r = 0.541 \), foreleg length \( r = 0.269 \), thigh length \( r = 0.613 \), leg length \( r = 0.509 \), trunk length \( r = 0.354 \), forearm length \( r = 0.448 \), upperarm length \( r = 0.414 \), arm length \( 0.458 \), shoulder width \( r = 0.376 \), thigh girth \( r = 0.495 \), calf girth \( r = 0.496 \), foreleg length/thigh length \( r = -0.430 \), intelligence \( r = 0.681 \).
percentage of body fat \((r = 0.401)\), body density \((r = -0.406)\), vital capacity \((r = 0.705)\), aerobic capacity \((r = 0.498)\), power \((r = 0.670)\), arm and shoulder strength \((r = 0.622)\), abdomen strength \((r = 0.388)\), and leg strength \((r = 0.674)\). The relationship between head circumference, upperarm girth, leg length/trunk length, forearm length/upperarm length, level of aspiration, concentration, average ankle flexibility, trunk-hip flexibility, shoulder flexibility and crawl stroke swimming learning scores were not found statistically significant at .05 level of confidence.

Multiple correlation was computed to determine those anthropometric, physiological and all combined variables which contribute most to the crawl stroke swimming learning. The result of the study indicated the following findings: foot length, thigh length, leg length and calf girth contribute most to the learning of crawl stroke swimming \((R = 0.694)\) among anthropometric variables with an efficiency of 28.02 percent of prediction. Among physiological variables percentage of body fat, body density, vital capacity, power, arm and shoulder strength and leg strength contribute most to the learning of crawl stroke swimming \((R = 0.830)\) with an efficiency of 44.232 percent of prediction. Among all the 32 variables taken collectively
foot length, foreleg length, leg length, forearm length, upperarm length, shoulder width, foreleg length/thigh length, forearm length/upperarm length, intelligence, percent body fat, body density, vital capacity, and arm and shoulder strength contribute most to the learning of crawl stroke swimming ($R = 0.899$) with an efficiency of 56.227 percent of prediction.

Multiple regression analysis by step down method resulted in the following equations for anthropometric (A), physiological (B), and all combined (C) variables:

**A:**
\[ Y = 88.6137 + 0.2660 \text{ (foot length)} + 0.3226 \text{ (thigh length)} - 0.1621 \text{ (leg length)} + 0.1690 \text{ (calf girth)}. \]

**B:**
\[ Y = 1046.3776 - 1.9323 \text{ (percent body fat)} - 867.6179 \text{ (body density)} + 0.0011 \text{ (vital capacity)} + 0.0712 \text{ (power)} + 0.1892 \text{ (arm and shoulder strength)} + 0.0179 \text{ (leg strength)}. \]

**C:**
\[ Y = 1214.1202 + 0.1621 \text{ (foot length)} + 0.5333 \text{ (foreleg length)} - 0.3301 \text{ (leg length)} - 0.6102 \text{ (forearm length)} + 1.0121 \text{ (upperarm length)} + 0.0746 \text{ (shoulder width)} - 13.3082 \text{ (foreleg length/thigh length)} + 16.7649 \text{ (forearm length/upperarm length)} + 0.0399 \text{ (intelligence)} - 2.3231 \text{ (percent body fat)} - 1033.3692 \text{ (body density)} + 0.0014 \text{ (vital capacity)} + 0.2083 \text{ (arm and shoulder strength)}. \]
Conclusions

Within the limitations of this study the following conclusions appeared justified as per the results obtained:

1. The anthropometric variables namely, weight, standing height, foot length, foreleg length, thigh length, leg length, trunk length, forearm length, upperarm length, arm length, shoulder width, thigh girth, calf girth, and foreleg length/thigh length are significantly related to the learning of crawl stroke swimming.

2. The behavioural variable of intelligence significantly contribute to the learning of crawl stroke swimming.

3. The physiological variables of body fat percentage, body density, vital capacity, aerobic capacity, power, arm and shoulder strength, abdomen strength, and leg strength significantly contribute to the quicker learning of crawl stroke swimming.

4. Among anthropometric variables head circumference, upperarm girth, leg length/trunk length, and forearm length/upperarm length seem to have no significant contribution to the learning of crawl stroke swimming.
5. Level of aspiration and concentration do not have significant relationship with crawl stroke learning.

6. Physiological variables namely, average ankle flexibility, trunk-hip flexibility and shoulder flexibility have no significant contribution to the learning of crawl stroke swimming.

7. Foot length, thigh length, leg length and calf girth contribute the most to success in crawl stroke swimming amongst anthropometric variables.

8. Amongst physiological variables percentage of body fat, body density, vital capacity, power, arm and shoulder strength, and leg strength contribute most to the learning of crawl stroke swimming.

9. Amongst the 32 anthropometric, behavioural and physiological variables chosen for this study, 13 variables namely, foot length, foreleg length, leg length, forearm length, upperarm length, shoulder width, foreleg length/thigh length, forearm length/upperarm length, intelligence, percentage of body fat, body density, vital capacity, and arm and shoulder strength contribute most to the quicker learning of crawl stroke swimming.
10. It is possible to predict crawl stroke swimming learning ability on the basis of anthropometric, physiological and all combined variables.

Recommendations

In the light of the results of this study it is recommended that:

1. Anthropometric measurements may be used to classify the students into groups for instructions in swimming in order to have uniformity in learning capacity.

2. In the teaching programme for novice swimmers emphasis should be laid on improvement of vital capacity, power and strength to enhance swimming learning ability.

3. While concentrating on the psychological approach to the teaching of swimming, emphasis should be laid on developing intelligence of the students.

4. The results of this study can be used by teachers and coaches in swimming as an aid in screening and selecting swimmers.

5. The study may be repeated by selecting subjects belonging to different age groups other than those employed in the present study.
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5. The study may be repeated by selecting subjects belonging to different age groups other than those employed in the present study.
6. A similar study may be conducted taking variables other than the variables chosen for this study.

7. A similar study may be conducted with female swimming beginners.

8. It is recommended that a longitudinal study may be taken up in order to examine the effect of the initial advantage gained on the attainment of higher degree of performance in competitive swimming.

9. It is recommended that the results of this study may be used by sports scientists, swimming coaches and physical education teachers to accumulate the evidences for building a more scientific basis for selecting subjects with desirable endowments as early in their lives as possible for shaping them into good swimmers.