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Statistical methods for the estimation of body shape by fitting 3D whole-body scanning date to homologous body model in Japanese elite female athletes

Introduction：In anthropometry for the athletes such as to talent identification and development, characteristics in body shape are one of the most important parameters as the results of specific physical training and /or routine workout performed. Until now, these parameters were typically measured under manually skilled techniques in anthropometry. In recent years, high sensing techniques in whole body measurement system for humans (that is called "Bodyline Scanner", Hamamatsu Photonics K.K., Japan) was developed [1], which shape data converts to Homologous Body Model (HBM) and identify the characteristic of its shape using statistical methods [2]. The purposes of present study were to obtain 3D whole body laser scan date and by fitting HBM, statistical characteristics in body shape were to develop especially for Japanese female sedentary and athletes in different athletic levels. Methods：Newly developed Bodyline scanner (BLS) was capable of digitizing whole body shape as three dimensional coordinates in the order of 2.5mm intervals in space (normal adult body shape put in ~500,000 points). The principle of the measuring method was optical triangle measurement, in which light source was using a laser diode. The color information was used to detect the position of land mark seals which was pasted on the skin according to the anatomical basis in human anthropometry. HBM was constructed by fitting the whole body laser scan date to standardized template (generic) model. Template model was used as Dhaiba model which was developed from Japanese in large populations by Digital human research group of National Institute of Advance Industrial Science and Technology (AIST). A statistical body shape model (SBSM) was developed by using principal component (PC) analysis in specific HBM group. Fifty females including athletes and sedentary persons aged from 15 to 21yrs were served as subjects. Results and Discussion：Using this newly developed methods, characteristic in body shape for female athletes were evident. Softball female athletes, for example, statistically characterized body shape was as follows; 1st PC: body size such as height and limb length, 2nd PC: circumference in lower trunk and hip, 3rd PC: thickness of upper trunk. PC scores were associated with anthropometric variables and specific body shape for elite athletes could be evaluated by plotting the PC scores in x-y coordinates. Conclusion: The methods for evaluating body shape statistically by fitting the whole body scan date to homologous boy model is useful for reliable prediction of specific body shape of female elite athletes.

References
[1] Funato, K. et al. (2012) Proc. Asian Workshop on 3D scanning technologies.
[2] Park, B-K and Reed, M.P.(2015) Ergonomics, 58, 1714-1725.