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ABSTRACT

The upper body muscular endurance of males and females 2-5 years of age was assessed, and relationships relative to sex, age, endurance and selected anthropometric measures were investigated. None of the relationships were found to be of practical predicative value; while upper body muscular strength increased with age, no significant differences between total sample sex or sex within each group were found. Height and weight were determined not to be of practical predictive value in upper body muscular endurance performances. (JD)

Upper Body Muscular Endurance Among Children 2-5 Years

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Running Head: Muscular Endurance

Abstract

Upper body muscular endurance, using the straight-arm hang, was assessed in 232 males and females, 2-5 years of age. Reliability for the straight-arm hang trials ranged from .86 to .99 for sex and .94 to .99 for the four age groups. Weight, height and age measures increased in chronological order and were significantly ($p < .01$) different between groups. Endurance increased with age; 2 and 3 year olds not significantly different ($p > .05$), but the 4 and 5 year old groups were significantly different ($p < .01$) from each other and the 2 and 3 year old groups. Group x sex ANOVA revealed no significant ($p > .05$) difference in endurance between total sample sex or sex within each group. Correlation analysis also revealed that height and weight were not practical indicators of upper body muscular endurance.

Upper Body Muscular Endurance Among Children 2-5 Years

Traditionally, spring dynamometers or cable tensiometers have been used to assess strength and endurance in children. The most widely used instrument has been the grip dynamometer which has been reported as a total, as well as isolated strength indicator. The assessment of muscular endurance in children, especially those under six years of age is critically lacking in the literature. Gabbard, Kirby and Patterson (1979) have proposed an alternative instrument, the straight-arm hang, to assess upper body muscular endurance among children 3-5. The authors secondary objective was to determine the muscular endurance characteristics of children in relationship to movement on play apparatus (the horizontal ladder). The researchers investigated the use and reliability of the straight-arm hang among 135 males and females ranging in age from 24 to 71 months. The authors reported reliability coefficients (intraclass correlation coefficient technique) of .68 for the 2 year olds, to a quite acceptable .95 for the 5 year olds. Gabbard and Patterson (1979) while investigating the relationship and comparison of selected anthropometric measures to muscular endurance and strength in 103 three to five year olds, reported reliability coefficients of .95 to .99 for straight-arm hang trials.

Elkus and Basmajian (1973) studied electromyographic activity while adults hung by their hands and reported the pectoralis major, finger flexors, wrist extensors and wrist flexors as actively involved. In 1975 Brantner and Basmajian reported the existence of a substantial training effect on performance of the straight-arm hang. The investigators proclaimed the task as an upper body endurance activity and reported muscle fatigue as a significant performance factor. Gabbard and Patterson (1979a) found that grip style (thumb under or thumb over the bar) did not significantly affect hang performance among adult gymnasts. The authors also revealed a test-retest coefficient of .91 for the two grip styles. In light of the above findings, the straight-arm hang test was assumed to be a valid and reliable assessment of upper body muscular endurance among children and adults.

Thus, the purpose of this study was (a) to assess the upper body muscular endurance of males and females 2-5 years of age, and (b) to compare and investigate relationships relative to sex, age, endurance and selected anthropometric measures.

Subjects

Subjects were 223 males and females ranging in age from 24 to 71 months. Participants were randomly selected from three sources: private day care centers, public school and the Texas A&M Child Movement Center. Scores were collected and compiled according to sex and age range group (months): 24-35, 36-47, 48-59, and 60-71.

Instrumentation and Procedure

The hanging rack was constructed as described by Gabbard, Kirby and Patterson (1979). A digital .01 sec stop clock (Lafayette Model #54015) and micro switch imbedded in the 1.27 cm diameter hanging bar, were used for timing the length of the hang. Three trained individuals conducted the assessment process. One individual weighed and measured for height, while another lifted the subject up to, and made needed adjustments at the bar. A third person controlled the clock and recorded the scores. Each subjects' arms and hands were extended overhead to estimate ground clearancd for the feet, which was designated to be no less than 6 inches. Time started (micro switch wire across bar) when the assistant took support away from the subject after the lift up and terminated when one or both hands were released from the bar. Subjects were instructed and hands adjusted so that the thumb was gripped under the bar.

A standardized motivation technique was employed to interest the subjects and attain optimum performance. The instrument was referred to as the "Gorilla Machine". Pre-trial conversation was directed around the strength of a gorilla and how the subject might exert a similar performance. During the trial, the tester restated to the subject every 5 sec, "hang on, don't give up!" An interval timer (Lafayette Model #52011) with visual signal, was used to control pauses between motivational statements (5 sec interval with 2 sec lag for statement). Subjects were tested in group fashion to increase the possibility of maximum effort, as revealed in a previous pilot study using other subjects.

The investigation took place on Monday, Wednesday, and Friday of the same week. The first session was used as a practice period to familiarize the subjects with the instrument, procedures, and record weight, height, age, and sex. A single trial was given during each of the remaining two sessions and the highest score (maximum hang) used in the analysis. Parents and institutional authorities were presented a memo explaining the experiment and asking not to allow play apparatus activity prior to each session.

Results and Discussion

Mean values and reliability information are presented in Table 1. An intraclass correlation coefficient technique (Safrit, 1973) was utilized to calculate reliability for hang-time trials by group and sex.

Insert Table 1 about here

Coefficients ranged from .86 to .99 for sex and .94 to .99 for groups. The total sample reliability coefficient was .98. These correlations supported the assumption for consistent individual trials.

Results of the ANOVA and Duncan's multiple range test revealed that weight, height and age means increased in chronological order and were significantly ($p < .01$) different between groups. Maximum hang performance measures increased with age. The 2 and 3 year old groups were not significantly different ($p > .05$), but the 4 and 5 year old performances were significantly different ($p < .01$) from each other and the 2 and 3 year olds. A Group x Sex ANOVA revealed no significant ($p > .05$) differences on maximum hang performances between total sample sex or sex within each group. It might be noted however that the females were lighter and their maximum hang performances were greater than males in all but the 5 year old group.

Table 2 represents correlation information for key variables.

Insert Table 2 about here

Even though there were a number of significant correlations, the authors felt that none of the relationships were of practical predicative value.

In conclusion, upper body muscular endurance, as assessed by using the straight-arm hang, increased with age among children 2-5 years; the increase was significant between all groups except the two and three year olds. There were no significant differences between total sample sex or sex within each group on maximum hang performances. Height and weight were determined not to be of practical predicative value in upper body muscular endurance performances.

Table 1

Mean Values and Reliability Information for Groups and Sex

Age Groups (mo)	Sex	N	Age (mo)	Height Mean ± SD (cm)	Weight Mean ± SD (kg)	Max. Hang Mean ± SD (sec)	Initial/Retest Endurance Tests R
24-35		42	31.0 ± 3.2	90.4 ± 6.9	13.7 ± 1.8	41.5 ± 26.1	.99
	F	15	30.1 ± 3.4	86.8 ± 5.5	12.8 ± 1.5	43.3 ± 24.5	.99
	M	27	31.4 ± 3.1	92.4 ± 7.0	14.2 ± 1.7	40.5 ± 27.3	.99
36-47		73	42.1 ± 2.5	97.4 ± 4.5	15.0 ± 1.6	42.8 ± 18.7	.94
	F	35	42.0 ± 2.4	98.0 ± 5.0	14.7 ± 1.8	43.4 ± 21.5	.99
	M	38	42.3 ± 2.6	97.8 ± 4.1	15.2 ± 1.3	42.2 ± 16.1	.86
48-59		53	53.8 ± 3.0	106.5 ± 5.3	18.0 ± 2.5	68.1 ± 27.7	.95
	F	25	53.4 ± 1.9	105.0 ± 4.7	17.1 ± 2.5	68.5 ± 29.0	.94
	M	28	54.2 ± 3.8	107.9 ± 5.6	18.7 ± 2.3	67.9 ± 27.2	.95
60-71		55	64.6 ± 2.4	111.5 ± 6.1	20.0 ± 1.9	85.3 ± 26.5	.97
	F	32	64.9 ± 2.5	111.2 ± 6.3	19.4 ± 1.7	79.9 ± 22.4	.95
	M	23	64.3 ± 2.4	112.0 ± 6.0	20.8 ± 2.1	93.0 ± 30.3	.98
Total		223	48.4 ± 12.3	101.9 ± 9.5	16.7 ± 3.1	59.1 ± 30.4	.98

Table 2

Correlation Information for Height, Weight and Endurance

Group (mo)	Sex	N	Maximum Hang / Height	Maximum Hang / Weight
24-35	F	15	-.52**	-.59**
	M	27	-.08	-.14
	Total	42	-.20	-.27
36-47	F	35	-.31	-.21
	M	38	-.29	-.34**
	Total	73	-.30**	-.26**
48-59	F	25	-.35	-.48**
	M	28	.08	.03
	Total	53	-.11	-.22
60-71	F	32	-.22	-.23
	M	23	-.18	.01
	Total	55	-.18	-.00
Total		223	.37*	.37*

Significant

* .01

** .05

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