CHAPTER - II

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For any specific research project to occupy a place in the development of a discipline, the researcher must be thoroughly familiar with both previous theory and research. To assure this familiarity, every research project in the behavioural sciences has, as one of its early stage, a review of the theoretical and research literature.

The literature related to any problem helps the scholar to discover what is already known, which would enable the investigator to have a deep insight, clear perspective and a better understanding of the chosen problem and various factors connected with the study. So a number of books, journals, and websites were referred. In the following pages, an attempt has been made to present briefly a few of the important researches and studies conducted abroad and in India, as they have significant bearing on the present study.

The literature in any field forms the foundation upon which all future work will be built. If we fail to build upon the foundation of knowledge provided by the review of literature, the researcher might miss some work already done on the same topic.
The purpose of the study was to predict the basketball playing ability on selected traits of men varsity players. Sixty players were randomly selected from the university basketball teams. Three experts assessed the basketball playing ability. The independent variables were zigzag dribbling for 30 seconds, basketball shooting for 30 seconds, motor ability (vertical jump and shuttle run), anthropometric measurements (Standing height, body weight, arm length and leg length) and physiological variables (resting pulse rate and vital capacity). The Wherry Doolittle method of multiple correlation analysis revealed that zigzag dribbling for 30 seconds, basketball shooting for 30 seconds and standing height contributed in order of correlation to the basketball playing ability among university men players.42

This study investigated whether sprint triathlon performance can be adequately predicted from laboratory tests. Ten triathletes [mean (SEM), age 21.8 (0.3) years, height 179 (2) cm, body mass 67.5 (2.5) kg] performed two graded maximal exercise tests in random order, either on their own bicycle which was mounted on an ergometer or on a treadmill, to determine their peak oxygen consumption (VO(2)peak). Furthermore, they

participated in two to three 30-min constant-load tests in both swimming, cycling and running to establish their maximal lactate steady state (MLSS) in each exercise mode. Swim tests were performed in a 25-m swimming pool (water temperature 27 degrees C). During each test heart rate (HR), power output (PO) or running/swimming speed and blood lactate concentration (BLC) were recorded at regular intervals. Oxygen uptake (VO2) was continuously measured during the graded tests. Two weeks after the laboratory tests all subjects competed in a triathlon race (500 m swim, 20-km bike, 5-km run) [1 h 4 min 45 s (1 min 38 s)]. Peak HR was 7 beats.min(-1) lower in the graded cycle test than in the treadmill test (p<0.05) at similar peak BLC (approximately 10 mmol.l(-1)) and VO2peak (approximately 5 L.min(-1)). High correlations were found between VO2peak during cycling (r=-0.71, p<0.05) or running (r=-0.69, p<0.05) and triathlon performance. Stepwise multiple regression analysis showed that running speed and swimming speed at MLSS, together with BLC in running at MLSS, yielded the best prediction of performance [1 h 5 min 18 s (1 min 49 s)]. Thus, our data indicate that exercise tests aimed to determine MLSS in
running and swimming allow for a precise estimation of sprint triathlon performance.43

The aim of this study was to determine the anthropometric and physiological profile of 200-m sprint kayakers and to examine relationships with 200-m race performance. Twenty-six male kayakers who were categorized in two ability groups, international (Int) and national (Nat) level, underwent a battery of anthropometric and physiological tests and a 200-m race. Race time was significantly lower in International than Nat (39.9 +/- 0.8 s and 42.6 +/- 0.9 s, respectively). International demonstrated significantly greater measures of mesomorphy, biepycondylar humeral breadth, circumferences of the upper arm, forearm and chest, peak power and total work in a modified Wingate test, total work in a 2-min ergometry test, peak isokinetic power, and peak isometric force. Significant relationships were found between 200-m time and a number of anthropometric variables and anaerobic and dynamometric parameters. Stepwise multiple regression revealed that total work in the modified Wingate alone predicted 200-m race time (R2 = 0.53, SEE = 1.11 s) for all 26 subjects, while biepycondylar

humeral breadth alone predicted race time \( (R^2 = 0.54, \text{SEE} = 0.52 \text{ s}) \) in Int. These results demonstrate that superior upper body dimensions and anaerobic capacities distinguish international-level kayakers from national-level athletes and may be used to predict 200-m performance.\(^{44}\)

The performance of 326 collegiate football players attending the 2000 National Football League combine was studied to determine whether draft status could be predicted from performance measurements. The combined measured height and weight along with 9 performance tests: 225-lb bench press test, 10-ycd dash, 20-ycd dash, 40-ycd dash, 20-ycd pro agility shuttle, 60-ycd shuttle, 3-cone drill, broad jump, and vertical jump. Prediction equations were generated for 7 position categories with varying degrees of accuracy—running backs (RBs), \( r(2) = 1.00 \); wide receivers (WRs), \( r(2) = 1.00 \); offensive linemen, \( r(2) = 0.70 \); defensive linemen, \( r(2) = 0.59 \); defensive backs (DBs), \( r(2) = 1.00 \); linebackers, \( r(2) = 0.22 \); and quarterbacks, \( r(2) = 0.84 \). The successes of the prediction equations are related to the ability of the individual tests to assess the necessary skills for each position. This study concludes that the combine can be

used to accurately predict draft status of RBs, WRs, and DBs. The equations can also be used as a good to fair estimate for other positions.45

In order to study which parameter that best corresponds to performance during cross-country skiing, seven male and nine female cross-country skiers were tested with treadmill tests. Parameters measured or computed by metabolic gas measurements were the anaerobic threshold (AT), threshold of decompensated metabolic acidosis (TDMA), the exercise intensity where the Respiratory exchange ratio reaches 1.0 (R = 1) and peak oxygen (O2) uptake (VO2peak). Onset of blood lactate accumulation (OBLA, 4 mmol.l-1 blood lactate) was also measured. The various parameters were measured in percentage of maximal heart rate, percentage of peak O2 uptake, VO2 ml.kg-1.min-1, VO2 ml.min-1.kg-2/3 and VO2 l.min-1. Results from four large competitions were also collected to rank the subjects. With correlation analysis, it was revealed that in male subjects a high OBLA was associated with good ranking results (r=\(-0.829\) - \(-0.964\); P<0.05-0.001). In female subjects, the best association with competition results was found for R=1 (r=\(-0.829\) - \(-0.964\)).

Concerning VO2 measurements, for male subjects the unit l.min-1 is suggested to be used and for female subjects either the units l.min-1, ml.min-1.kg-2/3, or ml.kg-1.min-1 could be used when predicting performance in cross-country skiing. In conclusion, treadmill tests can be used for the prediction of performance in cross-country skiing. Further, various parameters from treadmill tests in men and women are best used as predictors of performance in cross-country skiing.46

The aim of this study was to predict indoor rowing performance in 12 competitive female rowers (age 21.3 +/- 3.6 years, height 1.68 +/- 0.54 m, body mass 67.1 +/- 11.7 kg; mean +/- s) using a 30 s rowing sprint, maximal oxygen uptake and the blood lactate response to sub maximal rowing. Blood lactate and oxygen uptake (VO2) were measured during a discontinuous graded exercise test on a Concept II rowing ergometer incremented by 25 W for each 2 min stage; the highest VO2 measured during the test was recorded as VO2max (mean=3.18 +/- 0.35 l.min-1). Peak power (380 +/- 63.2 W) and mean power (368 +/- 60.0 W) were determined using a modified

Wingate test protocol on the Concept II rowing ergometer. Rowing performance was based on the results of the 2000 m indoor rowing championship in 1997 (466.8 +/- 12.3 s). Laboratory testing was performed within 3 weeks of the rowing championship. Submitting mean power (Power), the highest and lowest five consecutive sprint power outputs (Maximal and Minimal), percent fatigue in the sprint test (Fatigue), VO2max (l.min-1), VO2max (ml.kg-1.min-1), VO2 at the lactate threshold, power at the lactate threshold (W), maximal lactate concentration, lactate threshold (percent VO2max) and VO2max (l.min-1) to a stepwise multiple regression analysis produced the following model to predict 2000 m rowing performance:

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\text{Time}_{2000} = -0.163 \times \text{Power} - 14.213 \times \text{VO2max (l.min-1)} + 0.738 \times \text{Fatigue} + 7.259 \quad (R^2=0.96, \text{standard error}=2.89). \]

These results indicate that, in the women studied, 75.7% of the variation in 2000 m indoor rowing performance time was predicted by peak power in a rowing Wingate test, while VO2max and fatigue during the Wingate test explained an additional 12.1% and 8.2% of the variance, respectively.47

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Little is known about the nature of task and ego orientations that are key motivation constructs. The purpose of this study, therefore, was to examine the extent to which perceived social, contextual, and personal factors predicted the goal orientations of youth sport participants. The sample consisted of 166 male and female adolescent soccer players, who completed self-report measures at the end of a 7-week competitive season. A canonical correlation analysis revealed that the set of predictor variables accounted for 24% of the variance in player goal orientations. Higher scores on perceived soccer competence, perceived parent task orientation, and particularly perceived parent ego orientation were primarily associated with higher scores on player ego orientation. In addition, higher scores on perceived soccer competence, perceived parent task orientation, and perceived mastery climate, as well as lower scores on perceived performance climate, were associated with a higher level of player task orientation. These findings are interpreted and discussed in terms of future research directions.48

One purpose of this work was to study the relationship of goal orientations and the perceived motivational climate created by the coach in relation to 219 competitive Spanish tennis players': a) perceived improvement in different facets of the game, b) satisfaction with their competitive results, overall level of play, and coach, and c) ratings of their coach. The second purpose was to examine whether the dependent variables were best predicted by the perceived situationally emphasized goal structure created by the coach and/or the athletes' dispositional goal perspective. Intermediate (N=70), advanced (N=124), and professional (N=25) level players completed Spanish versions of the TEOSQ and the PMCSQ-2 and items assessing perceived improvement specific to tennis, satisfaction and coach ratings. The results were consistent with the tenets of goal perspective theory and provide further support for the promotion of a task involving atmosphere in sport.49

To examine the combined effect of goal setting and self-talk, 41 professional and semiprofessional soccer players from four different teams were tested on a soccer-shooting task. Teams were assigned to one of four conditions: (a) self-talk, (b)

goal setting, (c) goal setting plus self-talk, and (d) do your best control. Subjects performed one baseline measurement and three experimental sessions. Analysis showed that performance, compared to the do your best condition, in the combined condition is immediately enhanced, whereas self-talk and goal-setting effects were significant from Session 3. No significant differences in performance were observed among experimental groups, except in Session 2, during which the combined group scored significantly better than the goal-setting group. It seems that, whereas both goals setting and self-talk are effective in enhancing performance, some advantage may be derived from a combined intervention. Findings are discussed in the perspective of past research efforts on goal setting and self-talk.50

The purpose of this study was to examine the relationships among competitive worries, sport confidence, and performance of young athletes. Participants were 143 young swimmers aged 11 to 12 years. The athletes completed trait and state questionnaires (competitive worries and sport confidence) in noncompetitive and competitive conditions, respectively. The results indicated: (a) significant relationships among trait and

state characteristics and between trait General Self-confidence and performance ratings in both races as well as between performance ratings in Races 1 and 2; (b) significant differences in state variables among athletes with moderate or high and low scores on the trait variables; (c) significant differences in performance among athletes with moderate or high and low scores on the trait General Self-confidence and trait Positive Thinking in Race 1 and on variables trait General Self-confidence, state General Self confidence, and state Positive Thinking Race 2; and (d) trait General Self-confidence and trait Confidence in Unfavorable Situations were the most important predictors of young swimmers' performances. These results may be useful in application to competitive sports for young athletes. They may help in psycho diagnostic procedures and may be used for both the content and the direction of individual programs for psychological preparation of young athletes.51

Thirty-three subjects were tested on competitive trait and state anxiety immediately before and after a competitive motor task of short duration (average performance time of 25 seconds). It required precise coordination of correct muscular activity,

timing as well as speed, and physical strength that included explosive shifts in direction of movement. Two types of performance measures were employed, (a) number of errors during the performance and (b) the time it took to complete the motor task. Analysis showed a positive relation between trait anxiety and performance errors when a linear model was applied; however, when a curvilinear model was used, a strong significant U-relationship between errors and pre competition state anxiety emerged. Further, a strong positive linear relation between post state anxiety and number of performance errors was observed. The results indicate that making errors in performance situations is a critical factor in producing post competition state anxiety.52

Prediction of speed skating performance with a power balance model requires assumptions about the kinetics of energy production, skating efficiency, and skating technique. The purpose of this study was to evaluate these parameters during competitive imitations for the purpose of improving model predictions. Elite speed skaters (n = 8) performed races and sub maximal efficiency tests. External power output (P(o)) was

calculated from movement analysis and aerodynamic models and ice friction measurements. Aerobic kinetics was calculated from breath-by-breath oxygen uptake VO$_2$. Aerobic power (P(aer)) was calculated from measured skating efficiency. Anaerobic power (P(an)) kinetics was determined by subtracting P(aer) from P(o). We found gross skating efficiency to be 15.8% (1.8%). In the 1,500-m event, the kinetics of P(an) was characterized by a first-order system as $P(\text{an}) = 88 + 556e^{-0.0494t}$ (in W, where t is time). The rate constant for the increase in P(aer) was -0.153 s$^{-1}$, the time delay was 8.7 s, and the peak P(aer) was 234 W; P(aer) was equal to $234[1-e^{-0.153(t-8.7)}]$ (in W). Skating position changed with pre-extension knee angle increasing and trunk angle decreasing throughout the event. We concluded the pattern of P(aer) to be quite similar to that reported during other competitive imitations, with the exception that the increase in P(aer) was more rapid. The pattern of P(an) does not appear to fit an "all-out" pattern, with near zero values during the last portion of the event, as assumed in our previous model. Skating position changed in ways different from those assumed in our previous model. In addition to allowing improved predictions, the results demonstrate the importance of observations in unique subjects to the process of model construction.53

53 J.J. de Koning et al., "Experimental Evaluation of the Power
To establish the validity of a 15 m multistage shuttle run test (MSRT) as a predictor of anaerobic capacity (expressed as mean power output (MPO) from the 30 second Wingate anaerobic test (WAnT)) in female university standard games players. METHODS: Data came from three phases using a total of 72 players (mean (SD) age 20.3 (1.5) years, body mass 64.9 (8.8) kg, and stature 1.67 (0.04) m). The repeatability of the MSRT was assessed in phase 1 by applying 95% limits of agreement (LoA) to the test and retest results from a random sample of 20 players. In phase 2, linear relations between MPO and performance on the MSRT were investigated in a random sample of 36 players. As a result, a calibration model \( Y = a + bX \) was developed and cross validated in phase 3, in which the remaining 36 players performed both the WAnT and the MSRT. Time (seconds) to volitional exhaustion/disqualification from the MSRT was substituted into the calibration model from which MPO was predicted. The agreement between MPO predicted and MPO measured from the WAnT was quantified using LoA. RESULTS: Insignificant bias between repeat applications of the MSRT (mean (diff) (SD (diff))=1.0 (3.5) seconds (4 (14) m), \( t=1.23, p=0.230 \) was found from phase 1. Data were homoscedastic

(r=0.061, p=0.799) with LoA +/- 6.9 seconds (+/- 27 m). In phase 2 the strongest correlation was between MPO (W/kg(0.67)) and time to volitional exhaustion/disqualification on the MSRT; r=0.715 (r(2)=51.1%, p=0.0005). As a result, the calibration model developed was: MPO (W/kg (0.67))=12.5 + (0.2 x time (seconds)) with a standard error of prediction of 2.1 W/kg(0.67).

The cross validation in phase 3 showed insignificant bias between measured and predicted MPO (mean(diff) (SD(diff)) = 0.3 (2.8) W/kg(0.67), t=0.75, p=0.460). Data were homoscedastic (r=0.05, p=0.774) with LoA +/- 5.5 W/kg(0.67). The MSRT requires minimal equipment and training of assessors, and it is easy to perform. In the population studied, it provides scores that are repeatable, and anaerobic capacity (MPO) can be successfully predicted from its performance. It would seem therefore to be a useful field based test for use by female games players, their coaches, and support scientists.54

The purpose of this study was to evaluate the contribution of anthropometric dimensions to improving the accuracy of repetitions-to-fatigue (RTF) using an absolute load of 225 lbs to predict 1 repetition maximum (1RM) bench press performance in

college football players. Sixty-one players from an NCAA Division II team were evaluated for 1RM bench press performance, RTF using an absolute load of 225 lbs, and measured (5 skinfolds, 2 skeletal length, and 2 muscle circumferences). Anthropometric dimensions (percent fat, lean body mass, and arm cross-sectional areas) were derived at the conclusion of 8 weeks of heavy resistance training during the off-season. None of the anthropometric dimensions made a significant additional contribution to RTF (r=0.96, SEE=12.3 lbs) for predicting 1RM. Of the currently available NFL-225 prediction equations found in the literature non significantly underestimated 1RM from RTF by an average of 1.1 lbs (+/-12.7 lbs), whereas 5 other RTF equations significantly over predicted by 3.5-9.0 lbs (+/-12.2-14.1 lbs). Anthropometric dimensions neither reduced the error associated with prediction of 1RM bench press using the NFL-225 test in college football players nor do they explain why some players are significantly over or under predicted when using muscle endurance repetitions.55

In an attempt to more clearly understand the strength characteristics of female rock climbers and whether those

variables affect and predict climbing performance, 2 indoor climbing performance tests (route and bouldering) were compared to a series of muscular strength tests performed by moderate ($n=6$), intermediate ($n=6$), and expert ($n=6$) female rock climbers. Significant differences ($p<0.05$) were found between the expert group and the moderate and intermediate groups for climbing specific hand strength, as well as 1-arm lock-off strength when expressed as a strength-to-weight ratio. Multiple correlations showed that these variables ($r>0.426$) as well as a questionnaire of past climbing performance ($r>0.86$) significantly correlated to the tests of indoor climbing performance. In conclusion, climbing-specific tests of hand strength and of one arm lock-off strength reliably and sensitively measured 2 significant variables in the performance of indoor rock climbing, and a questionnaire of past best performance may be an accurate tool for the prediction of indoor climbing performance.\textsuperscript{56}

Strength and conditioning professionals who work with collegiate football players focus much of their time and effort on developing programs to enhance athletic performance. Although

there has been much speculation, there is little scientific evidence to suggest which combination of physical characteristics best predicts athletic performance in this population. The purpose of this investigation was to examine the relationship among 6 physical characteristics and 3 functional measures in college football players. Data were gathered on 46 NCAA Division I college football players. The 3 response variables were 36.6-m sprint, 18.3-m shuttle run, and vertical jump. The 6 regression variables were height, weight, percentage of body fat, hamstring length, bench press, and hang clean. A stepwise multiple regression analysis was performed to screen for variables that predict physical performance. Regression analysis revealed clear prediction models for the 36.6m sprint and 18.3m shuttle run. The results of this investigation will help strength and conditioning specialists better understand the variables that predict athletic performance in Division I college football players.  

One hundred and forty-two male Tae Kwon-do competitors completed the Competitive State Anxiety Inventory-2 about 1 hr. before competition. Multivariate analysis of variance showed that

the players who won reported lower cognitive and somatic anxiety and higher self-confidence than those who lost. Discriminant function analysis indicated that 89 (62.68%) participants could be correctly classified as winners or losers on the basis of their pre-competition Competitive State Anxiety Inventory-2 scores. The findings concur with previous research in karate.58

**Uppal**59 and **Roy** conducted a study on assessment of motor fitness components as predictors of soccer playing ability for 30 male soccer players from Jiwaii University, Gwalior. They were administered five tests for motor fitness components namely speed (50 x d dash), agility (4x10 mts shuttle run), Max leg strength (standing broad jump) of cardio respiratory endurance (Cooper’s 12 min run / walk test). They concluded that all the independent variables strength and cardiovascular endurance) were significantly related to dependant variable (soccer playing ability).

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Elder developed a motor fitness test designed to evaluate the following eight basic components; Strength, endurance, power, ability, flexibility, speed, balance and body size and age. The composite score on 14 motor fitness items served as the criterion for the selection of tasks to compose the final battery. The tests thus selected were; floor push-ups, standing brand jump trunk flexion forward.

Bride et al. were contracted to investigate and determine the effect of involvement in power lifting, Olympic lifting and sprinting on strength and power characteristics in the squat movement. A standard one repetition maximum squat test, Gump squat tests and vertical jumps with various loads were performed. The power lifters (Pl, n=8) Olympic lifters (OL, n=6) and sprinters (S, n=6) were significantly stronger than the controls (C, n=8) (P<0.05). In addition the Olympic group outputs, velocities and jump heights in comparison to the PL and C group for jump trails at various loads. The PL group was significantly higher in peak force and peak power for jump trails at various loads in comparison to the control group. The data


indicates that strength and power characteristics are specific to each group and are most likely influenced by the various training protocols utilized.

*Morrow, Hotler and Nelson*⁶² made a comparative study on women inter collegiate basketball players volleyball players and non-athletes. They took 330 women college students at the subject for this study. The subjects were 110 women from each of the above listed groups. Various anthropometric and performance characteristics were obtained on each subject. The fat weight, lean weight, arm length, upper and lower body iso-kinetic strength were measured. Athletes were found to differ significantly from non-athletes on all variables. It was indicated that basketball players had lower sprint time and greater upper and lower body strength than volleyball players.

*Meitei*⁶³ has conducted a study is an attempt to explore the area of physical fitness and technical skill as possible reasons of the poor performance of Indian Women shot putters. The study was conducted on 25 women of national, university


and state level. The performance of Indian Women shot putters was compared with the equivalent norms and found that the athletes are poor in technical efficiency, specific strength, specific speed, general speed, and explosive strength. It was also found that maximum strength level is above the norms. But it is conversion to explosive strength is poor.

*Indu Mazumdor*\(^\text{64}\) conducted a study in the modern game of basket ball. A player is required to continuously be in movement over a certain period of time (40 minutes) varying his pace from fast to slow or medium and vice versa, many a time hopping, jumping and changing directions. While in movement this puts a great deal of demand in terms of physical effort on the part of each player. In the area of International competitions one can hardly differentiate the top notch contenders from one another in terms of their levels of fitness. However, the deciding factor some times remains with fitness. The world's topmost sporting nations are very much conscious of these facts and concentrated on the development of the basic physically fitness components and the related components. Cardio vascular endurance is one of the major physical fitness components

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\(^{64}\) Indu Mazumdor, M. Edwin “Comparative Relationship Of Selected Physical Fitness Variables To Playing Ability In Basket Ball At Different Levels Of Performance”, *Sai Scientific Journal*, vol. 23(4), 2000, pp 42-46.
required for basket ball as this game is fast and exciting and it involves continuous movements and actions with or without the ball. Since basketball requires almost instant movement over a longer period of time one must try to attain higher levels of muscular and cardio-vascular endurance. Besides physical fitness, technical training also plays an important part in the total training process of the sportsmen. It has been fully recognized by all experts and sports scientists that performance in basketball teams not only directly depends on the mastery of skills but also on the optimum development of physical and psychological factors of players.

Weekes and his associates reported the importance of physical fitness in the ability to do physical task in their study. Their purpose in the study was to investigate physical fitness levels in police cadets and to compare the findings with published physical fitness levels in a work force sample. Male police cadets were measured in the variables of present body fat, upper body strength and aerobic fitness two weeks after entering the police academy. The researches concluded that although police cadets may be more aerobically fit than the workforce

sample there is a need to develop upper body strength as it relates to their job performance. The study suggests that individuals entering into the law enforcement profession at the onset may not be physically superior to the general public.

**Stuvart and Collings**\(^{66}\) compared the vital capacity of 20 athletes to an equal number of non-athletes and found that mean vital capacity of the athletes was significantly higher than that of the non athletes. It was concluded that this significant difference in vital capacity was due to regular training.

**Crane**\(^{67}\) and others conducted a study to examine differences in pulmonary function measurements between endurance - trained (ET) and sprint - trained (ST) athletes. The ET groups comprised of 12 (4 females, 8 males, between the age group 20-43) short course triathletes trained in one or more activities at least 30 minutes/day, three days/week. The ST group included 9 (4 females, 5 males, between the age group 18-21) athletes who trained at least six days/week in a series of sprints (100-180 metres). Pulmonary function measurements included: forced vital capacity (FVC), forced expiratory volume

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(FEV), peak expiratory flow (PEF), forced expiratory flow (FEF), and maximal voluntary ventilation (MVV). Measurements were taken on a portable computerized spirometer (vitalograph COMPACT). The results obtained suggested that the ET and ST have comparable impact on pulmonary capacity and function. Although endurance athletes must be hypothesized to have higher pulmonary function values, these data imply that sprint training stresses the respiratory system sufficiently to produce similar levels of pulmonary performance. Difference between these athletes appears dependent on oxygen delivery and utilization rather than superior ventilatory function.

**Giam** proposed to assess and compare the max Vo2 of 15 top class competitive male athletes, 13 badminton, 17 hockey, 28 soccer and 7 squash players in Singapore. Most of these sportsmen were on the respective national teams when they were studied. Their max Vo2 was determined in a human performance laboratory from direct analysis of their expired respiratory gases with an automated and calibrated Beckman Metabolic Measurement Cart during an all-out run on a Quinton 24-72 research treadmill. The following table indicates whether

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the differences of group mean values for max Vo2 are statistically significant (p 0.05) or not significant (NS, when p 0.05) for the different groups of sportmen studied when compared with each other.

Ghose\textsuperscript{69} and others, conducted a study on inter correlations between Vital Capacity (VC) maximum voluntary ventilation (MVV), forced expiratory volume at 1.0 spc (FEV 1.0) taking up in 58 males, aged between 23 and 34 years, playing basketball, soccer and field hockey. Separate correlations between vital capacity and body weight as well as between vital capacity and body surface area showed that vital capacity was more dependent on height.

Ghosh\textsuperscript{70} and others undertook a study on pulmonary capacities of different groups of sportmen in India. Pulmonary functional capacities, vital capacity (VC), maximum voluntary ventilation (MVSS), forced expiratory volume in 1 second and FEV 1.0 (per cent VC) of 168 sportmen belonging to different sports activities and of 10 sedentary individuals were undertaken for study. It was observed that the pulmonary


function capacities of different groups of sportsmen were higher than those of the sedentary group. The mean VC of the basketball, boxing, cricket, football, hockey and the table tennis groups, the mean MVV of all the groups except the athletic, badminton and football groups, and the mean FEV 1.0 of football, hockey, swimming and soccer groups were significantly higher than those of the sedentary group. The mean values of all the three pulmonary function capacities of only the hockey group was found to be significantly higher than those of the sedentary individuals. The available reported pulmonary capacity values, except FEV 1.0 of a few groups of sportsmen studied abroad, were higher than those of their counterparts studied here. These might be due to the ethnic variation as well as the variation in age, body size and level of physical fitness which influences the different pulmonary capacities.

Hendrickson and others studied the cardio respiratory fitness, body composition and lipid and lipoprotein profiles of 9 national class stair climbers (X ± SD age=28, 4 ± 3.8 yrs) and compared their finding with previously published data on endurance athletes of similar age. Other studies included

relative body fatness via hydrostatic weighing, vital capacity (VC), one second forced expiratory volume (FEV) and serum triglycerides, total cholesterol and HDL cholesterol. The results of the study showed that pulmonary function studies yielded VC and FEV values of 5.3 and 4.2L, respectively. Average Vo2 max (68.0 ± 7.3 ml. Kg-1 min-1) was similar to values reported for elite cyclists and rowers, but lower than for world class marathoners. Per cent body fatness (9.4 ± 2.4%) was similar to or lower than other athletic groups, but higher than that of elite distance runners. Mean total cholesterol (153 ± 34 ml/dl), triglycerides (70 ± 28 mg/dl) and HDL cholesterol (48 ± 4 mg/dl) were comparable to or lower than the values previously reported for distance runners. National class stair climbers have similar physiologic profiles to other elite endurance athletes. The findings highlight the potential of stair climbing training to improve cardio respiratory fitness, body composition and lipid and lipoprotein profiles.

Results showed that ability, self-efficacy, goal-setting, and goal commitment were predictors of performance at the various stages of the experiment. Personal goal setting was affected by level of ability, as well as by perceived self-efficacy and
satisfaction. Self-efficacy and goal commitment were direct as well as indirect determinants of performance.\textsuperscript{72}

Cognitive anxiety is the mental component of anxiety caused by negative expectations about success or negative self-evaluation (e.g., worry, negative self-talk, and unpleasant imagery). Somatic anxiety is the physiological or affective component of anxiety that is directly related to autonomic/physiological arousal (e.g., what the athlete feels, rapid heart rate, butterflies in the stomach, tense muscles). Sample 1 comprised male (N=15) and female (N=13) collegiate swimmers. Each swimmer completed the Competitive Sport Anxiety Inventory II (CSAI-II) prior to an early season invitational meet, a mid-season conference dual meet, and the Big Ten Conference championships. Sample 2 was composed of male (N=31) and female (N=39) serious swimmers who competed at the National Sports Festival (average age 17.4 yr). The CSAI-2 was completed once after practice two days before competition and again within one hour of the most important race at the meet.

Anxious swimmers generally perform slower times. The cognitive component of anxiety showed a stronger relationship to performance decline than the somatic component. However, the somatic-anxiety to performance relationship was found to be different between sprint and distance swimmers. Better-performing sprinters tended to control their somatic anxiety better than poorer performers. In distance events, better performers tended to attain higher levels of physiological arousal than poorer performers. It is important that swimmers approach competitions with confidence and a positive mind-set. Any negative talk is likely to indicate the swimmer has a strong likelihood of performing below expectations. For distance events, it is important to "get up" for a race to mobilize sufficient energy to maintain a strong pace. However, sprinters must remain controlled with an optimum level of physiological arousal. The mental state of pre-race preparations is more important than the physical state that is attained. It is imperative that swimmers remain mentally controlled during the pre-race period.73

Confidence has been found to vary with temporal proximity to an upcoming task. People's confidence that they will perform

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well tends to diminish as the time of performance approaches. It is proposed that this phenomenon is due in part to pre-task arousal, which cues the level of confidence. Arousal that is part of preparing to perform may be misattributed to diminished confidence. Undergraduate students (M=14; F=74) were formed into three groups experiencing different preparatory conditions for interpreting arousal.

A misattribution condition group (N=28) was informed that a local noise would make them feel nervous and aroused. A proximate control condition group (N=30) was told that the noise would have no effect.

A distant condition group (N=30) made similar performance predictions to the previous two groups but was told the tasks would be performed well into the future (a perceived temporal difference with the other two groups).

Subjects were informed that the investigation concerned the effects of subliminal noise on cognitive performance, specifically the ability to predict one's performance on upcoming tasks. Anxiety and nervousness scores were significantly correlated and therefore, combined into an "arousal" score. Distant condition subjects were less aroused than either of the other two groups. Arousal increased as the task performance...
approached. For confidence, it was highest in the distant group and significantly more than in the proximate control group. The misattribution group also exhibited greater confidence than the proximate group. 

Some components of expectancy theory, which may counteract each other, were evaluated for their relationships with arousal. Undergraduate students (N=46) served as Ss. Task confidence was manipulated by providing Ss feedback on a "practice" mathematics examination. Poor performers were deemed to have lowered task performance and good performers increased, because of the practice experience. The manipulation effect was checked with two short questionnaires that also evaluated perceived incentive and arousal. After the assessments, Ss were told they would not have to actually take an examination.

A significant relationship was revealed between perceived incentive and arousal. A significant negative correlation was found between task confidence and arousal. Confident individuals will likely exhibit lowered arousal but if incentive is high, then arousal should rise. Advocating that one should be

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confident and perform under high incentive conditions will cause competing effects on arousal, the outcome on performance yet to be determined by research. Whether this phenomenon exists in sports needs to be verified.75

Female (N=14) and male (N=10) introverts, and female (N=17) and male (N=7) extroverts, ranging in age from 19 to 47 years, were measured for physiological and subjective arousal. A digi-span task or recalling a series of digits ranging in length from six to nine, was performed as the experimental task. Positive and negative feedback was manipulated after the task. Subjects were tested individually.

There was no difference in performance between the groups on digi-span performances before experimental testing. However, using a change score (pre and post test difference) introverts performed significantly better than extroverts did. Mean state anxiety scores increased significantly more in the introvert group than in the extrovert group. Physiological arousal was not different pre or post test between the groups. Positive feedback increased ratings of self-efficacy and negative feedback decreased ratings similarly in both groups. Performances

between negative and positive feedback conditions were significantly different. Self-efficacy did not predict a significant amount of variance in the performance changes. Only state anxiety accounted for a significant proportion of the change scores. State anxiety may mediate the self-efficacy and performance relationship, and may underlie performance differences between introverts and extroverts on simple tasks. Analogizing this to sports, well learned and familiar tasks are likely to improve more in introverts than extroverts in competitions as long as state-anxiety can be controlled.\textsuperscript{76}

Attributions for success and failure were assessed in two groups of collegiate athletes: runners and swimmers (N=48) whose performance outcome is objectively timed, and gymnasts/divers whose performance outcome is subjectively rated. Subjects completed the Revised Causal Dimension Scale, which measured locus of causality, controllability, and stability towards wins and losses (outcomes), and the Sport Attribution Style Survey, which measured internality, stability, globosity, controllability, and intentionality towards hypothetical positive or negative sporting events (performance).

No significant differences between the groups were revealed. Both groups indicated an internal focus for attributions toward all outcomes. Unstable attributions were made towards wins and losses (outcomes), but stable attributions towards positive and negative sporting events (performance). Keeping in mind the restricted sample in this study, college athletes are unstable in defining reasons for wins and losses, and thus, reasons could change under different circumstances, but reasons for performances are stable and will not readily change.77

College track athletes (N=7) participated in the study. It was found that achievement motivation goals were related significantly with performance (5 and 10 km running times) and with injury. It was proposed that more serious athletes develop anatomical propensities towards injury (e.g., poorer hamstring and quadriceps flexibility) because of the greater amount of physical stress they endure.

High aspirations to perform are a characteristic of better track athletes. High levels of performance and improvement

should not be expected from individuals who are not "driven" to achieve.\textsuperscript{78}

Track and field athletes (M=20; F=26) were divided based on whether they were optimists or pessimists. The majority of athletes were pessimistic, which was characterized by significantly elevated levels of state anxiety when compared to optimists. However, performances did not differ between the groups. Pessimism and state anxiety might differ between athletes but those differences are not related to performance.\textsuperscript{79}
