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A Study on the Transition and Classification of Somatotyping

Experts of medicine, philosophy and psychology found that human somatotypes were related to personality or physical characteristics and classified somatotypes into various forms. This study explored the changes and types of somatotyping methods from Before Christ to present day and identified the status of studies of somatotypes in the area of physical therapy. This study covered the methods applied in various majors with a focus on those provided in books and papers of Heath BH. and Carter JEL.

Based on the results, there are officially twelve assessment methods. Currently, the method of Heath & Carter is most widely applied. Somatotypes are studied in many areas. It is actively explored in the area of pain physical therapy, thermotherapy and integumentary physical therapy. Also, the soft tissue physical therapy area seeks interdisciplinary studies.

This study found that there were various assessment methods in diverse areas. It is likely that continuous studies will develop new assessment methods. It is hoped that in the area of physical therapy, somatotypes shall be applied more amply.

Key words: *Somatotype; Somatotyping; Physical Therapy; Assessment Method*

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INTRODUCTION

Somatotypes refer to outer-most, morphological forms of human bodies classified based on appearance characteristics and change according to physical constitution, environment, disease, nutrition and exercise. Somatotypical studies have contributed to our understanding of diversity of human builds and been applied to specific diseases(1), osteoporosis(2), relations between musculoskeletal system and aging(3), exercise programs for individual athletes(4), and potentials of athletes(5, 6, 7, 8, 9). Also, somatotypes are affected by environmental factors such as occupation(10), nutrition, housing, medical support, and lack of primary health medicine(11). They are important in our daily life for their useful application in industries of electronics and clothes as well as anthropology, bio-engineering, medicine, and sports. Especially, in the area of physical therapy, somatotype studies related to thermal and integumentary physical therapy(12), musculoskeletal system exercise treatment(13), obesity control physical therapy(14, 15), and sports physical therapy(16, 17, 18) were diligently pursued. At the same time, most of the studies relate to obesity.

As for the somatotypical studies, around B.C. 15, Hippocrates classified long and thin habitus phthisicus and short and fat habitus apoplectieus, which were followed by various other methods. Recently, Kretschmer's methods(1921) were the starting point which was followed by Sheldon's method(1940), Hooton's method(1940s), Bullen and Hardy's method(1946), Cureton's method(1947), Parnell's M.4 deviation chart method(1954, 1958), Damon's anthropometric method(1962), Medford equations(1966, 1969), Peterson's method for children(1967), the Leuven method(1967~1980), and the Heath-Carter somatotype method(1967). Currently, the Revised Heath-Carter somatotype method is being widely applied(19).

The Health-carter somatotype method is an anthropometric classification method with higher

reliability and feasibility and has become the most widely applied method in the world(19). Recently, it was revised to attempt different classifications that fit other ethnic groups(20).

Therefore, the study explored the history and assessment methods of somatotyping from ancient to contemporary times with an aim to discuss continued and new attempts to identify somatotyping methods and the necessity of wider application in the area of physical therapy.

Types of Methods to Classify Somatotypes

Earlier Classification of Physical Builds

In BC, 15th century, Hippocrates, a Greek doctor divided somatotypes into habitus phthisicus and habitus apoplectieus. The former refers to long and thin body builds which are vulnerable to tuberculosis and the latter is short and fat body builds which are more exposed to blood vessel diseases and strokes. Celsus, an editor of the Rome Medical Encyclopedia in AD 1st century wrote that it was necessary to learn about the nature of constitution in order to understand why a certain person was thin while others were not. Galen, a Greek doctor in AD 2nd century, maintained the theory of four types of humours and said we needed to know patients' humour constitution for diagnosis and treatment of diseases. In BC 4th century, Aristotle said specific bodies had specific characteristics. In the early 11th century, an Arabic doctor and philosopher, Avicenna recommended humours studies related to personality. The typological system based on Hippocrates' pattern was famous in France between late 18th century and early 19th century. In 1797 and 1828, Halle and Rostan, respectively, described the three physical constitutions covering type digestif, type musculaire, and type cerebrale. Later in about 1880, Huter divided them into cerebral(ectomorphy is prevalent), muscular(mesomorphy is prevalent) and digestive (endomorphy is prevalent) types(19).

Kretschmer's methods

Kretschmer was a German psychologist who wrote about physical and psychological forms in his book published in 1921, 'Körperbau und Charakter (Physique and character)'. He divided somatotype into leptosome habitus, athletic habitus, and pyknic habitus. His types are similar to di Giovanni's grouping in which the gradual changes from psychose to normality are recognized.

Leptosome habitus was a type where height is long but bone and muscle development is poor, corresponding to introvert people. Athletic habitus stands between pyknic habitus and leptosome, referring to body types of narrow shoulders and large muscles and bones. Pyknic habitus is small in height. They have narrow shoulders and thick bodies. Obese type is merry, sociable, and extrovert people(21).

Sheldon's Method

Sheldon introduced the term and concept of somatotype in the book published in 1940, ' The Varieties of Human Physique'.

As the three basic elements determining body builds, he focused on intestines generated from embryological endomorphy, bones and muscles developed from mesomorphy, and skin, sensual organs, and nervous development from ectomorphy and combined them to classify into a few categories. Sheldon's endomorphy, mesomorphy, and ectomorphy are similar to Kretschmer's pyknic habitus, athletic habitus, and leptosome habitus, respectively.

Endomorphy type is people with thick fat layers and have bone structures developed from endomorphy. In shape, they are round and fat. In mesomorphy, people are muscular and robust with bone structures developed from mesomorphy. Ectomorphy people are thin and have bone structures developed from ectomorphy from their births.

Those classified based on this system will have three-digit body shape numbers. The first to third digits related to endomorphy to ectomorphy order and each digit has a scale ranging from one to seven. Higher number relates to more definite classification. For example, extreme endomorphy type is displayed as 711. The first digit, 7 is the degree of endomorphy while the second and third digits, 1 and 1, respectively refer to the degrees of mesomorphy and ectomorphy. If some one pertains to the extreme endomorphy type and shows little mesomorphy but medium level of ectomorphy, this person will be 714. Therefore, 171 and 117 will stand for extreme mesomorphy and ectomorphy, respectively. While the classification numbers are of mutually exclusive correlations, if one class provides a higher mark, there will be no higher marks in other classes. Actually, the extreme forms such as 711, 171, and 117 are rare or non-existent and normal builds will be near 444(22).

Hooton's method

Hooton revised the Sheldon's method for the rating of the US army in the 1940 in large scale. He preferred the term, body build to somatotype and prepared for ratings based on height-weight ratio and

somatotype photograph testing. He defined the first element as a concept to cover obesity development, the second element as a concept of bone size and muscular quantity, and the third element as a concept of relative body thinness or elongation. He assessed chest, abdomen, upper limbs, and lower limbs to rank the first and second elements and derived the means of four areas to decide the total body rating as to obesity, bone, and muscle development pertaining to the classes. The three elements are divided into 1–7 ranks according to the waist–hip ratio(HWRs). HWRs calculate by applying both metric and imperial units. Hooton applied the former and Sheldon used the latter. Hooton used the whole–unit 7–point scale while Sheldon applied the 13–point scale(23).

Bullen and Hardy's method

In 1946, Bullen and Hardy developed the Checklist of 105 Specific Points based on the elemental priority standards from Sheldon's criteria. They believed that their checklist should minimize the rating continuum, enable comparison of all age and sex groups, and become an universal scale to be applied to all groups. This method was applied to Bullen's studies in 1952, Dandy's studies in 1953, Kraus' studies in 1951, and studies of Roberts & Bainbridge in 1963.

Bullen and Handy calculated the final somatotype based on the regional ratings of five areas, covering 1~6 of endomorphy, 2~7 of mesomorphy, and 1~7 of ectomorphy. But there was no report as to the presence of any application of absolute rating values that are same to both sexes(24).

Cureton's method

In 1947, Cureton developed the somatotype classification method by summing up inspectional ratings of the photographs, palpation, skinfold measurement, HWRs, and vital capacity and strength assessment and developed a checklist that summarizes the somatotype rating. In the same year, the more simplified physique rating method was divided into external fat within 1~7 scales, muscular development and condition, and skeletal development. rating scales were based on the body composition criteria while the third element(as part of ectomorphy) was redefined to combine the characteristics related to mesomorphy. Cureton certainly applied the original criteria of Sheldon and more simplified methods of his own. He believed that the rating system mostly consisted of bone, muscle, and fat calculation. As he worked with university students and young athletes, he didn't apply the age–adjusted scale. He seems to have understood all ratings phenotypically(25).

Parnell's M.4 deviation chart method

Parnell contributed to objectification of somatotypic classification for the first time in 1954 and 1958. He developed the scoring method to use anthropometric measurement and recorded the results in M.4 deviation charts to use them along with the pictures. The M.4 deviation charts included tables to obtain anthropometric somatotypes. Parnell replaced Sheldon' component name with fat, muscular(muscularity), and thin types(linearity), abbreviated as F, M and L, respectively. The fat(endomorphy type) type decision is based on skinfold measurement while the muscular type(mesomorphy type) works based on height, bone diameter, and limb thickness. The thin type(ectomorphy type) works based on HWRs. As shown in the M.4 Deviation Charts for Adults, the three element scales were collected from various age brackets(26, 27).

Damon's anthropometric method

In 1962, Damon et al. applied multiple regression techniques to forecast somatotype based on anthropometric measurements of black and white peoples. The 49 samples provided their weight, length, depth, circumstance, skinfold, grip strength, and pulmonary functions. In the seven–point scale, 80% of the forecast were within a half of the picture observation unit ratios provided by Damon(who experienced the Sheldon's method). Multiple correlation coefficients of endomorphy, mesomorphy, and thin type of white and black people, respectively were 0.78, 0.66, 0.90 and 0.83, 0.84, 0.88. In a certain equation, in order to forecast given components, ten different measured values were applied. Grip strength and pulmonary functions were not applied to any other equations (28).

Medford equations

In 1971, Clarke applied an equation to forecast somatotype components of boys aged 9~17. Sinclair(1966, 1969) and Munroe et al.(1969) derived a regression equation from anthrophometric and performance measures for the somatotype forecasting defined by Heath. Diversity in an equation of multiple regression correlation was significantly high in the first and the third constituents but low in the second constituent. The second constituent improved when the first and the third values were applied to regression equations(29).

Peterson's method for children

In 1967, Peterson provided ages and somatotype

ratios of children aged 6~15. He provided their age and somatotyping ratings but did not include other data or measured values. In order to grade body ratios, he needed the variously terms methods such as somatoscopy, photoscopy, and scopy without applying objective criteria. Pictures are arranged in the ascending endomorphy, beginning from one to seven. Well arranged, it does not seem to be useful for studies related to growth of children(30).

The Leuven method

Researchers compared the methods of Sheldon, Parnell, and Heath and Carter to develop a modified method of somatotyping titled the Leuven method. Out of the following three, they derived phenotypical somatotype(31, 32, 33).

(1) The first estimate of endomorphy type based on the total of subcutaneous fat of three areas(34);

(2) The first estimate of ectomorphy type based on HWRs(35); and,

(3) Mesomorphy type measurement(the final ratio) based on pictures aged 16~24(36)

The Heath-Carter somatotype method

Heath and Carter(1967) combined the modified form of Parnell's 'M.4 Technique' to make the Heath's system more objective. They defined somatotype as the 'present morphological conformation' and expressed the primary components of physique that allow us to understand personal phenological characteristics and body composition in three-dimensionally. The first component or endomorphy refers to relative fatness and leanness. The second component refers to a condition where mesomorphy has more developed skeletal frame compared to height. The third component or ectomorphy refers to a condition where somatotype is of linearity. When deciding ratios(grades), HWRs take up largely, but not entirely. This will be assessed based on the first and the second stretched-outness, longitudinal distribution, or body form. Extremes of each component are found in both ends of the scale. Lower ratios of the first element mean that there is an extremely small amount of non-essential fat. On the other hand, higher ratios relate to higher non-essential fat ratios. If the second element is lower, skeletal frames are light and muscles are not definite. If it is higher, musculoskeletal system is significantly developed. If the third element is lower, weight takes up more in comparison with height. On the other hand, if it is higher, overall, weight takes up much less in comparison with height. At the same time, bodies or constituent parts are linear and HWRs is higher. Height, weight, four subcutaneous areas(triceps of arm, subscapular, suprailiac, and calf), diameters of upper arms and femur, circumferences of calves and flexed arms, age, and modified HWRs tables will be necessary to decide the Heath-Carter ratings (grades). The Heath-Carter anthropometric somatotype is highly related to the Heath criterion ratings. If data are provided on the ratings forms, calculation will become immediately available. Finally, somatotyping ratings consist of anthropometric somatotype, somatotype photograph, and somatotype and HWRs distribution tables(19).

Comparison of Somatotyping Methods

Sheldon, Parnell, Heath-Carter method aims to provide a system that is appropriate for all sexes and age brackets. Hooton combined Sheldon's genetic and phenotypic concepts(the third element in specific). Also, Bullen & Hardy, Kraus, Dandy, Roberts & Bainbridge, Cureton, Damon, Clarke, Ostyn et al. supported Sheldon's concept except for phenotypic ratios. Their modifications were appropriate for specific people who did not consider Sheldon's standards. The most recently suggested Heath-Carter method originated from correction and simplification of Sheldon's system. It was designed to provide objective phenotype methods and became the most widely applied somatotyping method.

The somatotyping method provides significant differences among measurement tools. Also, it is not possible to explain all differences due to assessors' errors or unreliable measurement techniques. The comparison using the same method differs by gender and age of the subjects of experiment. While the difference in measurement methods applied to male juveniles is very small, it is larger with children, older adults, and females. The two significant methodological differences include the ratios of genotype against phenotype and those of open component scales against closed components scales. Even if a difference between means is small, the overall somatotype distribution will have a significant difference in the somatotype chart category(19).

Body Type Studies in the Area of Physical Therapy

In the area of physical therapy, there are important studies that inform of the necessity to provide attempts based on somatotypes. Obese type is higher than robust type in terms of core temperature while thin type is lower than robust type in terms of core temperature(37) and it is necessary to consider these

aspects upon ultrasonic, ultrahigh frequency, and shortwave therapy. Areas of soft tissues damaged differ by somatotype(38) and there are differences in muscular torque and output(39), which must be considered upon exercise therapy or soft tissues physical therapy. Somatotypes are not related to exercise-related transient abdominal pain(ETAP) but abnormal posture around thoracic vertebrae will affect ETAP(40), which shall be considered upon any pain physical therapy. Body fat affects exposure to diseases, too. More body fat relates to more exposure to uncontagious chronic illnesses and cardiovascular diseases(41) while body mass is highly related to dyslipidemia and obesity(42), which shall be considered upon obesity-related physical therapy.

Also, sports system training does not affect sexual or height growth of juveniles(43) but physical constitution or somatotype will determine performance of anaerobic exercise(44), which shall be considered when there is any exercise therapy or sports physical therapy.

CONCLUSION

The above-explained somatotyping consists of photograph assessment, planimetry, measurement of human bodies, and functional performance, which have been modified and developed from pioneers' methods. Somatotyping provides difficulties of comparative description of all differences due to its unreliable measurement or assessors' errors. Somato types differ by race, region, or gender, resulting in different assessment results. Therefore, it will be necessary to obtain results of measurement from the largest populations of various regions and races and the method of assessment in application of these will result in the most reliable data. Somatotypes change as time goes. It will be desirable to suggest new assessment indices and methods based on the results of regular assessment.

Studies applying somatotypes in the area of physical therapy have increased consistently. Somatotypes are closely related to physical therapy. Based on the somatotyping methods introduced so far, if we consider psychological, physiological, and kinematic characteristics pertaining to each somatotype and apply the results to the field, treatment will become more efficient.

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