CHAPTER II

REVIEW OF RELATED LITERATURE

INTRODUCTION

The related literature reviewed for better understanding of the problem investigated and to interpret the results are presented in this chapter. The reviews are classified under the following headings:

1. Studies related to specified training on handball skills and performance
2. Studies related to deaf and dumb
3. Studies related to vibrator aid and sign language training
4. Summary of the literature.

2.1. STUDIES RELATED TO SPECIFIED TRAINING ON HANDBALL SKILLS AND PERFORMANCE

Eliasz (2015) studied the relationships between throwing velocity and motor ability parameters of the high-performance handball players. Statistically significant differences were found between maximal ball velocity during throws with a cross-over step, and ball velocities during other analyzed throws. The highest ball velocity was achieved during the throw with a cross-over step performed by play-makers. Among the motor ability factors, total muscle strength of the body (ISI), strength of trunk flexors (abdominal muscles) and maximal arm (shoulder joint) angular velocity (MSD) have a decisive effect on the ball velocity in analyzed throwing techniques. The maximal arm speed is the most important factor determining ball velocity during-technically the simplest - throw on the spot. Muscle strength has greater influence on ball velocity during - technically more complicated - throw with an upward jump.

Ion, et al., (2014) examined the learning to play handball technique is to find and assimilate technical processes driving expression of the players optimal opportunities and increase their effectiveness as structured driving current game. This research was conducted at the level of junior handball teams during a competitive year in which research subjects were in training a large percentage of technical exercises, assessed by control samples prepared by federation of specialized or domain experts. To assess the level of technical training and progress have passed control samples at the beginning and end of the research.

Loffing and Hagemann (2014) conducted two experiments to examine experienced and novice team-handball goalkeepers' ability to predict the type of throw in handball penalties and to identify the observers' reliance on local versus globally distributed spatial cues. In Experiment 1, following a 2 (Skill) 5 (Temporal Occlusion Condition) factorial design participants were provided with videos of team-handball penalties where the amount of viewing time was varied. In Experiment 2, another sample of experienced and novice goalkeepers watched videos of spatially manipulated penalties where specific parts of the thrower's body or the ball were either removed or presented in isolation (2 [Skill] 9 [Display Condition] factorial design). In Experiment 1, experienced goalkeepers outperformed novices and both groups similarly improved their performances with later occlusion conditions. In Experiment 2, experienced goalkeepers were again superior to novices, and local cues (e.g., ball and hand) were sufficient for better than chance predictions in both groups.

Moreover, experienced in contrast to novice goalkeepers (i) suffered from the removal of and (ii) benefited from the addition of distal (i.e., throwing arm and ball) as well as proximal (i.e., upper body) kinematic features. This research is in line with previous findings on perceptual-cognitive expertise in sports and suggests that experienced team-handball goalkeepers rely on multiple, globally distributed cues when making anticipatory judgments.

Wei and Ji (2014) randomly selected a 60 elderly with mild cognitive impairment (MCI) and they were divided into training group (n = 30) and control group (n = 30). The mini-mental state examination (MMSE) score and abilities of daily living scale (ADL) score before, after 3-month, and after 6-month handball training period was measured. The results showed that MMSE score was increased and ADL score was decreased in training group after 3-month and 6- month intervention ($P < 0.05$), while there were no significant changes in MMSE or ADL in control group. These preliminary results indicated that handball training can improve cognitive ability in MCI.

Singh and Ram (2013) correlated anthropometric dimensions and physical fitness components with playing ability and also to develop the regression equation for the prediction of handball players playing ability. The research was conducted on Inter-University level 200 male handball players of age range 18-25 years. Twenty seven anthropometric measurements and six physical fitness components as independent variables and cumulative score of two skill tests as dependent variable were evaluated of each subject. SPSS (11.5) computer software was used to analyze the data. The study revealed that the body weight and linear measurements, i.e., standing height, sitting height, total arm length, upper arm length, leg length, thigh length, lower leg length, hand length and hand breadth; body diameter measurements, i.e., elbow and shoulder diameters; body girth measurements, i.e., shoulder, chest and abdomen girths; skin-fold measurements, i.e., biceps, triceps and sub-scapular skin-folds; body composition variables i.e., lean body mass and fat weight and physical fitness components i.e., speed, agility, arm and leg strength have significant correlations with playing ability of handball players. The multiple correlations of highly correlated nine independent variables taken together with playing ability has been found highly significant and hence the developed equation can be used in the prediction of playing ability.

Cetin and Ozdol (2012) determined the effects of 12-week strength training on the jumping throw performance in young handball players. 18 handball players (age:13.66±0.5 year; height:160.0±6.25 cm; weight: 49.0±8.97 kg) participated to the study. The Training Group Program: A 12 week strength training and handball technical training program were supervised 3 times a week and each session was 60 min. Control Group Program: A 12 week handball technical training program were supervised 3 times a week and each session was 60 min. Push up, vertical jump (VJ), performances and some kinematic parameters (velocity (VCG) and height (hCG) of center of gravity) were evaluated before and after training program.

For kinematics parameters, performances were recorded with a camera (50Hz) and evaluated with Video point 2.0. program. There were significant differences between before and after training program in push up and the height of center of gravity parameters($p<0.05$). But there is no significant differences found that vertical jump (VJ) and velocity of center of gravity (VCG) ($p>0.05$).

Graib, et al., (2012) identified the impact of anxiety and tension on the level of performance of basketball aiming skills for deaf players in Jordan, because its appropriateness for this study the researcher used the descriptive approach, a deliberately sample composed of 10 practitioners of the game of basketball players from the Prince Ali Deaf Club (Zarka) was chosen, a number of conclusions have been reached some of them was the high performance skills of aiming caused a low level of concern among members of the sample.

The relationship between the two variables were statistically significant but was in reverse, the researchers recommended a growing interest in developing performance skills in basketball and aiming skill in basketball and carrying out more experimental and competitive games for the purpose of eliminating the barrier of fear and tension, and granting the deaf players high confidence in his performance.

Wagner, et al., (2012) determined differences in performance and movement variability for several throwing techniques in different phases of the throwing movement, and of different skill levels. Twenty-four team-handball players of different skill levels (n = 8) performed 30 throws using various throwing techniques. Upper body kinematics was measured via an 8 camera Vision motion capture system and movement variability was calculated. Results indicated an increase in movement variability in the distal joint movements during the acceleration phase.

In addition, there was a decrease in movement variability in highly skilled and skilled players in the standing throw with run-up, which indicated an increase in the ball release speed, which was highest when using this throwing technique. The researchers asserted that team-handball players had the ability to compensate an increase in movement variability in the acceleration phase to throw accurately, and skilled players were able to control the movement, although movement variability decreased in the standing throw with run-up.

Debanne a**nd Laffaye (2011)** conducted a study to predict the throwing velocity of the ball in Handball with anthropometric variables and isotonic tests. The aims of this study were; to (1) investigate the influence of general anthropometric variables, Handball specific anthropometric variables, and upper-limb power and strength on ball-throwing velocity in a standing position and (2) predict this velocity using multiple regression methods. Forty- two skilled male Handball players (age 21.0 ± 3.0 years; height = 1.81 ± 0.07 m; body mass = 78.3+11.3 kg) participated in the study. Researchers measured general anthropometric variables (height, body mass, lean mass, body mass index) and Handball specific anthropometric parameters (hand size, arm span). Upper-limb dynamic strength was assessed using a medicine ball (2 kg) throwing test, and power using a one repetition maximum bench press test. All the variables studied were correlated with ball velocity. Medicine ball throwing performance was the best predictor (r = 0.80).

General anthropometric variables were better predictors (r = 0.55–0.70) than Handball specific anthropometric variables (r = 0.35–0.51). The best multiple regression model accounted for 74% of the total variance and included body mass, medicine ball throwing performance, and power output in the 20kg bench press. The equation formulated could help trainers, athletes, and professionals detect future talent and test athletes’ current fitness.

Shahbazia, et al., (2011) investigated physical and mental fitness of Iranian men's handball national players. Samples of the research were 15 of Iranian men's handball national players. Selected physical fitness tests (such as: sit and reach, VO2max, power, strength, speed, reaction time, agility) and OMSAT3 questionnaire used for measure physical and mental fitness respectively. The results of Pearson correlation showed that there was no significant relation between the factors of physical fitness and mental preparation in athletes ($p>0.05$).

Physical fitness scores were lower than optimal level whereas they had a very good mental preparation. Although the research subjects had low physical fitness, they achieved considerable results in Asian games. Therefore, it seems that high psychological preparedness in athletes may be effective in earning such a great position (silver medal).

Buchheit, et al., (2010) compared the effects of speed/agility (S/A) training with sprint interval training (SIT) on acceleration and repeated sprint ability (RSA) in well-trained male handball players. In addition to their normal training program, players performed either S/A (n = 7) or SIT (n = 7) training for 4 wk. Speed/agility sessions consisted of 3 to 4 series of 4 to 6 exercises (e.g., agility drills, standing start and very short sprints, all of <5 s duration); each repetition and series was interspersed with 30 s and 3 min of passive recovery, respectively.

Sprint interval training consisted of 3 to 5 repetitions of 30-s all-out shuttle sprints over 40 m, interspersed with 2 min of passive recovery. Pre- and posttests included a countermovement jump (CMJ), 10-m sprint (10m), RSA test and a graded intermittent aerobic test (30-15 Intermittent Fitness Test, V(IFT)). In well-trained handball players, 4 wk of SIT is likely to have a moderate impact on intermittent endurance capacity only, whereas S/A training is likely to improve acceleration and repeated sprint performance.

Chelley, Hermassi and Shephard (2010) investigated relationships between peak power (PP) as measured by upper limb (PPUL) and lower limb (PPLL) force-velocity tests, maximal upper limb force assessed by 1 repetition maximum bench press (1RMBP), and pullover (1RMPO) exercises, estimates of local muscle volume and 3-step running handball throwing velocity (T3-Steps). Fourteen male handball players volunteered for the investigation (age: 19.6±0.6 years; body mass: 86.7±12.9 kg; and height 1.87±0.07 m).

Lower and upper limb force-velocity tests were performed on appropriately modified forms of a Monark cycle ergometer, with measurement of PPUL and PPLL, and the corresponding respective maximal forces (F0UL and F0LL) and velocities (V0UL and V0LL). T3-Steps were assessed using a radar Stalker ATS system. Muscle volumes of the upper and lower limbs were estimated with a standard anthropometric kit. T3-Steps was closely related to absolute PPUL and to F0UL ($r=0.69$, $p<0.01$ for both relationships). T3-Steps was also moderately related to 1RMBP and 1RMPO ($r=0.56$, $p<0.05$; $r=0.55$, $p<0.05$ respectively), and to PPLL and F0LL ($r=0.56$, $p<0.05$; $r=0.62$, $p<0.05$, respectively). When PPLL was expressed per unit of limb muscle volume, the relationship with T3-Steps disappeared. This suggests the importance of muscle volume to performance in throwing events.

Force-velocity data may prove useful in regulating conditioning and rehabilitation programs for handball players. Our results also highlight the contribution of both the lower and the upper limbs to handball throwing velocity, suggesting the need for coaches to include upper and lower limb strength and power programs when improving the throwing velocity of handball players.

Garcia, et al., (2010) analyzed the differences in general and specific throwing capacity of handball players as a function of the age category. Differences between throwing velocity to goal without and with opposition have also been addressed. Ninety four handball senior and U-18 players were assessed in four different situations of throwing: 1) heavy medicine ball throw, 2) light medicine ball throw, 3) throwing velocity without opposition and 4) throwing velocity with opposition. Senior players were found to perform far better than the U-18 players in all four throwing situations ($p<0.001$; t1=6.958; t2=8.244; t3=8.059; t4=5.399; df=92).

Throwing velocity was higher without than with opposition for both groups; the throwing velocity of the senior group was 7.79% lower ($p<0.01$; t=8.317; df=47) when there was opposition, whereas U-18 players' velocity lowered by 6.03% ($p<0.01$; t=4.469; df=45). The results suggest that age can be a determining factor in handball players' throwing capacity, both general and specific. Likewise, the presence and interference of a goalkeeper appears to affect throwing velocity in a negative way, especially in senior players.

Rivilla-García (2010) analyzed the differences in distance throwing with heavy and light medicine ball and throwing velocity between handball players of different competitive and professional level. Likewise, the relationship between the three throwing test of progressive specificity was analyzed: throwing with heavy medicinal ball (TH), throwing with light medicinal ball (TL) and throwing velocity (TV). For this purpose, sixty-five professional (P), semi- professional (S) and non-professional (N) players were evaluated.

In the three throwing test, the results revealed that the values were significantly better as the competitive and professional level increased (TH: F 2, 63 = 34.399; TL: F 2, 63 = 53.75; TV: F 2, 63 = 70.364). Thus, in all throwing situations, the professional group showed higher values ($p<0.001$) than the semi-professional and non-professional groups. In all groups, significant and positive correlation between the three throwing tests were observed ($p<0.01$).

The correlation value between TH-TV (P: r=0.469; S: r=0.619; N: r=0.687) was lower than the correlation value between TL-TV (P: r=0.652; S: r=0.818. N: r=0.891). Therefore, handball players' throwing ability is a decisive factor in competitive and professional level. Moreover, the results suggest that the TL is a better predictor of throwing velocity than the TH, more so in non-professional players.

Rivilla–Garcia, et al., (2010) analyzed the differences in throwing capacity among the playing positions in elite and amateur male team handball players (n=48) in four throwing tests: throwing with a heavy (THMB) and light medicine ball (TLMB), throwing velocity without (TV) and with opposition (TVO). The backs achieved the highest scores while goalkeepers had the lowest scores in the most specific tests, TLMB (F 4, 43=2.886; $p<0.05$), TV (F 4,=4.857; $p<0.05$) and

TVO (F 4, 43=12.828; $p<0.01$). The analysis of differences revealed that TV was higher than TVO ($p<0.01$) in all cases. The results suggest that the playing position is determinant in specific throws. Furthermore the influence of opposition is significant in throwing velocity, decreasing it in all positions.

Vuleta, at al., (2010) defined reliability and factorial validity of four field specific handball tests used for the assessment of explosive (throwing) power of elite handball players. The subjects were 18 top level Croatian national handball players. The participants were tested during the middle of the competitive season. Three throws were measured for each test (R4M, R6M, R9MRS and R9MJS). The reliability was assessed through the AVR, ICC and Cronbach's α coefficients, and the validity through the correlations obtained by the principal components factor analysis. The R6M, R9MRS and R9MJS tests had high reliability coefficients (α = 0.93, 0.93 and 0.91).

The principal components analysis extracted one statistically significant component. The R4M test had the lowest correlation with the component ($r = 0.52$), and the other three tests had correlation coefficients between 0.88 and 0.93. The results of the study proved that the most reliable and appropriate tests to assess the explosive (throwing) power of handball players are the R6M and R6MRS tests.

Wagner, et al., (2010) studied that the jump throw is the most applied throwing technique in team- handball ; however, a comprehensive analysis of 3D-kinematics of the team-handball jump throw is lacking. Therefore, the purpose of our study was: 1) to measure differences in ball release speed in team-handball jump throw and anthropometric parameters between groups of different levels of performance and (2) to analyze upper body 3D- kinematics (flexion/extension and rotation) to determine significant differences between these groups.

Three-dimensional kinematic data was analyzed via the Vicon MX 13 motion capturing system (Vicon Peak, Oxford, UK) from 26 male team- handball players of different performance levels (mean age: 21.2 ± 5.0 years). The participants were instructed to throw the ball (IHF Size 3) onto a target at 8 m distance, and to hit the center of a square of 1×1 m at about eye level (1.75 m), with maxi- mum ball release speed. Significant differences between elite vs. low level players were found in the ball release speed ($p<0.001$), body height ($p < 0.05$), body weight ($p < 0.05$), maximal trunk internal rotation ($p < 0.05$), trunk flexion ($p < 0.01$) and forearm pronation ($p < 0.05$) as well as trunk flexion ($p < 0.05$) and shoulder internal rotation ($p < 0.001$) angular velocity at ball release.

Results of the study suggest that team-handball players who were taller and of greater body weight have the ability to achieve a higher ball release speed in the jump throw, and that an increase in trunk flexion and rotation angular velocity improve the performance in team-handball jump throw that should result in an increase of ball release speed.

Buchheit, et al., (2009) compared the effect of high-intensity interval training (HIT) versus specific game-based handball training (HBT) on handball performance parameters. Thirty-two highly-trained adolescents (15.5±0.9 y) were assigned to either HIT (n=17) or HBT (n=15) groups, that performed either HIT or HBT twice per week for 10 weeks. The HIT consisted of 12-24 x 15 s runs at 95% of the speed reached at the end of the 30-15 Intermittent Fitness Test (V(IFT)) interspersed with 15 s passive recovery, while the HBT consisted of small-sided handball games performed over a similar time period.

Before and after training, performance was assessed with a counter movement jump (CMJ), 10 m sprint time (10 m), best (RSAbest) and mean (RSAmean) times on a repeated sprint ability (RSA) test, the V(IFT) and the intermittent endurance index (iEI). After training, RSAbest (-3.5±2.7%), RSAmean (-3.9±2.2%) and V(IFT) (+6.3±5.2%) were improved (P<0.05), but there was no difference between groups. In conclusion, both HIT and HBT were found to be effective training modes for adolescent handball players. However, HBT should be considered as the preferred training method due to its higher game-based specificity.

Buchheit, et al., (2009) determined whether a 4-a-side handball (HB) game is an appropriate aerobic stimulus to reach and potentially enhance maximal oxygen uptake ($\dot{V}O_2max$), and whether heart rate (HR) is a valid index of $\dot{V}O_2$ during a handball game. Nine skilled players (21.0 ± 2.9 yr) underwent a graded maximal aerobic test (GT) where $\dot{V}O_2max$ and HR–$\dot{V}O_2$ relationship were determined, HR and blood lactate ($[La]_b$) were recorded during a 2 × 225 s (interspersed with 30 s rest) 4-a-side handball game and were compared to those measured during an 480-s running intermittent exercise (IE). Mean $\dot{V}O_2$ tended to be higher in handball compared to IE (93.9 ± 8.5 vs 87.6 ± 7.4%, p = 0.06), whereas HR was similar (92.3 ± 4.9 vs. 93.9 ± 3.9% of the peak of HR, p = 0.10). $[La]_b$ was lower for handball than for IE (8.9 ± 3.5 vs. 11.6 ± 2.1 mmol.l–1, p = 0.04).

Time spent over 90% of $\dot{V}O_2max$ was higher for handball than for IE (336.1 ± 139.6 s vs. 216.1 ± 124.7 s; $p = 0.03$). The $HR - \dot{V}O_2$ relationship during GT was high ($r2 = 0.96$, $p < 0.001$) but estimated $\dot{V}O_2$ from HR was lower to that measured ($p = 0.03$) in handball, whereas there was no difference in IE. 4-a-side handball game can be used as a specific alternative to IE for enhancing aerobic fitness in handball players. Nevertheless, the accuracy of HR measures for estimating $\dot{V}O_2$ during handball is poor.

Singh, et al., (2009) prepare the 'norms profile' of specific skills of handball players with a view to compare and evaluate further planning of handball game as it's not being practiced in our country at present. So, an objective was set by the researchers to prepare the norms for each important specific skill of handball game at school, university and senior level of performance. Total of five hundred eighty six (N=586) players of handball were examined during School National championship (N=200), All India Inter University championship (N=195) and Senior National championship (N=191).

The tests of specific skills of Handball, standardized by Singh (2007) were used to record the specific skills of handball players. The percentile values were distributed through SPSS. These prepared norms are presented in tabular form. The research evaluation highlights that there is an increase of specific skills with participation level of handball players. Speaking specifically, the different levels' include the level of school to university and then from university to senior level. The implicational interpretation will result in the form of an increased competitive ability of the players.

Ziva and Lidora (2009) studied physical characteristics, physiological attributes, throwing velocity, accuracy and on court performances of male Handball players. For this purpose amateur player, experienced players, professional and national team players were selected. Five main findings emerged from our review: (1) Elite players are heavier and have higher fat-free mass than amateur players. (2) The maximal oxygen uptake of male players was between 50 and 60 ml kg^{-1} min^{-1}. (3) Throwing velocity was higher by as much as 9% in elite male players compared with amateur male players. (4) Heart rates can rise above 160 beats min-1 in male players during a game. (5) On- court distance covered in a game averaged approximately 4 km and ranged between 2 and 5 km, depending on playing position.

The methodological concerns based on the reviewed studies are: (a) a lack of on-court physiological data; (b) a lack of experimental/manipulative studies; (c) limited data on throwing accuracy; and (d) a lack of longitudinal studies. The practical implications include: (a) strength and power exercises should be emphasized in conditioning programmes, as they are associated with both sprint performance and throwing velocity; (b) speed and agility drills should also be implemented in conditioning programmes; and (c) specificity of training based upon the position of the player is of great importance when planning strength and conditioning programmes.

Marques, et al., (2007) examined the relationship between ball throwing velocity during a 3-step running throw and dynamic strength, power, and bar velocity during a concentric-only bench-press exercise in team-handball players. Fourteen elite senior male team-handball players volunteered to participate. Each volunteer had power and bar velocity measured during a concentric-only bench-press test with 26, 36, and 46 kg, as well as having 1- repetition-maximum (1-RMBP) strength determined. Ball-throwing velocity was evaluated with a standard 3-step running throw using a radar gun.

Ball-throwing velocity was related to the absolute load lifted during the 1-RMBP (r = .637, P = .014), peak power using 36 kg (r = .586, P = .028) and 46 kg (r = .582, P = .029), and peak bar velocity using 26 kg (r = .563, P = .036) and 36 kg (r = .625, P = .017). Conclusions: The results indicate that throwing velocity of elite team-handball players is related to maximal dynamic strength, peak power, and peak bar velocity. Thus, a training regimen designed to improve ball-throwing velocity in elite male team-handball players should include exercises that are aimed at increasing both strength and power in the upper body.

Nikolaos, et al., (2007), compared a 6-month specific handball training program and a typical physical education program on various strength and jumping skills. The participants (M age = 13.7 years, SD = 1.5) were divided into the Handball Group (n = 51) and the Physical Education Group (n = 70). The Handball Group performed 3 sessions/week (60 min) including ball-handling drills, horizontal and vertical jump-shots, fast-break, and several defensive skills. The Physical Education Group performed the program provided by the Ministry of Education including track and field and other team-sport drills.

Analyses of covariance showed that the handball group displayed greater improvement in explosive strength of upper limbs, jumping performance, maximum isometric force of right grip, and 10 m running velocity. These findings showed that handball training can significantly improve preadolescent performance of upper and lower limbs. The inclusion of specific handball drills into the physical education program is recommended.

Rogulj, et al., (2007) found the influence of some motor abilities on Ball Speed during Shot in Handball. The influence of basic motor abilities on the speed of ball during the jump shot and the floor shot in Handball has been analyzed with the sample consisting of 42 students of the first year of the Faculty of kinesiology in Split. The predictory system consisted of 8 variables intended to estimate speed, agility, movement frequencies, stamina & explosive and repetitive strength whereas the ball movement speed as a criterion variable was measured by radar pistol.

The result of the regression analysis indicates that the ball movement speed was determined in a great deal by motor ability efficacy. Individually, the ball movement speed during the jump shot and the floor shot is determined, at the level of statistical importance, only by explosive strength in the form of throw. It was acceptable because this very ability from the aspects of kinesiology and anatomy requires, to the maximum extent, the kinetic efficacy of the ball throw in Handball.

Schorer, et al., (2007) examined the movement patterns of 5 left-handed handball players (ranging from beginner to national level) who threw a handball to different sections of a goal as if a goalkeeper were present. The authors used time-continuous, 3-dimensional kinematic data to assess intraindividual movement patterns and considered subjects' intraindividual differences relative to different targets. Cluster analysis yielded the highest assignment rates for level of expertise; a mean of 92% of trials was correctly assessed.

The authors observed an interaction with expertise for the intraindividual movement patterns. Variability in the novice throwers was increased, whereas (a) advanced throwers experienced a period of stability, and (b) the expert thrower's variability was increased. The results indicate that random variability characterizes novice motor performance, whereas active functional variability may exemplify expert motor performance.

Tillaar and Ettema (2007) investigated the contribution of upper extremity, trunk, and lower extremity movements in over arm throwing in team handball. In total, 11 joint movements during the throw were analyzed. The analysis consists of maximal angles, angles at ball release, and maximal angular velocities of the joint movements and their timing during the throw. Only the elbow angle (extension movement range) and the level of internal rotation velocity of the shoulder at ball release showed a significant relationship with the throwing performance. Also, a significant correlation was found for the timing of the maximal pelvis angle with ball velocity, indicating that better throwers started to rotate their pelvis forward earlier during the throw. No other significant correlations were found, indicating that the role of the trunk and lower limb are of minor importance for team handball players.

Visnapuu, et al., (2007) reported that in handball and basketball the longer the finger length the better the accuracy of the shot or throw. All shots and throws are finished with the wrist and fingers. It can be proposed that athletes with longer fingers and greater hand surface parameters also probably have greater grip strength. The aim of this study was to investigate the influence of general body and hand-specific anthropometric dimensions on handgrip strength in boys participating in handball and basketball training. In total, 193 boys aged 10-17 years participated in this study. They were divided into 6 groups: 10-, 11-, 12-, 13-, 14-15-, and 16-17-year-olds. The body height and body mass were measured and body mass index was calculated as general anthropometric parameters. The outlines of the hands of the boys were drawn on paper with a thin marker. Three groups of hand anthropometric parameters were measured: 5 finger spans, 5 finger lengths, and 5 perimeters of the hand. Handgrip strength was measured on the dominant hand with a Lafayette dynamometer.

As a rule, general anthropometric parameters determined the maximal handgrip strength more accurately than did specific hand anthropometric parameters. From the specific hand anthropometric parameters, finger lengths and perimeters of the hand significantly correlated with the maximal handgrip strength. In summary, fingers are the smallest, lightest parts of the motor apparatus, and, therefore, they represent the parts most easily deflected by force from the ball, but at the same time, finger control was especially important for the accuracy of different shots, both in handball and basketball. Thus, it was especially necessary to measure finger length and perimeters of the hand for practical reasons.

Marques and Gonzalez (2006) investigated the changes in physical parameters produced during an in-season resistance training (RT) and detraining (DT, or RT cessation) in 16 high level team handball players (THPs). Apart from normal practice sessions, THPs underwent 12 weeks of RT. Subjects performed 3 sets of 3-6 reps with a load of 70-85% concentric 1 repetition maximum bench press (1RMBP), 3 sets of 3-6 reps with a load of 70-95% of 4 repetition maximum parallel squats (4RMPS), plus vertical jumps and sprints. The 1RMBP, 4RMPS, speed over

30 m (S30), jump (countermovement jump height [CMJ]; CMJ with additional weights [20kg and 40kg], and ball throw velocity (BTv) were tested before the experimental period (T1), after 6 weeks (T2), and after the 12-week experimental period (T3). Immediately after these 12 weeks, THPs started a 7-week DT period, maintained normal practices.

The CMJ and the BTv were the only parameters evaluated during DT. The most important gains ($p < 0.001$) in S30 were obtained between T1-T2 and T1-T3. The BTv improved significantly ($p < 0.001$) only between T1-T2 and T1-T3. The most relevant increases ($p < 0.001$) in jumping performance took place between T1-T2 and T1-T3. The 1RMBP showed significant increases ($p < 0.001$) only between T1-T2 and T1-T3. The 4RMPS increased significantly between all testing trials. After the DT, THPs showed no significant losses in CMJ performance. However, they declined significantly in BTv ($p = 0.023$). The results suggest that elite THPs can optimize important physical parameters over 12 weeks in-season and that 7 weeks of DT, although insufficient to produce significant decreases in CMJ, are sufficient to induce significant decreases in BTv. It is concluded that after RT cessation THPs reduced BTv performance.

Souza, et al., (2006) analyzed the changes in metabolic and motor performance variables in handball players during a training program following a model proposed by Verkhoshanski and adapted by Oliveira. Eleven handball players, from 20 to 32 years old, body weight 89.5 ± 10.4 kg (70.2 and 105.1 kg), height of 184.4 ± 6.7 cm (171.8 and 198 cm) participated in this study. All participants were members of "UniFil/Londrina" Handball Team of Londrina, Paraná. The subjects were tested and retested after developing a 16-week training program, prior to the start of the National League Championship. Data were analyzed using t-test for repeated measures ($p < 0.05$).

The results showed very important adaptations with an increase in velocity strength (7.8%, $p < 0.05$), explosive strength (8.1%, $p < 0.05$) and agility (6.4%, $p < 0.05$). Moreover, the training program allowed for some metabolic adaptations, such as anaerobic power (30.5 and 37.5%, $p < 0.05$), and the total time the players could stand at the Yo-yo test, respectively. Aerobic power, measured by VO_2max, also increased (8.1%, $p < 0.05$). The results suggest that the program proposed was able to create positive motor capacities responses that were observed in the lasting training posterior effect.

Gorostiaga, et al., (2005) compared physical characteristics (body height, body mass [BM], body fat [BF], and free fatty mass [FFM]), one repetition maximum bench-press (1RM (BP)), jumping explosive strength (VJ), handball throwing velocity, power-load relationship of the leg and arm extensor muscles, 5- and 15-m sprint running time, and running endurance in two handball male teams: elite team, one of the world's leading teams (EM, n = 15) and amateur team, playing in the Spanish National Second Division (AM, n = 15). EM had similar values in body height, BF, VJ, 5- and 15-m sprint running time and running endurance than AM.

However, the EM group gave higher values in BM (95.2 ± 13 kg vs. 82.4 ± 10 kg, $p < 0.05$), FFM (81.7 ± 9 kg vs. 72.4 ± 7 kg, $p < 0.05$), 1RM (BP) (107 ± 12 kg vs. 83 ± 10 kg, $p < 0.001$), muscle power during bench-press (18 - 21 %, $p < 0.05$) and half squat (13 - 17 %), and throwing velocities at standing (23.8 ± 1.9 m .

s (-1) vs. 21.8 ± 1.6 m . s (-1), $p < 0.05$) and 3-step running (25.3 ± 2.2 m . s (-1) vs. 22.9 ± 1.4 m . s (-1), $p < 0.05$) actions than the AM group. Significant correlations (r = 0.67 - 0.71, p < 0.05 - 0.01) were observed in EM and AM between individual values of velocity at 30 % of 1RM (BP) and individual values of ball velocity during a standing throw. Significant correlations were observed in EM, but not in AM, between the individual values of velocity during 3-step running throw and the individual values of velocity at 30 % of 1RM (BP) ($r = 0.72$, $p < 0.05$), as well as the individual values of power at 100% of body mass during half-squat actions ($r = 0.62$, $p < 0.05$).

The present results suggest that more muscular and powerful players are at an advantage in handball. The differences observed in free fatty mass could partly explain the differences observed between groups in absolute maximal strength and muscle power. In EM, higher efficiency in handball throwing velocity may be associated with both upper and lower extremity power output capabilities, whereas in AM this relationship may be different. Endurance capacity does not seem to represent a limitation for elite performance in handball.

Pori, Bon and Sibila (2005) studied the jump shot is one of the most important elements of specific handball motor behaviour. The researchers wanted to assess it with the method of expert modelling. The sample of subjects consisted of ten male elite handball players, members of the national Slovenian teams that play in the first national handball division (average height - 191.1 4.48 cm; average body mass - 90.0 ± 4.40 kg, average age - 23.4 4.2 years; average training experience in senior teams - 5.3 2.1 years).

The investigators analysed six backcourt players, two wing players and two pivots. Each of the subjects executed, after a 20-minute warm-up, three jump shots. Data processing was performed by APAS (Ariel Dynamics, California, USA). Expert modelling was performed with the SPEX expert system. The researchers formed a success tree containing 17 variables, representing all five phases of the jump shot. In order to assess the validity of this kinematic model, three independent referees also assessed the quality of the jump shot. The ranks obtained from their marks were then compared with the ranks obtained with the SPEX expert model.

On the basis of the obtained results the researchers then constructed an expert mark for each analysed player. The level of concordance of the referees was high (W = 0.875), the coefficient of correlation between the actual ranks and the referee ranks was statistically significant (0.912). The final finding was that a kinematic model of the jump shot constructed in this way can also be a good criterion for assessing the quality of the basic technique of the jump shot for seniors.

Rogulj, et al., (2005) identified the differences in motor and psychological variables according to playing positions from a sample of 53 elite female junior and senior national Handball players, Motor status included 8 variables for assessment of explosive strength of landing and throwing, agility, speed strength, movement frequency, and flexibility. Psychological status was analyzed through 4 dimensions according to Eysenck: extroversion, psychotic behaviour, neurotic behaviour, and lie.

The anthropologic features analyzed showed statistically significant differences. Considering motor abilities, differences were recorded in the variables for assessment of speed strength, agility and leg movement frequency, where wings predominated, whereas goalkeepers showed predominance in flexibility. In psychological status, differences were present in the variable for assessment of extroversion which was most pronounced in wings, whereas psychotic behaviour was more expressed in those at pivot position.

The differences were primarily consequential to the selection of players of a specific anthropologic profile for particular playing positions. The hypothesis of the impact of kinesiologic specificities of a particular playing position on the formation of the players' anthropologic profile should be scientifically tested. Study results might found application in training and contest practice, especially in forming anthropologic models for particular positions during the process of player selection.

Skoufas, et al., (2002) studied the throwing velocity is an important task that affects substantially the performance of a handball player. Several training methods have been suggested in order to improve this ability. The purpose of this study was to investigate the effect of training with light balls to the throwing velocity of male novice athletes and the effect of a following detraining. The subjects performed 20 weeks of handball training and were divided in two groups: one was using normal handball balls for training and the other 20% lighter ones. The first ten weeks were used for handball players to be familiar with throwing technique.

The evaluation tests performed before, in the middle and the end of the specific training period and then after 4 weeks of detraining. The estimation of the throwing velocity was taken out of the mean velocity of 7 shots against a fixed target, placed 6 meters away from the subjects. A radar gun was used for measuring the ball release velocity. The results showed that training with lighter balls could improve the performance of throwing more than using normal balls. Additionally, the benefit of training was maintained 4 weeks after detraining only for the group that used the lighter ball for training.

These findings are in agreement with previous studies that involve similar movements of other sports and suggest that the decreased resistance during training that involves ballistic movements can be advantageous for the player's performance, and therefore, trainers are encouraged to apply this method of training as a tool for improving the efficiency of shooting of novice handball players.

2.2. STUDIES RELATED TO DEAF AND DUMB

Ghosh (2014) compared the selected physical fitness components between the Deaf & Dumb and Normal school boys of west Bengal. For the purpose of the study forty two (N=42)) subjects were randomly chosen of which twenty two were deaf and dumb boys (n=22) and twenty were normal school boys (n2=20). The age of the children ranged from 12 to 20 years. They were selected from three separate districts of West Bengal Kolkata, Burdwan and Hooghly. The five different physical fitness components i.e. Speed, Agility, Muscular endurance, Flexibility and Explosive leg strength were considered as variables for the present study. The data were collected by using standard tools and techniques. Mean, standard deviation (SD) and independent t-test were the statistics used in this study for data interpretation. Level of significant difference between two groups was set at $p<0.05$.

For statistical calculations Excel Spread Sheet of windows version 7 was used. Result of present study revealed that in Speed, Agility and Muscular

Endurance no significant difference existed between the Normal and Deaf & Dumb Boys. But in Flexibility & Explosive leg strength significant difference existed between the Normal and Deaf & Dumb Boys. It can be concluded from the results of the study that in flexibility the normal boys were better than the deaf and dumb boys but the Explosive leg strength of the Deaf & Dumb Boys were better than the normal boys.

Khidr (2010) designed to know the effect of using a computer as a new way to learn some judo skills to the players with hearing difficulty who suffer from loneliness. This research had been applied on young students, aged 13-15 years from the deaf and dump school in Zagzig city. The Researcher adapted the experimental method for two groups which had been divided into a study group and a control group using previously and later measurements for both groups. The researcher used Bortious intelligent measure that has a scale to estimate loneliness. The educational computer program was found to have a positive effect on learning judo skills to the players with hearing difficulty who suffer from loneliness.

Singleton and Morgan (2005) had stated that bilingual deaf education is all about providing a child with the acquisition of both languages so that he was able to successfully negotiate his way in both worlds (i.e., hearing and deaf). A child with bilingual skills should possess linguistic and cognitive competence as well as a clear understanding of his identity so that he can choose to participate in either linguistic and cultural group, depending on the situation. In addition, it was important to remember that deaf educational placement is not about tracking a deaf child into either world, but rather, allowing access to both.

Ibrahim (2004) studied the motives associated with football practice with deaf and dumb Egyptian Union registered disabled sports, aimed at designing a scale to measure motivation of deaf and dumb to exercise football and identify the motivations of deaf to exercise football, and ranking the motivation of deaf and dumb to practice football, and the study also aimed to identify differences in motivations between deaf footballers, the researcher used descriptive approach for the study sample of (48) deaf player, and in the light of the particular sample study the motivations for practicing football for the deaf was the rewards the physical fitness and health, the challenge of disability, social relations and fame.

Abdullah and Yakoot Zidane (2000) conducted a study aimed to put a proposal training program for developing capacity linked to mobility performance skill for some volleyball skills of deaf and dumb, and it also aimed to know the impact of special mobility abilities on the level of skills for some volleyball skills related to sending from top and passing by hands from top and defensive of sending and passing by hands from down “crushing blows’ for deaf and dumb, the researcher used several researcher methods in this study, experimental and scanning approach, experimental design approach and semi experimental approach, the study sample consisted of (30) deaf student, the results helped in achieving the expected objectives of the study with the superiority of experimental group to control group .

Ali, Radwan and Zakaria Mohammed (2000) conducted a study to note the impact of a proposal program on some variables of cognitive dynamic sense, functional varieties and physical variables of the deaf and dumb, the researchers use experimental approach to a sample of (18) students, divided into two groups experimental (9) and control (9), the main results was that the proposed program had led to improved capacity of cognitive dynamic sense under study and physical and functional variables.

According to **Zozo and Hassan (1999)** the effectiveness of using preliminary games to learn basic skills proposal to teach basic skills and improving some mobility capabilities in handball for deaf and dumb. The researcher used experimental approach on a sample of 60 pupils from the sixth and seventh graders from hearing-impaired, they were divided into two groups, experimental (30) students and controller (30) students, the most important results were that the preliminary games led to learn games and improve the basic skills of handball in the deaf and dumb and improving the motor capacity associated with these skills.

Almuhandis (1990) conducted a study to see the impact of kinetic education program proposed on kinetic consent and some components of the motor performances to the pupils with impaired hearing (9-12) years, the researcher used the experimental approach on a sample of (55) pupils of hearing-impaired aged (9 – 12) divided into two experimental number (28) and control (27) and the most significant results of the program had a positive impact on components of motor performance and on the degree of motor satisfaction.

2.3. STUDIES RELATED TO VIBRATOR AID AND SIGN LANGUAGE TRAINING

Spelmezan, et al., (2012) demonstrated the potential for teaching sport skills with realtime tactile instructions. Ten amateurs learned a riding technique with a wearable system that automatically provided tactile instructions during descents. These instructions were in sync with the movements of the snowboard and signaled how to move the body. Author found that tactile instructions could help snowboarders to improve their skills. This report gave insights into the snowboarders' opinion and gave recommendations for teaching sport skills with tactile instructions. The findings helped identify the conditions under which tactile instructions can support athletes in sports training.

Warnock, McGee-Lennon and Brewster (2012) carried out an empirical user study with aged participants which evaluated the performance, disruptiveness and subjective workload of visual, audio, tactile and olfactory notifications and then compared the results with earlier findings in younger participants. It was found that disruption and subjective workload were not affected by modality, although some modalities were more effective at delivering information accurately. It was concluded that although further studies need to be carried out in a real-world settings, the findings support the argument for multiple modalities in assisted living technology.

Auvray, et al., (2011) conducted a study to investigate the extent to which tactile information that was unavailable for full conscious report can be accessed using partial-report procedures. In Experiment 1, participants reported the total number of tactile stimuli (up to six) presented simultaneously to their fingertips (numerosity judgment task). In another condition, after being presented with the tactile display, they had to detect whether or not the position indicated by a (visual or tactile) probe had previously contained a tactile stimulus (partial-report task). Participants correctly reported up to three stimuli in the numerosity judgment task, but their performance was far better in the partial-report task: Up to six stimuli were perceived at the shortest target-probe intervals.

A similar pattern of results was observed when the participants performed a concurrent articulatory suppression task (Exp. 2). The results of a final experiment revealed that performance in the partial-report task was overall better for stimuli presented on the fingertips than for stimuli presented across the rest of the body surface. These results demonstrated that tactile information that was unavailable for report in a numerosity task can nevertheless sometimes still be accessed when a partial-report procedure was used instead.

Alathari (2009) conducted a study on the impact of instructional method of sign language and lip reading in teaching some basic skills in volleyball game for the deaf and mute, and aimed to identify the impact of the practical approach of the method of sign language and lip reading to learn some basic skills in volleyball game for deaf and mute, it also aimed to identify the best method in teaching some basic skills in volleyball game for the deaf and mute. The sample of the study consisted of 20 players of Hope Institute for deaf in Baghdad Governorate, experimental approach has been used in this study, and the results showed that both methods of sign language and lip reading had a positive impact on learning and mastery of skills. The results showed that sign language was more effective than lip-reading in learning the skills of throwing the ball from the bottom ,and throwing it front bottom to front and didn't show any difference in the skill of throwing form the top between lip reading and sign language.

Eccarius and Brentari (2007) analyzed the phonological and prosodic properties of two-handed classifiers in three sign languages—American Sign Language, Hong Kong Sign Language, and Swiss German Sign Language. Their analysis was two-fold—first they examined the restrictions the forms placed on handshape choice, and then they looked at their prosodic and morpho-syntactic structures by examining the interaction between the temporal relations of the two hands and other prosodic cues, such as eye blinks.

From the point of view of well-formedness at the word level, their work showed that: (i) in the majority of cases, two-handed classifiers obeyed the Dominance Condition of Battison (1978) while all other forms limited their complexity in a similar way at the featural level; (ii) different classified types exhibited systematic behavior with regard to their internal handshape complexity, in particular with regard to a difference between whole entity and handling classifiers, and (iii) in the majority of cases, two-handed classifiers have the same timing properties as prosodic words.

With regard to larger prosodic units, they have found evidence of the prosodic–syntactic interface at work in classifier constructions in a number of systematic ways involving national phrases. Two-handed classifiers can be divided into four major groups with regard to their prosodic structure, one of which was found only in Hong Kong Sign Language, while the other three exhibited a general pattern that applied to all three of the sign languages in their study. The findings revealed that the phonological structures and principles that hold true in non-classifier forms were also obeyed by classifiers to a large extent.

Gallace, et al., (2007) studied only under conditions of unimodal stimulus presentation. It was therefore unclear whether the same limitations on correctly reporting the number of unimodal visual or tactile stimuli presented in a display might be expected under conditions in which participants had to count stimuli presented simultaneously in two or more different sensory modalities. In Experiment 1, they investigated numerosity judgments using both unimodal and bimodal displays consisting of one to six vibrotactile stimuli (presented over the body surface) and one to six visual stimuli (seen on the body via mirror reflection). Participants had to count the number of stimuli regardless of their modality of presentation.

Bimodal numerosity judgments were significantly less accurate than predicted on the basis of an independent modality-specific resources account, thus showing that numerosity judgments might rely on a unitary amodal system instead. The results of a second experiment demonstrated that divided attention costs could not account for the poor performance in the bimodal conditions of Experiment 1. they discussed these results in relation to current theories of cross-modal integration and to the cognitive resources and/or common higher order spatial representations possibly accessed by both visual and tactile stimuli.

Morgan and Woll (2007) gave a brief overview of the description of the constructions in sign language known as classifiers. Authors focused on the need to carryout theoretically driven linguistic analyses of their use in order to understand the structure and function of these pervasive devices within the grammars of different sign languages. Research on classifiers at the level of phonology, morphology, syntax, semantics and discourse structure as well as in different populations of signers (native, non-native, child and atypical signers) will assist us in the understanding of these complex structures within the context of current research on sign language linguistics.

Tait, Nikolopoulos and Lutman (2007) assessed the effect of age at implantation on the development of vocal and auditory preverbal skills in implanted children. The study assessed 99 children, 33 in each of three groups (those implanted between 1 and 2 years; 2 and 3 years; and 3 and 4 years). Preverbal skills were measured in three areas: turn taking, autonomy and auditory awareness of spoken language, using the Tait video analysis method.

The youngest implanted group made an exceptional progress outperforming in all measures than the other two groups ($p < 0.01$), 6 and 12 months post-implantation, whereas there was no such difference before implantation. In the youngest group, there was also significantly greater use of an auditory/oral style of communication: 85% of the group by 12 months post-implantation compared with 30% and 18% of the two older groups. Vocal and auditory preverbal skills developed much more rapidly in children implanted between 1 and 2 years in comparison with older implanted children and reached a significantly higher level by 6 and 12 months post-implantation.

In addition, younger implanted children were significantly more likely by 12 months post-implantation to adopt an auditory/oral mode of communication. These findings favoured cochlear implantation as early as between 1 and 2 years, provided that correct diagnosis and adequate hearing-aid trial had been achieved.

Gallace, et al., (2006) made a research work to support the claim that two different and dissociable processes were involved in making numerosity judgments regarding visual stimuli: substituting (fast and nearly errorless) for up to 4 stimuli, and counting (slow and error-prone) when more than 4 stimuli were presented. The researchers studied tactile numerosity judgments for combinations of 1-7 vibrotactile stimuli presented simultaneously over the body surface. In experiment 1, the stimuli were presented once, while in experiment 2 conditions of single presentation and repeated presentation of the stimulus were compared.

Neither experiment provided any evidence for a discontinuity in the slope of either the RT or error data suggesting that subitisation does not occur for tactile stimuli. By systematically varying the intensity of the vibrotactile stimuli in experiment 3, the researchers demonstrated that the participants were not simply using the 'global intensity' of the whole tactile display to make their tactile numerosity judgments, instead of using information concerning the number of tactors activated. The results of the three experiments reported here were discussed in relation to current theories of counting and subitising, and potential implications for the design of tactile user interfaces were highlighted.

Summers, et al., (2005) compared two experiments on the discrimination of time-varying tactile stimuli, with stimulus delivery to the distal pad of the right index finger and to the right wrist (palmar surface). Subjects were required to perceive differences in short sequences of computer-generated stimulus elements (experiment 1) or differences in short tactile stimuli derived from a speech signal (experiment 2). The pulse-train stimuli were distinguished by differences in frequency (i.e., pulse repetition rate) and amplitude, and by the presence/absence of gaps (approximately 100-ms duration). Stimulation levels were 10 dB higher at the wrist than at the fingertip, to compensate for the lower vibration sensitivity at the wrist.

Results indicate similar gap detection at wrist and fingertip and similar perception of frequency differences. However, perception of amplitude differences was found to be better at the wrist than at the fingertip. Maximum information transfer rates for the stimuli in experiment 1 were estimated at 7 bits s(-1) at the wrist and 5 bits s(-1) at the fingertip.

Finney and Dobkins (2001) measured contrast sensitivity in deaf and hearing subjects to moving stimuli over a range of speeds (0.125–64°/s). It was hypothesized that if ASL use drives differences between hearing and deaf subjects, such differences may occur over a restricted range of speeds most commonly found in ASL. In addition, the researchers tested a third group, hearing native signers who learned ASL early from their deaf parents, to further assess whether potential differences between groups results from ASL use.

These experiments reveal no overall differences in contrast sensitivity, nor differences in visual field asymmetries, across subject groups at any speed tested. Thus, differences previously observed between deaf and hearing subjects for discriminating the direction of moving stimuli did not generalize to contrast sensitivity for moving stimuli, a result that has implications for the neural level at which plastic changes occurred in the visual system of deaf subjects.

Summers, et al., (1997) carried out experiments to investigate the information transfer available via a single vibrator on the fingertip. In a first experiment, for stimuli with durations 80 to 320 ms, discrimination of a one-octave step change in frequency at the halfway point was investigated. Results were similar for three stimulus types--sinewave, monophasic pulse and tetraphasic pulse--

suggesting temporal cues were more important than spectral cues in this task. In a second experiment, subjects were required to perceive changes in a sequence of stimulus elements.

A presentation rate of 6.25 elements s-1 was found to give better results than a rate of 12.5 elements s-1. In the former case, the potential information transfer per element was estimated to be approximately 1.0 bits, corresponding to an information transfer rate of around 6 bits s-1. Implications for the design of a tactile aid to lip reading were discussed.

Phillips, et al., (1994) conducted a study of clinical experience and research findings gathered from using vibrotactile aids over 7 years. This interest grew from a research project to evaluate four wrist-worn vibrotactile aids for the rehabilitation of the profoundly deaf. To facilitate this, a training programme was developed to help patients get the most from the aid. Having found that the RNID/Summit Tam vibrotactile aid was the most appropriate, this has been fitted to over 50 patients. The results of the comparative trial, an evaluation of our methods and a discussion of our clinical experience using vibrotactile aids with profoundly deafened patients are presented.

Summers, et al., (1994) established the best strategy for transmitting speech-derived information via a single tactile channel, measurements were made on the perception of frequency- and/or amplitude-modulated pulse-train stimuli, with a comparison of the electrotactile and vibrotactile modalities. In one experiment, vibrotactile perception of 2-oct step changes in stimulus frequency was found to be significantly better than electrotactile on a time-scale appropriate for the transmission of speech features (e.g., with practiced subjects, information transfer of 69% with 200-ms vibrotactile stimuli, 32% with 200-ms electrotactile stimuli). Perception of step changes in stimulus amplitude was similar in the two modalities when changes in amplitude were tailored to match the different dynamic ranges available.

In a second experiment, vibrotactile-perception of voice fundamental frequency with various codings was investigated. Both experiments showed information transfer for vibrotactile stimuli to be greater when frequency and amplitude modulation were used together rather than with one or the other in isolation (sentence-stress identification scores: 66% for FM stimuli, 69% for AM stimuli, 80% for FM/AM stimuli). It could be concluded that frequency- and amplitude-modulated vibratory stimulation was a good choice in a practical device for the profoundly hearing impaired.

Galvin, et al., (1993) conducted a study to maximize the benefits available through a tactile device, it must be accompanied by an effective and adaptive training program. There are a number of factors to be considered in the design of such a training program, including the type of tasks and response formats to include, the amount of training, subject motivation and device use, the characteristics of the potential user population, the specific device to be used and the type of information it provided, and the evaluation procedures to be followed.

The type and saliency of the information provided by a particular tactile device were highlighted as the most important yet neglected consideration in designing a training program. The training program used with the University of

Melbourne's multiple-channel electrotactile device was presented to show how these important factors might be addressed, to indicate the flexibility required in a training program, and to provide a general framework on which researchers may base the development of programs for other tactile devices.

Morley and Rowe (1990), in their study the effect of changes in amplitude on the perceived pitch of cutaneous vibratory stimuli was studied in psychophysical experiments designed to test whether the coding of information about the frequency of the vibration might be based on the ratio of recruitment of the PC (Pacinian corpuscle-associated) and RA (rapidly adapting) classes of tactile sensory fibres. The study was based on the previous data which showed that at certain vibration frequencies (e.g. 150 Hz) the ratio of recruitment of the PC and RA classes should vary as a function of vibration amplitude.

Sinusoidal vibration at either 30 Hz or 150 Hz, and at an amplitude 10 dB above subjective detection thresholds was delivered in a 1 s train to the distal phalangeal pad of the index finger in eight human subjects. This standard vibration was followed after 0.5 s by a 1 s comparison train of vibration which (unknown to the subject) was at the same frequency as the standard but at a range of amplitudes from 2 to 50 dB above the detection threshold. A two-alternative forced-choice procedure was used in which the subject had to indicate whether the comparison stimulus was higher or lower in pitch (frequency) than the standard.

Marked differences were seen from subject to subject in the effect of amplitude on perceived pitch at both 30 Hz and 150 Hz. At 150 Hz, five out of the eight subjects reported an increase in pitch as the amplitude of the comparison vibration increased, one experienced no change, and only two experienced the fall in perceived pitch that was predicted if the proposed ratio code contributed to vibrotactile pitch judgements. At 30 Hz similar intersubject variability was seen in the pitch-amplitude functions. The results did not support the hypothesis that a ratio code contributes to vibrotactile pitch perception. This study concluded that temporal patterning of impulse activity remains the major candidate code for pitch perception, at least over a substantial part of the vibrotactile frequency bandwidth.

Weisenberger (1989) evaluated the Siemens Hearing Instruments Minifonator, a single-channel, wrist-worn vibrotactile aid in a laboratory setting with hearing-impaired adults. Eight subjects, with hearing loss greater than 70 dB in the better ear, were administered a test battery including sound-field detection, speech awareness threshold, environmental sound identification, syllable rhythm and stress categorization, and sentence identification subtests.

Performance on each subtest was compared for hearing-aided and tactile-aided conditions. Mean performance levels for the two conditions were comparable for all but one subtest. However, closer inspection revealed that the data for the hearing-aided condition were bimodal: some subjects proved to be good hearing aid users and other performed at chance levels with their hearing aids.

Performance in the tactile-aided conditions did not show such variability and mean levels fell between the hearing-aided levels for "good" and "poor" hearing aid users. The effects of training with the device were assessed for two normal-hearing subjects, who were trained in 1-hour daily sessions over a several week period on the environmental sounds and syllable rhythm and stress subtests. Results indicated substantial improvements in performance over the course of training.

Weisenberger and Russell (1989) compared two commercially available single-channel vibrotactile aids, designed to transmit information about acoustic stimuli to persons who cannot perceive such stimuli through conventional amplification, in a number of tasks with the same subjects. Both devices employed a vibratory transducer worn on the wrist. One device represented characteristics of the envelope of the waveform by using it to modulate the amplitude of a 250-Hz carrier vibration (an amplitude-modulated, or AM, signal). The other device presented and amplitude-modulated a broad-band signal whose spectral characteristics preserved information about the signal. Subjects performed several tasks.

On some tasks (sound detection, environmental sound identification, syllable rhythm and stress categorization) information about the envelope of the stimulus was expected to be sufficient for good performance. On others (speech sound recognition) additional information about the spectral fine structure of the signal spectrum was anticipated to be required for good performance. Results indicated that the subjects performed comparably with both devices on all tasks, suggesting that they did not make use of the spectral information available in the more complex signal.

2.4. SUMMARY OF THE LITERATURE

The reviews are presented under the three sections namely studies related to specified training on handball skills and performance (n=34), studies related to deaf and dumb (n=10), and studies related to vibrator aid and sign language training (n=18). All the research studies that are presented in this section prove that specified training with vibrator aid instruction, specified training with combination of vibrator aid and sign language methods contribute significantly for better improvement in psychomotor and Handball skill performance. From the previous presentation of studies **(Abdullah, 2000), (Ali, et al., 2000), (Button, et al., 2003), (Chelley, et al., 2010), ((Eliasz, 2015), (Ellis and Stewart, 1997), Etnyre, 1998), (Gallace, et al., 2015), (Gorostiaga, et al., 2005), (Graib, et al., 2012), (Ibrahim, 2004), (Ion, et al., 2014), (Khidr, 2010), (Morley and Rowe, 1990), (Muller and Loosch, 1999), (Singh, et al., 2009), (Summers, et al., 2005), (Vulet, et al., 2006), (Wagner, et al., 2010), (Weisenberger and Russel, 1989), (Woll, 2001)** and **(Zozo and Hassan, 1999),** were carried out in the area of sports for disabled, including deaf and hearing difficulties. Hence, in the present investigation, the researcher aimed to notice the importance of sporting activities to contribute to solving the problems of people with special needs and adapting to society.