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Golden Research Thoughts

DEVELOPMENT & STANDARDIZATION OF AN INSTRUMENT TO MEASURE CHILDHOOD MOTOR-ABILITY

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Abstract:-

Background: To construct & standardize the Motor-Ability Test for Early Childhood Period so it would be more appropriate for that age group.
Objectives: To construct the test of the Motor-Ability Test for Early Childhood Period & verify its reliability and validity and to provide percentile norms for the test for future comparison.Methods: The whole test was administered in two phases. The first phase was related to construct & standardize the preliminary motor test battery. The second phase of the study was to develop age related norms, comprising 7 test items out of 50, by using the appropriate statistical techniques. One Physician was hired to look-after the participant children during the testsResults: Content validity was established by expert judgment. Factor analysis had revealed validity co-efficient ranging from 0.58 to 0.95 with the mean of 0.77. The test's overall internal reliability coefficient of 0.89 (Cronbach's alpha) and 0.96 (Mc Donald's Omega) highlighted the strong inter-item agreement among the items on the instrument. Objectivity of Correlation Co-efficient was reported with the mean score of 0.80Conclusion: Preliminary testing along-with the II nd stage provided evidence for the reliability and validity of the Motor-Ability Test for the Early Childhood Period which is first of its kind in human history. Future testing of the scale needs to be done with middle & late childhood period and test to be made for the children belonging from different socioeconomic and cultural groups..

Keywords:

Development & Standardization , Instrument , Measure Childhood Motor.

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INTRODUCTION :

A basic responsibility of professional physical educators has been the evaluation of the physical status of population especially students. Measurement and/or evaluation are necessary in order to determine one's motor fitness proficiency and as a means of determining if physical education programs are adequately fulfilling established goals and objectives. Tests and measurements in the field of physical education are comparatively recent outgrowth of the general testing movements (Achenbach 1992; Barnett & Peter 2004). Beginning late in the 19th century as strength tests, tests of track and field and anthropometric measurements, they have increased in number and completeness with amazing rapidity (Burton & Miller 1998, Bruininks & Bruininks 2005). During to the relative objectivity of most of the skills on abilities measured, the development of tests in physical education has avoided many of the pitfalls that have been encountered by test builders in the mental disciplines (Duger et. al. 1999, Eurydice 2002, Flegel & Kolobe 2002).

Motor abilities of children depend on motor development which means the development of control over bodily movements through the coordinated activity of the nerve centers, the nerves and the muscle (Smits-Engelsmann et al 1998, Simons & Van 2003). This control comes from the development of the reflexes and mass activity present at birth (Gallahue & Ozmun 2006; Darrah et al 2007; Peerlings 2007). After five years of chronological age, major development takes place in the control of finer coordinations, which involve the small muscle groups used in grasping, throwing and catching balls, writing and using tools (Tieman et al 2005; Tripathi et al 2008).

The Bayley Scales of Infant Development, are norm-referenced (Bayley, 1969). The complete Bayley Scales consist of a mental scale (163 items), a motor scale (81 items), and a behavior record for social and attentional behaviors. Those using these scales can compare infants and toddlers from 2 months to 2.5 years to mental and motor norms.

Another well-known norm-referenced scale is the Denver Developmental Screening Test (Frankenbur & Dodds, 1967). This test can be used from birth to 6 years of age and assesses four areas:

1.Gross-motor performance (31 items)
2.Fine-motor performance (30 items)
3.Language development (21 items)
4.Personal-social skills (22 items)

A third well-known norm-referenced scale is the Gesell Developmental Schedules (Gesell & Amatruda, 1949). All these instruments are well standardized, but their motor scales are less reliable and valid than is desirable. In this sense they are useful but limited in the information they provide about motor development.

Since there were no other tests purporting to measure the motor ability of early childhood period, it was not possible to delve deep into its related literature.

1)OBJECTIVES:

The objectives of the study were divided into two parts:

1.1. to Construct & Validate the motor-Ability Test for the Early Childhood Period;
1.2. to develop the appropriate age-related norms and scores for comparisons for those who choose to utilize the proposed testing protocols in the future and.

2)DESIGN AND METHODOLOGY OF THE STUDY

The whole study was finished in two phases. The first phase was related to construct & standardize the preliminary motor test battery. The second phase of the study was to develop age related norms, by using the appropriate statistical techniques.

2.1. Construction of the Test;

The purpose of this part was to develop a preliminary motor test battery and a protocol for each of the tests that were representative of the tasks performed by the children.

The details of the procedure are described in the order given below:

2.1.1. Procuring Consent from Parents/guardians;
2.1.2. Sampling;
2.1.3. Procedure;
2.1.4. Motor-Ability Components;
2.1.5. Experimental Test Items;
2.1.6. Method of execution of each motor skill.
2.1.1 Procuring Consent from Parents/guardians:

Since all the subjects of the proposed study were children belonging to early childhood period i.e. from 2 to 6 years of chronological age. Hence they were not in a condition to give their consent, that's why the informed consent was obtained from all children's parents or legal guardians for participation in our study.

2.1.2 Sampling:

It is one of the most important aspects of the methodology followed in an investigation. The sample for the present study was young male children of +2 to 6 years of chronological age. All the children were randomly obtained from Day-care Centers, Nursing Schools, Play-way Schools, Health Clinics especially pediatrics. The sample was divided into two phases:

1) Construction and Standardisation of the Test; and
2) Development of Norms for each age group.

(1)At the outset, sample was recruited randomly for the construction and standardisation of the test only. No grouping of children was made during this phase. The sample for this phase was 400, selecting roughly 100 subjects for each age group, exposed to as much as 50 different motor skills. Then after taking the data, all the skills were factor analysed for the standardization phase.
(2)For the development of norms for the test, four separate groups of children were made:

(a) +2 years up-to 3 years;
(b) +3 years up-to 4 years;
(c) +4 years up-to 5 years;
(d) +5 years up-to 6 years.

The sample for the standardization of the test was 400 for each group.

2.1.3 Procedures:

Participants:- The participants for the first phase of the study i.e. 'Construction & Standardization Phase' study were 400 boys who ranged in chronological age between 2 to 6 years, and were tested during a 06 months period. Then after the elapse of another six months during which the data were factor analyzed for the standardization phase, the researcher again started collecting data for the second phase of the study i.e. the development of age related norms for the proposed study. One registered Physician had been hired to look-after the participant children during the tests.

2.1.4 Motor-Ability Components:

Following a review of related literature and consulting various other physical educators and pediatricians, seven components were identified and selected as appropriate measures for use in a general motor-ability test battery for boys of the 2 – 6 years of chronological age. The seven components selected were: (1) Cardiovascular endurance; (2) Muscular endurance; (3) Speed; (4) Flexibility; (5) Power; (6) Agility; and (7) Balance.

2.1.5 Experimental Test Items:

Fifty experimental test items were selected to measure the seven identified components of motor-ability.

3) ANALYSIS AND INTERPRETATION OF DATA

The present study intends to construct and standardized the general motor-ability test for early-childhood period. The dependability and generalizability of the findings of any research study, to a large extent, are determined by the techniques used for analysis and interpretation of data.

The data collected were subjected to advanced statistical techniques, such as Factor Analysis which have been used in this study to decipher the behavior of numerical date concerning attributes to motor-ability test. The Pearson-product-moment technique was used to inter-correlate the scores from the 50 test items. The resulting co-relational matrix was used to factor analyze the data using the principle axes method with the varimax criterion for rotation. The factor analysis yielded seven factors with Eigen values above 0.5.

Given our premises, we investigated the four different age groups of subjects and using both first-order and second-order factor analyses and several factor rotation strategies. The four age cohorts we considered were: (a) children 2 to 3 years of age, (b) children 3 to 4 years of age, (c) children 4 to 5 years of age and (d) children 5 to 6 years of age.
Methodology: Information from the data sheets was entered into Microsoft Excel XP. Data from the field activities done by children were analyzed and descriptive statistics were computed using an SPSS statistical package (Version 10) to factor analyze the test items and to determine the mean, and SD for each test

variable.

4) DEVELOPMENT OF THE TEST BATTERY FOR THE STUDY

The test items were selected to be included in the test on the basis of results obtained from the factor analysis to serve as the criteria to measure the general motor ability of boys of early childhood period ranging from two years to six years of age. In this connection, the size of the tests factor loading was examined on its primary factor loadings as well as on how pure the test was measuring the factor indicated by near-zero loadings on the factors covered better by the other factors.
The criteria considered for developing the test were as follows:

i)Objectivity and reliability co-efficient of the selected test items.
ii)Rotated factor loadings of variables.
iii)Communality of the variables.
iv)Significant T-values.
v)Identified component of motor-fitness with respect to the selected test items.

Considering the administrative feasibility logistic and educational application following motor fitness test is recommended for the boys belonging to early childhood period.

Table 3: Constructed & Validated Motor Ability Test for Boys.

Factor	Test Item	Loading
I	Standing Broad Jump	.724
II	10-yards Crawling	.784
III	Sit and Reach	.758
IV	Bass Stick Test (Length wise)	.881
V	Kraus-Weber Floor Test	.718
VI	Over-Arm Hanging	.729
VII	300-Meter Run/Walk	.721

This test battery would consist of the most valid measure of the seven factors identified.

Preceding test battery is easy to administer with high reliability and need no complicated equipment to use. All the tests in the battery are easy to understand both by the administrators as well as children. Children do need extra attention and explanation along-with the specific demonstration, sometimes, is part and whole method.

5)METHOD TO EXECUTE TEST ITEM OF THE STUDY:

5.1. STANDING BROAD JUMP:

Instructions: The student assumes a starting (semi-crouched) position behind the take-off line with feet approximately shoulder-width apart. When ready, the student takes off on two feet and jumps as far as possible. Students should be encouraged to swing their arms and flex their legs at the knees in preparation for the jump. The distance is measured from the point where the body touches nearest the take-off line to the take-off line. Three consecutive trials are permitted.

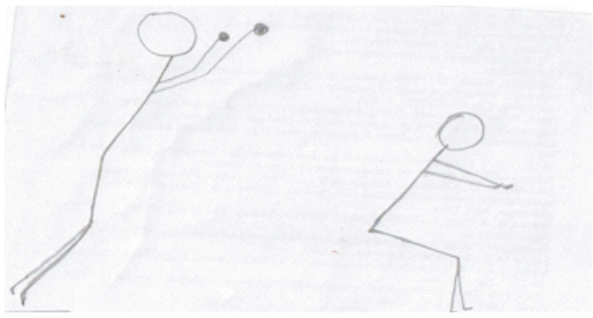


Figure-1 Standing Broad Jump

Equipment Needed: Measuring tape (12'), tumbling mats for use on hard surface or jumping pit for outdoor use, marking tape.

Scoring Procedures: The distance jumped on the best of the three trials is recorded to the nearest inch.

Organizational Hints: The test administrator should be kneeling in the landing area in order to be able to accurately mark the distance jumped. An assistant to help record scores is beneficial. If mats are used, students not being tested should be positioned on the corners to keep the mat from sliding on the floor.

5.2. 10 YARDS CRAWLING

Instructions: The child assumed a standing position on the signal to start, the child moved to a squat position then moved onto a front learning rest position, then on the signal "Go", he started moving on one's hands and knees, and tried to cover the distance of 10-yards as fast as possible.

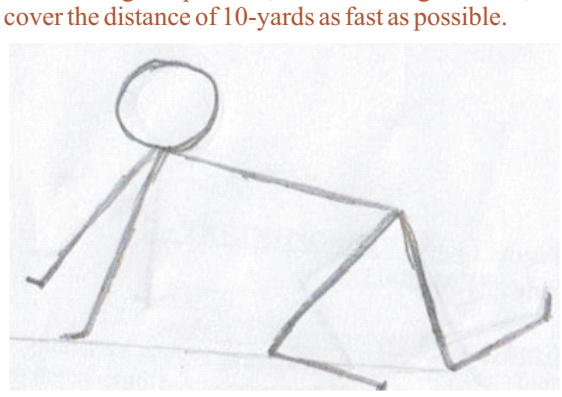


Figure-2 10-yards Crawling

Equipment Needed: Stopwatch.

Scoring Procedures: The amount of time elapsed between the start and the moment the child crossed the finish line was the recorded score. Time was reported to the nearest tenth of a second.

Organizational Hints: The researcher positioned himself at the finish line and simultaneously lower the arm from a raised position and shout "Go" to signal the start. Using an assistant to record the time (to the nearest tenth of a second) allowed more efficient test administration.

5.3. SIT AND REACH:

Instructions: The child sat comfortably on the floor with shoes off, legs fully extended, and feet shoulder-width apart and flat against the sit-and-reach apparatus. Arms are extended from the body over the measuring scale with hands placed one on top of the other with finger pads on top of fingernails. The child reached directly forward sliding along the scale four times and held the position of maximum reach on the fourth trial.

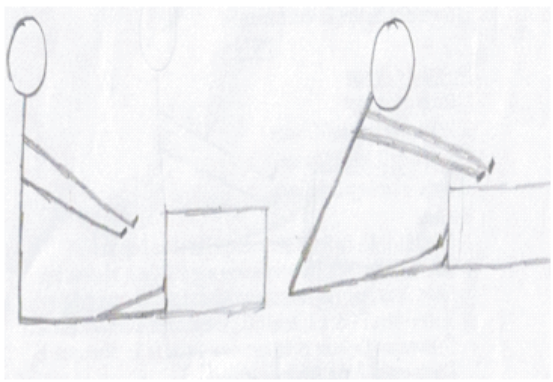


Figure-3 Sit and Reach Test

Equipment Needed: The sit-and-reach apparatus (solid box, 12 inches tall and 9 inches long). Measuring scale is marked on top of box with 9 inch mark at far end and zero inch mark at end near the child.

Scoring Procedure: The most distant point reached on the fourth trial was recorded to the nearest centimeter as the child's score.

Organizational Hints: The test administrator placed his hands on the child's knees to prevent flexing during the test. If there was a discrepancy in the student's movement, the test was repeated.

5.4. BASS STICK TEST (LENGTHWISE)

Instructions: The child was instructed to place the ball of the dominant foot lengthwise on a 1"x1"x12" stick. On the signal to "Go", the child lift the other foot off the ground, holding his balance as long as possible to a maximum of 60 seconds. The stopwatch was stopped when the opposite foot or any part of the support foot touched the floor. The test was completed three times on each leg for a total of six trials.

Figure -4 Bass Stick Test

Test Area: Any smooth, flat area away from a wall was suitable for administration of this test.

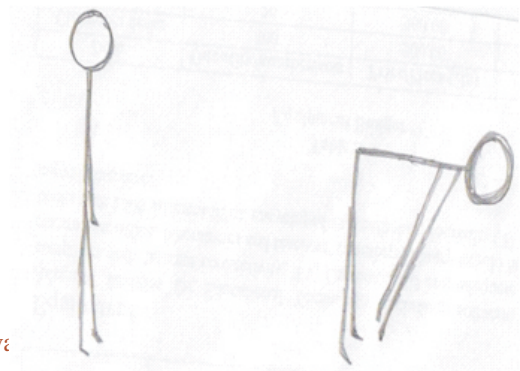
Equipment Needed: Stopwatch; tape on other adhesive material to secure stick to floor; 1"x1"x12" stick.

Scoring Procedure: The sum of the three best trials was recorded (in seconds) as the child's score.

Organizational Hints: Children who lost their balance during the first three seconds of the test were retested without penalty.

5.5. KRAUS-WEBER FLOOR TOUCH

Instructions: The child assumed a standing position with feet together. Shoes were off. Arms were hanging comfortably by the sides. Using static movement and not flexing the leg at the knee, the child bent forward and down, attempting to touch the floor with the tips of the figures and to hold this position for three counts.



Equipment Needed: Stopwa

Scoring Procedures: If the floor-touch position was held for the full three seconds, the child received 10 points. If the floor was not touched, 1 point was subtracted for every inch between the floor and the child's out-stretched fingers.

Organizational Hints: As with the sit-and-reach, the researcher had to hold the legs straight to prevent the child from flexing at the knee.

5.6. OVER-ARM HANGING

Instructions: The child grasped the bar with palms facing forward (away from the body). Spotters raised the child's body off the floor and helped him to grasp the ban. Feet should be free from the floor with legs straight and body held still throughout the duration of the test. The child held the position as long as possible.

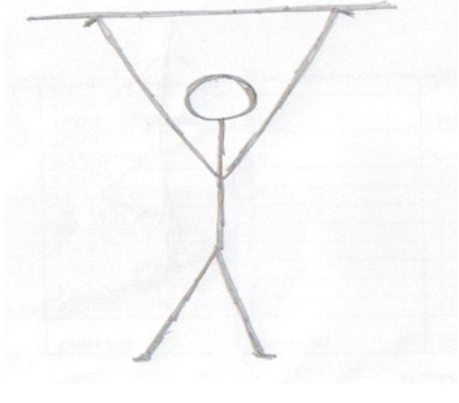


Figure-6: Over Arm Hanging Test

Test Area: An uncluttered area free of potential sources of accidents (e.g., chairs, walls).

Equipments Needed: A horizontal bar approximately one inch in diameter. This bar was adjustable to accommodate the tallest child to be tested.

Scoring Procedures: The score was the number of seconds (to the nearest second) the child held the over-arm hanging position, in one trial only.

Organizational Hints: The height of the bar was adjusted to that it was six in clues farther from the out-stretched hands of the child. Spotters were positioned in front of and behind the performer. The timer started the stopwatch as soon as the child was from both the spotters assistance and assumed the out-stretched over-arm hang position. Children were encouraged to remain motionless throughout the entire test. Raising of knees and kicking in the air was not allowed.

5.7.300-METERS RUN/WALK

Instructions: Children were instructed to run/walk 300 meters distance as fast as possible. Children began on the command "Ready, Start". Only one trial was permitted.

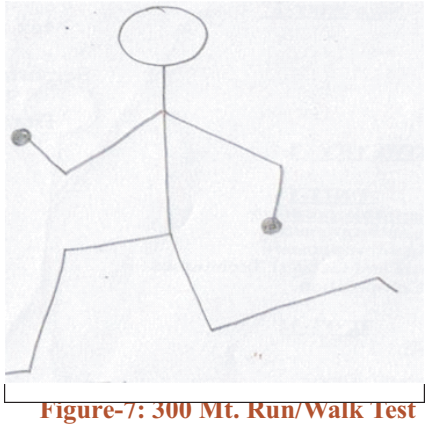


Figure-7: 300 Mt. Run/Walk Test

Equipment Needed: Stopwatch and boundary markers for the running area.

Scoring Procedures: The time taken to cover the 300 meters distance was recorded in minutes and seconds.

Organizational Hints: Instruction emphasizing pacing and practice preceded test administration. Administering the test under hot, humid, or windy conditions was avoided.

6)VALIDITY, RELIABILITY AND OBJECTIVITY OF THE STUDY:

6.1 Validity:

Factor analysis has revealed validity co-efficient ranging from 0.58 to 0.95 with the mean of 0.77. Content validity was established by expert judgment. Construct validity was determined by factor analysis of the seven test variables performed by the standardization population.

6.2 Reliability:

Synonyms for reliability include consistency, repeatability, and precision. A systematic observation system should possess reliability so confidence can be placed in the collected data. Following forms of the reliability were taken to make the test reliable.

6.3 Inter-rater Reliability of the Test:

The Kappa agreement for each item of the constructed test is shown in table below at $p<0.0001$. The Kappa agreement for the test total point was 0.86

Table-4: Inter-rater agreement values for 7 variables motor ability test.

S. No.	Test variables	Kappa agreement p<0.0001 (n=400)
1.	Standing Broad Jump	0.77
2.	10-yards Crawling	0.76
3.	Sit & Reach	1.00
4.	Bass Stick Test (Length wise)	0.87
5.	Kraus-Weber Floor Touch	0.92
6.	Over-Arm Hanging	0.85
7.	300-Mt. Run/Walk	0.86

6.4 Inter-Item Agreement of the study:

Internal consistency of the items on the test was assessed using Cronbach's alpha (1951) and McDonald's (1985) omega calculation.

The Cronbach's alpha reliability coefficients for scores on the seven variables are given in the table below:

The test's overall internal reliability coefficient of 0.89 (Cronbach's alpha) and 0.96 (Mc Donald's Omega) highlight the strong inter-item agreement among the items on the instrument. The omega results also support the validity and generalizability of scores on the variables that comprise the test.

Reliability and Objectivity of the test are presented in table below:

Table-6: Objectivity and Reliability of Correlation Co-efficient:

S. No.	Test Variables	Objectivity (M=0.80)	Reliability (M=0.83)
1.	Standing Broad Jump	0.79	0.76
2.	10-yards Crawling	0.82	0.79
3.	Sit & Reach	0.87	0.88
4.	Bass Stick Test (Length wise)	0.81	0.89
5.	Kraus-Weber floor Touch	0.74	0.84
6.	Over-Arm Hanging	0.71	0.85

Summary:

At the end, a test that produces reliable and valid scores has been developed with the following scores:

(1)	Validity	:	0.77
(2)	Reliability	:	0.83
(a)	Inter-rater reliability (Kappa Agreement)	:	0.86
(b)	Inter-item reliability (Cronbach's Alpha)	:	0.89
(3)	Objectivity of the test	:	0.80

7)DEVELOPMENT OF NORMS FOR THE STUDY

No test is applicable without its norms. The development of norms was, but natural, one of the objectives of the study. In the present study percentile norms have been developed for the children pertaining to early childhood period on the basis of their age (2-6 years).

Below are given the percentile norms for each age group:

7.1. PERCENTILE NORMS FOR 2-3 YEARS AGE GROUP

	Standing Broad Jump	10-yards Crawling	Sit & Reach	Bass Stick Test	Kraus-Weber Floor Touch	Over Arm Hanging	300 Meters Run/Walk
Mean	12.4	32.23	2.74	15.33	5.44	7.33	260.5
SD	3.18	4.14	1.37	7.12	1.7	3.15	42.9
Range	8-20	19-44	0-9	0-41	2-10	1-14	180-309
P_{90}	11.16	14.7	2.46	13.8	8.5	12.05	170
P_{80}	9.92	16.24	2.19	12.26	7.82	10.11	190
P_{70}	8.68	19.8	1.91	10.73	6.8	7.6	205
P_{60}	7.44	21.17	1.64	9.19	5.6	5.8	215
P_{50}	6.2	24.75	1.37	7.66	3.09	4.8	227
P_{40}	4.96	26.15	1.09	6.13	2.74	3.9	240
P_{30}	3.72	29.28	0.8	4.6	1.63	3.07	257
P_{20}	2.48	31.43	0.54	3.06	1.08	2.8	263.4
P_{10}	1.24	33	0.2	1.53	0.54	1.07	287.5

7.2. PERCENTILE NORMS FOR 3-4 YEARS AGE GROUP

	Standing Broad Jump	10-yards Crawling	Sit & Reach	Bass Stick Test	Kraus-Weber Floor Touch	Over Arm Hanging	300 Meters Run/Walk
Mean	17.13	21.3	2.96	23.25	7.39	7.35	166.6
SD	4.19	4.75	1.63	10.57	1.53	3.31	33.21
Range	10-25	15-41	0-9	0-92	2-10	1-14	123-240.6
P_{90}	19.2	12.85	6	25.2	9.3	12.35	160
P_{80}	17.85	13.2	5.8	23.7	8	11.25	175
P_{70}	13.32	13.75	4.35	21.06	7.35	10.7	198.21
P_{60}	10.39	14.35	3.57	17.5	6.9	9.4	210.3
P_{50}	8.66	15.43	3.02	12.56	6.2	7.74	218.7
P_{40}	6.32	16.5	2.88	9.25	5.5	6.4	223.8
P_{30}	4.92	17.9	1.35	6.29	3.25	3.5	231.7
P_{20}	2.87	18.23	0.9	4.45	1.7	2.3	234.6
P_{10}	1.94	19.17	0.3	2.3	0.7	0.9	236

7.3 PERCENTILE NORMS FOR 4-5 YEARS AGE GROUP

	Standing Broad Jump	10-yards Crawling	Sit & Reach	Bass Stick Test	Kraus-Weber Floor Touch	Over Arm Hanging	300 Meters Run/Walk
Mean	31.62	19.05	6.1	69.25	8.6	7.42	139.07
SD	2.82	62	1.68	24.4	1.25	3.37	8.71
Range	26-37	13-23.6	2-9	28-144	5-10	1-15	123-162
P_{90}	33.5	16.3	6.49	67.32	9.92	10.43	140.32
P_{80}	27.8	17.75	5.35	65.2	7.74	9.3	144.2
P_{70}	22	18	4.5	62.3	6.05	8.75	146.7
P_{60}	18.71	18.52	3.66	60.8	5.35	8.2	150.8
P_{50}	15.31	19.21	3.05	55.25	4.75	7.32	154
P_{40}	12.64	19.85	2.44	52.15	4.1	5.45	157.7
P_{30}	9.48	21.6	1.83	50.45	3.75	4.25	158
P_{20}	6.32	22.8	1.22	43.75	3.2	2.15	159.1
P_{10}	3.16	23	0.61	39.61	2.75	1.26	160.2

7.4. PERCENTILE NORMS FOR 5-6 YEARS AGE GROUP

	Standing Broad Jump	10-yards Crawling	Sit & Reach	Bass Stick Test	Kraus-Weber Floor Touch	Over Arm Hanging	300 Meters Run/Walk
Mean	35.77	15.98	7.42	154.53	9.24	13.45	119.47
SD	4.94	1.71	1.04	25.17	0.73	8.99	16.26
Range	24--42	10.06-20.7	5--9	89-232	7—10	0.09--34	83.4-133.8
P_{90}	34.19	14.38	9.31	160.51	9.74	12.1	87.5
P_{80}	32.2	15.75	8.44	157.47	9.25	10.76	91.25
P_{70}	31.32	16.23	7.8	148.38	8.85	9.41	95.71
P_{60}	30.3	17.45	7.35	139.42	8.11	8.07	101.42
P_{50}	28.8	17.93	6.24	126.8	7.91	6.72	111.35
P_{40}	27	18.91	5.55	116.71	6	5.38	119.7
P_{30}	25.7	19.23	4.32	103.63	5.8	4.03	127.35
P_{20}	25	19.94	3.71	95.61	4.92	2.69	129.21
P_{10}	24.63	22	2.06	90.03	4.45	1.34	132.2

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