Discussion on further studies to measure and evaluate fitness and motor performance for preschool children; summary and previous studies in Japan and future consideratin

Review

Discussion on further studies to measure and evaluate fitness and motor performance for preschool children; summary and previous studies in Japan and future consideratin

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This article discusses and summarizes previous studies dealing with fitness and motor performance in preschool children from the viewpoint of measurement and evaluation, and determines topics for further studies. The studies reviewed in this article were mainly published in the "Japan Journal of Physical Education, Health and Sport Sciences" (edited by the Japan Society of Physical Education, Health and Sport Sciences), and the "Japanese Journal of Physical Fitness and Sports Medicine" (edited by the Japanese Society of Physical Fitness and Sports Medicine). The element of endurance should be included in the structure of fitness and motor performance in preschool children, as has been done in some studies of cardio-respiratory functions in preschool children. Further examinations are needed to validate the structure and to explore new elements. Considering that the measures obtained from one test are influenced by plural elements of fitness and motor performance, some multivariate analyses, such as factor analysis, would be useful to describe and quantify the pure elements. A test battery by maximal exertion by the subjects has been utilized in many previous studies, and the tests are applicable to measurements in both research and practical fields because validity, reliability, objectivity and practicability were examined, and the norms are published. However, studies for the availability of pass or fail test are necessary in the future. In general, periodic studies examining the conclusions of previous studies on the structure of fitness and motor performance, age and gender differences, and the related factors for preschool children are needed because the environments influencing preschool children vary from year to year.

Key words : preschool children, fitness, motor performance, studies in measurement and evaluation

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I Introduction

The decline in childhood physical fitness and motor performance and the rise in childhood obesity have recently been brought up as social problems. It is considered that the decrease in opportunity to exercise because of changes in exercise environment and in lifestyle is related to this tendency as well as to improper eating habits typified by overeating. As the clue to the solution, it is assumed to be appropriate to describe characteristics of childhood physical fitness and motor performance in preschool children, who are in the early

stages of their development process, by using proper methods for measurement and evaluation.

Physical characteristics unique to preschool children, and the continuity, relevance and difference between childhood and other developmental stages have been studied in the research area of physical education, health and sports science, and physical fitness and sports medicine, as well as the medical science which investigates human beings, because physical characteristics of preschool children are different from those of adults. At the same time, when comprehending and describing the physical characteristics of preschool children, it has been an important issue to establish an effective method to measure and evaluate them because the process, taking into account the characteristics of preschool children, is indispensable.

In respect to physical fitness and motor performance in preschool children, the variety of gross motor functions using large muscles increases, and characteristics different from those of other developmental stages, such as age and gender differences, are observed uniquely in preschool children in relation to motor tasks to be achieved, physiological functions and anthropometrical characteristics. Therefore, studies up to the present have been performed on physical fitness and motor performance in preschool children with various viewpoints, not exclusively in the study area of measurement and evaluation, and substantial data have accumulated. However, the results from previous studies, which vary in study areas, attributes of subjects, methods applied and terms to collect data, have not been fully classified and comprehended yet. It is necessary to classify the study results of the past on physical fitness and motor performance in preschool children, to clarify the present state of studies in relation to measurement and evaluation of physical fitness and motor performance in preschool children and to determine topics for further studies.

Although the studies on physical fitness and motor performance in preschool children have accumulated data both domestically and abroad, these results may not be generalized because of biological differences such as race, socio-environmental differences such as culture, or differences in years of schooling and in educational content, even though the chronological age of preschool children who are subjects of the study is the same. Considering the fact that our study result will contribute mainly to the targeted preschool children and to the practical fields of preschool education, it is realistic and meaningful to clarify the present state and to determine topics of further study in relation to physical fitness and motor performance in preschool children through the classification of the results from previous studies in physical education and physical fitness and sports medicine particularly in Japan.

This article tries to classify the results of studies which target physical fitness and motor performance in preschool children and have been conducted in physical education and physical fitness and sports medicine in Japan to date, and to comprehend the present state and to determine topics for further studies from the viewpoint of investigating the structure of ability and the method of measurement and evaluation. Academic journals on physical education, nurse-care and education in Japan are reviewed as reference literatures, including the “Japan Journal of Physical Education, Health and Sports Sciences” edited by the Japan Society of Physical Education, Health and Sports Sciences and the “Japanese Journal of Physical Fitness and Sports Medicine” edited by the Japanese Society of Physical Fitness and Sports Medicine.

II Investigating the structure of physical fitness and motor performance

Table 1ab shows the summarized list of previous studies on physical fitness and motor performance in preschool children published in academic journals such as the “Japan Journal of Physical Education, Health and Sports Sciences” and the “Japanese Journal of Physical Fitness and Sports Medicine”.

The structure of physical fitness and motor performance, coordination and other relating abilities in preschool children has been investigated by conducting multiple field tests which were selected based on the hypothetical structure of the targeted ability, and by utilizing factor analysis on measured values.

Matsui et al. (1955) determined the structure of motor performance in their early study in Japan, selecting 21 items among the performance test items suggested by Oseretzky and Kano, conducting factor analysis according to the multiple factor theory by Thurstone. They tried

Table 1a List of Studies on Physical Fitness and Motor Performance in Preschool Children in "Japan Journal of Physical Education, Health and Sports Science" and "Japanese Journal of Physical Fitness and Sports Medicine"

Reference	Subjects	Measured Items	Results and Conclusions
Matsui et al. (1955)	225 Children of 4-6 Years of Age 569 Children of 7-9 Years of Age	21-55 Items Selected from Oseretzky Test of Motor Proficiency and Kano's Test of Motor Proficiency, Intelligence Test	Essential test items to measure motor performance were selected and the developmental state (pass rate, etc.) and gender difference in each test were investigated. The structure of motor performance in preschool children was shown by utilizing Thurstone's factor analysis. The relationship of motor performance and intelligence was examined.
Takeuchi et al. (1968)	212 Children of 5-6 Years of Age	13 Items to Measure Muscular Strength, Muscular Endurance, Power, Speed, Physical Coordination, Balance, Agility, and Flexibility	A valid test battery to measure motor performance was designed by utilizing factor analysis and the reliability of the test was proved at the same time. The structure of motor performance was examined by gender (5 factors for boys, 6 factors for girls).
Morishita (1968)	41 Children of 5.1-60.8 Months of Age on Average at Shifting Point	Height, Weight, Relative Growth Curve	The height-weight relative growth curve of developing children of 1 month to 6 years of age was presented. Two developmental stages in infants and characteristics at the shifting point were shown.
Katsube et al. (1970)	135 Children of 3-5 Years of Age	7 Items; One-foot Stand, Side Jumps, Standing Broad Jump, Sit and Reach, Continuous Hopping, Back Strength and Running Broad Jump	Change in motor performance caused by exercise (1-2 months, once/day) was examined. Exercise effect was observed on the whole. Effect on muscular strength was large for boys, while effect on balance and skill were large for girls.
Munetaka et al. (1971)	532 Children of 4-5 Years of Age （Isolated Island, Housing Complex and City）	12 Items to Measure Muscular Strength, Muscular Endurance, Balance, Physical Coordination, Speed, Agility, and Flexibility, Family Make-Up, Academic Background, and Occupation	Regional difference (isolated island, housing complex and city) in motor performance and the influence by the difference of living conditions were examined. Regional characteristics were observed relating to motor performance according to items. Preschool children in city exceed those in island and housing complex on yearly development.
Ohyama (1974)	43 Boys (58.1 Months of Age on Average) 41 Girls (57.8 Months of Age on Average)	Height, Weight, Chest Girth, Sitting Height and 33 Items relating to Inheritance, Natural Environment, Family Environment, Rearing Environment and Nutrition	Congenital and acquired factors essential for preschool children's development were examined. Highly relevant factors were shown by gender and as a whole.
Matsuura and Nakamura (1977)	259 Boys of 4-8 Years of Age	10 Items; Grip Strength, Back Strength, Vertical Jump, Timed Dipping, One Leg Beam Balance, Trunk Extension, 25 Meter Dash, Continuous Jumping, Standing Broad Jump and Tennis Ball Throw for Distance	Developmental characteristics of fundamental motor ability were investigated. The proportion of fundamental motor ability in motor performance had a tendency to decrease with age. Motor performance development changed to gradual differentiation from undifferentiated state. Influence of physique and age decreased with age.
Nakamura and Matsuura (1979)	557 Children of 4-8 Years of Age	10 Items; Grip Strength, Back Strength, Vertical Jump, Timed dipping, One Leg Beam Balance, Trunk Extension, 25 Meter Dash, Continuous Jumping, Standing Broad Jump and Tennis Ball Throw for Distance	Developmental change in fundamental motor ability was examined taking gender difference into account. Boys excel girls in fundamental motor ability at every age group. Elements of fundamental motor ability differ by gender (4-6 years of age).

Table 1b List of Studies on Physical Fitness and Motor Performance in Preschool Children in "Japan Journal of Physical Education, Health and Sports Science" and "Japanese Journal of Physical Fitness and Sports Medicine"

Reference	Subjects	Measured Items	Results and Conclusions
Kishimoto and Baba (1980)	349 Children of 4-6 Years of Age	39 Items to Measure Balance (6 items), Body Exercise (14 items), Manual Exercise (9 items) and Reverse Action of Arms or Legs, and Imitating (10 items)	Growth tendency and gender difference in motor function were cross sectionally examined using pass-or-fail decision. The pass rate (4-6 years of age, 6 months interval) of 39 tasks was shown and age-related growth tendency was classified into 7 patterns.
Aoyagi et al. (1980)	234 Children of 3-6 Years of Age	20 Items to Measure Balance Coordination	The structure of coordination involved in balance was investigated and proper test items were selected. Nine factors were extracted by utilizing factor analysis and a test battery was designed. Three test items were shown to multilaterally measure coordination involved in balance.
Imanaka et al. (1981)	57 Children of 5 Years of Age 109 Children and College Students of 9-21 Years of Age	Running Test of 4 Types with 7 Items based on 25 Meter Dash, Restraint Coefficient for Run	The structure of running defined by running motor performance was analyzed from the stand point of class factor model. A factor of "general running ability" was extracted both in college students and preschool children, while the influence of the factor on the whole distribution was larger in adults.
Aoyagi and Matsuura (1982)	539 Children of 3-6 Years of Age	26 Items Selected based on Gallahue's Hypothetical Classification	Referring to Guilford's SI model and Ikai's three-dimensional development model, the structure of motor performance in preschoool children was examined. The space of motor performance was characterized by 3 axes of physique, coordinatiion and flexibility. Ten areas of motor performance were interpreted by cluster analysis.
Murase and Demura (1990)	192 Children of 4-6.5 Years of Age	12 Items of Motor Performance Tests 14 Items of Pass or Fail Tests	The structure of motor performance (5 factors) was investigated utilizing factor analysis. Validity of relative norms in pass-or-fail tests was examined from the relationship of motor performance tests and pass-or-fail tests, and the effectiveness of a test battery composed of pass-or-fail tests was reported.
Goshi and Demura (1992)	3,683 Children of 2.5-under 7 Years of Age	6 Items of Motor Performance Tests 37 Items of Behavior Observation Tests	Objectivity, reliability and validity of motor performance tests based on behavior observation were examined. Elements of motor performance were investigated by each area of locomotion, manipulation and stability. Test batteries of 16 items and 19 items were proposed and evaluation criteria were formulated.
Demura (1995)	282 Boys and 258 Girls of 3.5-6.5 Years of Age	17 Items of Static Balance Tests, 7 Items of Dynamic Balance Tests	Composing factors of static balance and dynamic balance were investigated utilizing factor analysis. The factors were examined relating to developmental characteristics and gender difference, the development pattern of each factor, existence of gender difference and ages when gender difference increases were shown.
Goshi et al. (1999)	338 Boys and 373 Girls of 3-6 Years of Age	26 Items of Pass-or-Fail tests, 6 Items of Motor Performance Tests	The relationship between pass-or-fail tests decided by motor achievement and motor performance tests by CGS scale was examined and their correlation was shown. The degree of shared evaluation both in pass-or-fail tests and motor performance tests was investigated. The relationship of both tests was suggested to increase with age.
Otoki et al. (1999)	141 Boys and 139 Girls of 3-6 Years of Age	Anthropometry (Height, Weight, Chest Girth, Waist Girth, Hip Girth, etc.), Subcutaneous Fat Thickness of 14 Body Parts, Body Composition Measurement	Age and gender differences of subcutaneous fat distribution in Japanese preschool children of 3-6 years of age were examined. Girls showed higher values of subcutaneous fat thickness than boys at almost all 14 body parts. However, large gender and age differences were not observed in the distribution pattern of subcutaneous fat.

to extract composing factors of motor performance and suggested 5 factors (balance, power, physique, manual dexterity and unknown) as elements composing motor performance. Later, Takeuchi et al. (1968) conducted motor performance tests of 13 items in the process of establishing test battery. By utilizing factor analysis, they clarified the gender-segregated structure of motor performance, consisting of power, muscular strength (grip strength), body coordination, static balance and flexibility for boys and of muscular strength (grip strength), leg power, muscular endurance, balance, body coordination and flexibility for girls. Among the other studies which examined the structure of motor performance in preschool children by utilizing factor analysis, Murase and Demura (1990) reported that motor performance in preschool children of 4-6.5 years old is composed of five factors (power, flexibility, muscular strength, balance and muscular endurance) as the result of motor performance tests of 12 items. In addition, Goshi and Demura (1992) divided motor performance into three areas; locomotion, manipulation and stability, and investigated pattern factors of motor performance in each area, while proposing achievement tests of motor performance based on the behavior observation. Studies investigating the structure of motor performance in preschool children by using the pass rate (achievement rate) of pass-or-fail tests are limited in number and they set more composing factors characteristically than the structure of motor performance clarified by using general motor performance tests (Demura et al. 1992; Goshi et al. 1998).

Furthermore, Aoyagi and Matsuura (1982) tried to describe motor performance in three-dimensional variable space referring to the SI model (structure-of-intellect model) of Guilford and the three dimensional development model of Ikai. They reported that the space of motor performance was defined by three axes of physique, coordination and flexibility in motion range, and that the structure of motor performance is composed of ten areas demonstrated by cluster analysis.

Matsuura and Nakamura (1977) focused on fundamental motor ability as "one area of motor performance which is involved in the achievement of every motion as fundamental ability, and not on motor performance as a whole", from the viewpoint of growth and development. They investigated the structure of fundamental motor ability, its developmental change, and age difference in the proportion of fundamental motor ability in motor performance. The study suggested that the fundamental motor ability of children of 4-6 years of age is mainly composed of physique, static muscular strength and power of upper and lower limbs for boys, maturity, physique and static muscular strength for girls.

In addition, the structures of coordination, balance and running have been investigated. Higashiyama and Niwa (1993; 1995) reported the structure of coordination in children of 4-8 years of age. Aoyagi et al. (1980) reported the structure of coordination composed of nine factors which are involved in balance motion, aiming to establish a test battery. Demura (1995) elucidated the structure of static balance and dynamic balance, and examined developmental characteristics and gender difference in each composing factor, indicating that static balance is composed of seven factors whereas dynamic balance of three. Moreover, Imanaka et al. (1981) reported the factor structure of running in preschool children from the stand point of the class factor model proposed by Burt.

As described above, the structure of physical fitness and motor performance or related abilities in preschool children has been studied, providing the present foundation in measuring and evaluating physical fitness and motor performance in preschool children. However, the previous studies mentioned above do not include endurance as an element in the structure of physical fitness and motor performance.

Cardio-respiratory function in preschool children has been frequently studied in Japan, and the quantification of endurance in preschool children has been attempted since the 1970s (Yoshizawa et al. 1975; Yoshida and Ishiko 1978). For instance, age difference in maximal oxygen uptake (Yoshizawa and Honda 1979), and presence or absence of gender difference (Yoshizawa et al. 1980) were studied, and a method to measure the maximal oxygen uptake, which is an index of endurance, suitable for preschool children was devised and examined (Kobayashi et al. 1983). Thus, endurance has been considered to be one of the essential elements to comprehend physical characteristics of preschool children. The fact that many of the studies investigating the structure of physical fitness and motor performance in preschool children (Takeuchi et al. 1968; Aoyagi et al. 1980) were published before or around the same time as the existence of trainability was confirmed (Yoshida et al. 1980; Yoshizawa et al.

1990), and that thereafter the importance of endurance in preschool children has been primarily indicated, would be one of the reasons why endurance has not been included in the elements of physical fitness and motor performance in preschool children.

As for other reasons, they are considered to be ascribed to the fact that previous studies investigating the structure did not include endurance in the hypothetical structure which was referred to in selecting tests, and that a proper field test to measure endurance had not been invented. Future studies are expected to include endurance in their hypothetical structure. By combining a motor performance field test with the measurement of maximal oxygen uptake which is classified as a laboratory test, and by inventing a field test suitable for measurement and evaluation of endurance, it is also anticipated that comprehensive evaluation will be possible in investigating subordinate areas of physical fitness and motor performance in preschool children including endurance.

In recent studies, it has been suggested that some characteristics relating to physical fitness and motor performance in preschool children would change according to generation (Akimaru et al. 2001; 2002), although the study results on the structure of physical fitness and motor performance in preschool children are limited. It is inevitable to comprehend the ability structure of preschool children by utilizing objective methods such as multivariate analysis, just as in previous studies, when measuring and evaluating. The presence or absence of generational change in the structure of physical fitness and motor performance in preschool children of today should be checked periodically.

III Age and gender differences in physical fitness and motor performance

Among the studies on physical fitness and motor performance in preschool children, the number of studies examining growth and development and gender difference is relatively large (Table 1ab). Examining the pattern constituting physical fitness, Morishita (1968) reported a height-weight related growth curve in children ranging from one month to 6 years of age. Ohyama (1974) examined the factors involved in physical growth, separating congenital factors from acquired ones, and clarified the degree of involvement of each factor. In contrast, studies on body composition in preschool children have been published recently. Otoki et al. (1999) studied gender difference in each body part and age difference in the distribution pattern. It is assumed that at the background of the former two studies exists the influence of social environment in which enrichment and improvement of nutritional status were aimed, while the latter study reflects problems such as the lack of exercise and the rise of obesity caused by improper eating habits (overeating mainly). It is critical to establish an appropriate method in measurement and evaluation in order to solve the problems caused by environmental change. In respect to the anthropometrical characteristics which constitutes physical fitness, some examination from the viewpoints of both physique and body composition is considered to be necessary.

Relating to motor performance, developmental change in children ranging from 4 to 9 years of age and presence or absence of gender difference have been investigated according to the pass rate (achievement rate) of 52 items of motor tasks by using cross sectional data in early studies in Japan (Matsui et al. 1955). Among the motor tasks in which gender difference was observed, the pass rate was higher for boys than girls at every task except two including hitting with a ball. Similarly based on cross sectional data, Kishimoto and Baba (1980) examined developmental change and gender difference in children ranging from 4 to 6 years of age according to the pass rate of 39 items of motor tasks to measure four areas of balance, body exercise, manual exercise and reverse action of arms or legs and imitating, and showed seven patterns relating to age-related changes.

In respect to developmental change and gender difference in fundamental motor ability, the proportion of fundamental motor ability in motor performance, the decline in physique, the influence of increasing age and the tendency of developmental change to shift toward the differentiation from the undifferentiated status were investigated by determining the score of each factor with factor scores gained from factor analysis (Matsuura and Nakamura 1977). It is suggested that boys exceed girls in fundamental motor ability at every age (4-8 years of age) in regard to gender difference (Nakamura and Matsuura 1979).

Among the other studies, Demura (1995) examined balance in preschool children (3.5-6.5 years of age) and

reported differences in development pattern and gender in each factor which constitutes dynamic and static balance. It is suggested that each pattern of age difference in terms of dynamic balance factors is not the same and that girls excel boys at dynamic balance with the difference increasing after 5 years of age.

Aside from factor scores, presence or absence of age and gender differences in physical fitness and motor performance in preschool children can be comprehended from the average value determined through a motor performance test and the pass rate of each motor task based on a pass-or-fail decision. Although previous studies used both cross sectional data and longitudinal data, longitudinal data in particular should be utilized in order to comprehend and describe the characteristics of preschool children more accurately because age difference is significant in preschool children.

It is assumed that plural motor performance elements affect the result of each test which constitutes a physical fitness and motor performance test battery. Therefore, age and gender differences in the elements can be examined in the purer form by determining ability scores of each factor applying factor analysis. Given this, it appears effective to perform studies with similar methods in the future.

It has been pointed out that the difference due to the measured generation and time is observed in age and gender differences of physical fitness and motor performance in preschool children (Matsuda et al. 1975; Kondo et al. 1987b; Akimaru et al. 2001; 2002; Sugihara et al. 2004), although reporting studies on age and gender differences in preschool children at present tends to decrease. The degree of applicable knowledge acquired in previous studies is open to question when comprehending age and gender differences in physical fitness and motor performance in today's preschool children, because the difference between generations has been indicated. It is necessary to validate the evidence of difference in characteristics among generations in terms of age and gender differences in physical fitness and motor performance in preschool children, as well as to confirm the structure of motor performance, periodically.

IV Examination of a method to measure and evaluate physical fitness and motor performance

A test battery for measurement and evaluation based on the structure of physical fitness and motor performance mentioned above, mainly through field tests, has been examined and proposed from the viewpoints of reliability, validity, objectivity and practicability in terms of the method to measure and evaluate physical fitness and motor performance in preschool children. In contrast, Shibayama et al. (1982) proposed a physical fitness test for preschool children based on physical fitness and motor performance tests proposed before. However, the number of articles which tried to establish motor performance tests for preschool children is limited. Takeuchi et al. (1968) have investigated the structure of motor performance by utilizing factor analysis, selected effective tests which are assumed to represent each element (standing broad jump, grip strength, ball bouncing, trunk flexion, one-foot stand, spot stepping and timed dipping) and proposed a test battery through the examination of the reliability of each test.

In addition, a motor performance test battery has been proposed with the norms for measurement and evaluation by Matsuda (1961), Matsuda and Kondo (1965; 1968) and Matsui et al. (1955) in Japan. An early test battery included one leg beam balance, sit and reach, trunk extension, timed dipping, standing broad jump, softball throw for distance and 25 meter dash. This motor performance test battery has been conducted on a nationwide scale and the norms for evaluation have been updated regularly (Matsuda et al. 1975; Kondo et al. 1987a; 1987b; Sugihara et al. 2004). In terms of the evaluation method, an assessment chart of physique and motor performance (20 meter dash, standing broad jump and tennis ball throw for distance) taking age in months into account (Harada and Harada 1999) was presented as well as the method using the norms.

Aside from motor performance, a series of studies focusing on "coordination" have been observed. In fact, systematic studies have been conducted on coordination in preschool children by the Research Center in Physical Education Foundation over the years (Matsui et al. 1974; Matsui and Katsube 1975; Ishiko et al. 1987, etc.). Kurimoto et al. (1981) have published the coordination test of the Research Center in Physical Education, which is composed of three items; jump over and crawl under, side jumps and zigzag run, with the norm score of each test.

Other than these tests on the basis of maximum exertion

described above, methods to examine motor performance of preschool children based on pass-or-fail decision have also long been invented (Kano and Yoshikawa 1953a; 1953b). However, this kind of measuring method had not fully been discussed. Given this, the validity of a test to measure and evaluate motor performance in preschool children is investigated at present through pass-or-fail decision on each motor task which is frequently observed in daily motor behavior of preschool children. Murase and Demura (1990) examined the validity of a pass-or-fail test to assess whether a certain coordination movement or motion can be achieved or not from the viewpoint of criterion-related validity, and suggested the availability of a pass-or-fail test in measurement and evaluation of motor performance in preschool children. Goshi and Demura (1992) also presented a test battery and its norm, examining objectivity, reliability and validity related to each achievement test of motor task through behavior observation.

Moreover, the validity of a method to assess physical fitness and motor performance of preschool children through observing daily motor behavior in preschool life by kindergarten teachers or nursery school teachers, and not through measured values from practical tests, has been discussed. Daily motor behavior of preschool children can provide a lot of information to assess physical fitness and motor performance in preschool children, because free activities which are not seen at measurement, as well as a considerable number of achieved motions, can be easily observed. The correspondence of observed values and estimated values (Murase et al. 1995; 1997) and the validity of the evaluation method (Murase and Baba 1998) by using estimated ranks have been discussed, and it is suggested that careful attention is needed because validity and reliability differs according to tests and motor tasks.

As stated above, a test based on maximum exertion has been mainly administered when measuring and evaluating physical fitness and motor performance in preschool children. Concerning this kind of test, the norms based on a large scale of examples have been published and the availability in measurement and evaluation is considered to be high. Furthermore, utilizing laboratory tests combining clinical methods applied in the area of pediatrics seems not only to expand the applicable scope including the decision of presence or absence or early detection of disorder and scouting for athletic talent, but to improve the precision of measurement and evaluation.

Although availability is suggested in evaluation methods using pass-or-fail tests for preschool children, validity, reliability and objectivity of every pass-or-fail test has not been fully discussed yet because of the wide variety of tests. The number of studies on the validity of evaluation methods based on the observation of daily motor behavior is limited at present. Thus it is necessary to prepare guidelines on points to remember concerning motor tasks used in evaluation and estimated values of each test, and to accumulate study results for the practical application of establishing measurement and evaluation methods available not only for kindergarten teachers and nursery teachers who can observe motion scenes, but also for guardians such as parents.

Additionally, sufficient consideration is needed on elements involving measured values in order to measure and evaluate physical fitness and motor performance properly. Some previous studies have examined influences including presence or absence of exercise effect, inhabited area and kindergarten environment on physical fitness and motor performance.

Concerning the influence of exercise on motor performance, Katsube et al. (1970) examined exercise effect during 1-2 months (once a day) and reported that exercise effect on motor performance was observed in general and that the effect on muscular strength is larger for boys than girls but that the effect on balance and skill is larger for girls than boys.

Concerning the relationship between motor performance and area of habitation, Munetaka et al. (1971) reviewed regional difference, age and gender differences in motor performance and physique comparatively, targeting preschool children in isolated islands, housing complexes and urban districts. The study determined that regional difference exists in motor performance depending on test items, and suggested that the degree of one-year development is larger for preschool children living in urban areas than those in isolated islands and housing complexes. Other than this, a study to compare the motor performance of preschool children living in housing complexes with those in the surroundings was conducted (Matsuda et al. 1971). More lately a study was conducted by Nagado et al. (1996) on the present state of motor performance and coordination in urban kindergarten children who presumably have less opportunity to

exercise. There are other studies such as the comparison of motor performance between a kindergarten children and a nursery school children (Sugihara et al. 1987a) and a report on the influence of kindergarten environment such as the amount of play equipment and the width of a playground and a playroom (Sugihara et al. 1987b). These studies indicated the items which showed difference in motor performance between kindergarten children and nursery school children, which are two institutionally different facilities. On the whole, it is reported that the results for nursery school children are better than for kindergarten children. It is also suggested that facility environment has less influence in the development of motor performance.

In respect to the elements involved in measured values, the whole measurement and evaluation procedures, not just measurement and evaluation of physical fitness and motor performance in preschool children, should be examined sufficiently. Many of the studies on the influence of residential environment and kindergarten environment were published in the 1970's and 1980's. Follow-up studies with similar standpoints and future studies on relating factors which influence measured items are expected to be conducted hereafter, in order to precisely comprehend and describe the present physical fitness and motor performance in preschool children. As for the relationship of measured values and psychological characteristics when conducting physical fitness and motor performance tests for preschool children, there are a few studies including one examining the relationship with intelligence (Matsui et al. 1955) and another with personality (Kobayashi and Kondo 1963). Studies on the relationship with psychological characteristics of subjects, which are involved in measured values as an influencing factor, and on the interference of psychological state at measurement, are yet to come.

V Conclusion

As the result of discussing the present state and determining topics for further studies, by classifying the study results examining physical fitness and motor performance in preschool children in physical fitness and sports medicine as well as physical education, health and sports science in Japan, and by focusing on the investigation of the structure of motor performance and the method of measurement and evaluation, the following points were suggested as future topics.

Concerning the structure of motor performance, which should be comprehended when measuring and evaluating physical fitness and motor performance in preschool children, future studies are expected to look at confirmation of presence or absence of structural change affected by generation difference, and on the structure of motor performance including endurance, which has rarely been included as a component.

In respect to examination of age and gender differences, longitudinal data should be used for preschool children whose change in growth and development is enormous. When considering the fact that plural ability elements are involved in measured values of one test, it is assumed effective to examine the elements of each, utilizing multivariate analysis. The data and analyzing methods of proper kinds should be selected according to the purpose of the study.

Since a test based on maximum exertion has been frequently used to measure and evaluate physical fitness and motor performance in preschool children, validity, reliability, objectivity and practicability of the test have been examined and the norm of the test has been invented, which are utilized in many studies or in practical fields. In contrast, concerning the validity of pass-or-fail tests based on a pass-or-fail decision for each motor task and the effectiveness of evaluation based on the observation of daily motor behavior, study results aiming for practical use are anticipated including the formulation of guidelines which indicate important points in terms of motor tasks and estimated values of each test, and the establishment of the method of measurement and evaluation available not only for kindergarten teachers and nursery school teachers but also for guardians such as parents.

In conclusion, it is estimated that physical characteristics of preschool children, who are the subjects of measurement and evaluation, have been changing because the environment surrounding preschool children, who are the subjects of our measurement and evaluation, is constantly changing, the physical characteristics of these children may also be changing to no small degree as effects of these environmental changes. As future topics common to several themes including the structure of physical fitness and motor performance, the characteristics of age and gender differences, and the related elements

of preschool children, it is considered necessary to conduct follow-up studies periodically and to examine the changes through comparing the study results with those of previous studies.

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