北星学園大学文学部北星論集第50巻（通巻第57号）（2013年３月）・抜刷

【資　料】

The Change of Physical Strength in Freshman Year Students of Hokusei Gakuen University for Three Decades

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Introduction

Japanese Ministry of Education developed the Physical Fitness Test and enacted the law for its application in 1964 (Meshizuka, et al., 1977). The law aims to collect the data of a physical capacity level and health condition of the students in all the grades. Its objective is to enhance their physical strength. Following the guideline, most of the Japanese public schools have been conducting the Physical Fitness Test since 1964 (Meshizuka, et al., 1977). Hokusei Gakuen University (HGU) also has been conducting the test since 1975. Physical education was a required class in the first two years until 2008. However, Japanese physical education policy makers faced a reversed result of physical strength in students according to the test. A physical capacity of the student decreased during the last three decades in some categories of the test, such as grip strength. The physical or health condition of the students could be directly associated with the quality of the life of their life later (Miyake and Minouchi, 2002). Therefore, it is very important to clarify the physical characteristics of students (Minouchi, et al., 1992). Especially, muscle strength and endurance are related to the ability to keep their standing position. Flexibility of the muscle and joint is also necessary to avoid the injuries. Even more, flexibility enhances the ability of the muscle activities. However, the decrease of flexibility is one of the factors, which deteriorates the quality of the later life among youth (Tsunoda, et al., 2010). We cannot ignore the decline of these test scores. If a physical education leader wants to improve the physical strength of the students in ten years, they have to find the better educational method to enhance physical strength of students. The result of Physical Fitness Test so far should be a clue to find the method. Therefore, it is important to continue to measure the physical strength of students in Japan.

This study aims to present the data collected in Hokusei Gakuen University to clarify the changes of physical capacity of the students, which supports the claims above and suggest what we can do in physical education class in higher education for better human life.

Key words : Physical Fitness, Thirty Years, Freshman Year

Methodology

Fitness tests are conducted on seven categories during the first month of a new school year (see Figure 1); (1) muscle strength of back, (2) muscle strength of grip, (3) agility in side step, (4) endurance ability, (5) flexibility in the forward flexion, (6) flexibility in back extension and (7) muscular power in vertical jump. Endurance ability was measured by the use of a step, whose height is 36cm for women and 40cm for men. The anthropometry of the body height and weight is also conducted during the same season.

Result

1. Anthropometry

Figure 2 indicates the changes of body height over three decades. The data of both genders are indicated with different marks. The square marks are mean value of male students and the circles are females'. Mean value of female students was approximately 157cm in the first year and reached 159cm in 1995. The mean value of the height of male students also reached 172.6cm in 1995. Since 1995, the height stayed around 159cm and 172.6cm for female and male students respectively until 2008. The height of male and female students' seems to have reached the plateau. No difference in the size of standard deviation throughout the years could be observed. On the other hand, the standard deviation of the height of each gender was 4.5cm for females and 5.5cm for men during the years.

The parabolic regression analyses are applied to the height of both genders. In Figure 2, the regression equations are indicated as well. Both regression equations indicate that the height in year 2000 is the maximum value. The regression coefficients are nearly one, which proves that the compatibility of these equations are significantly high and reliable.

2. Strength

The back strength (Figure 3) and grip strength (Figure 4) are measured to know the physical strength. Figure 3 shows the changes of the back strength. The square marks

Figure 1. Seven items of the physical fitness test

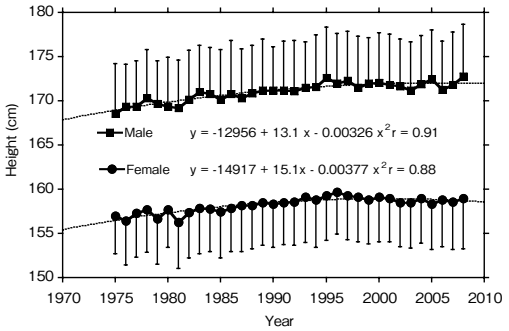

Figure 2. Changes of average height for 30 years: dotted line indicates parabolic regression analyses.

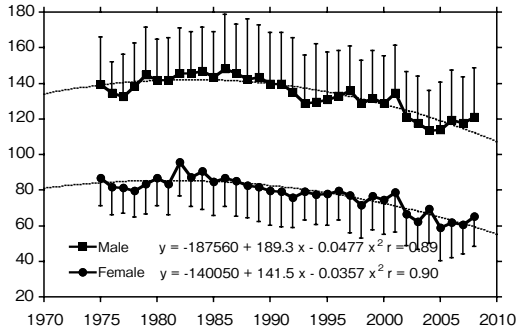

Figure 3. Changes of mean values of back strength in both genders over a period of thirty years: Fitting curves indicate the result of parabolic regression analysis

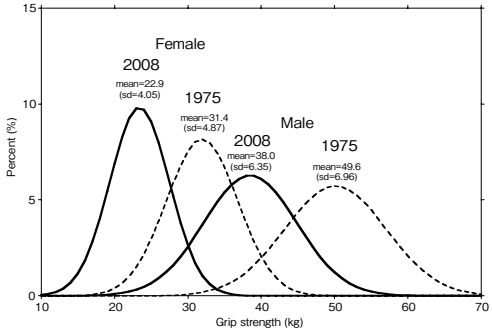

Figure 4. The distribution of the grip strength between the 1975 and the 2008

indicate the data of male students.

The circle marks indicate the data of female students. Mean values of the back strength of females decreased from 87kg to 58.9kg. The ones of males also decreased from 139.6kg to 114kg up to 2005 year.

The regression coefficients are close to 1, 0.89. This means that these regression equations are illustrating the change of the back strength for three decades.

The peak of the females' appeared in 1982. The peak of the males' appeared a little later, in 1985. The decrease of the back strength had begun in 1980s and continued up to present.

Figure 4 shows the frequency distribution in standardized grip strength. Solid lines indicate the latest data. Broken lines indicate the oldest ones. Both the genders' are shown in Figure 4. The difference of mean values between the initial data and the latest data are 11.6kg for the males and 8.5kg for the females. Mean values significantly decreased in both genders. Standard deviation became narrower (from 6.96 to 6.35 in male, and from 4.87 to 4.05 in females). On the contrary, Figure 4 indicates that the mean value has become smaller, and the occurrence of the mean value has become more frequent. It indicates that the grip strength of female students as a whole group has weakened.

3. Agility

The side step test measures the ability of agility. Muscle strength and contraction speed are important factors for determining the agility. In addition, students have to control the muscle activity for 20sec during the test. Therefore, this physical activity requires the active use of the central nerve system.

The ability of agility of female students reached the lowest level in 1998. However, it reached the lowest level in around 1990. The mean values have been clearly improving since then. From the different point of view, however, it can be observed that the ability of agility have merely fluctuate around 35 points in the female data since 1990.

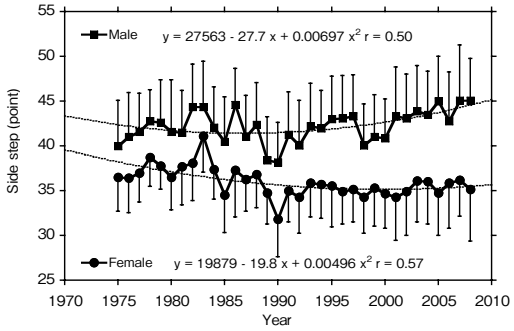

Figure 5. Changes of mean values of the side step in both genders over a period of thirty years: Fitting curves indicate the result of parabolic regression analysis

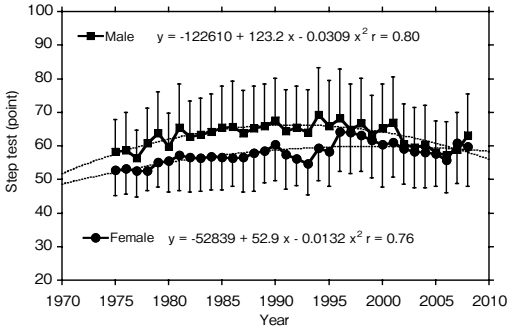

Figure 6. Changes of mean values of the step test in both genders over a period of thirty years: Fitting curves indicate the result of parabolic regression analysis. The height of the step is 36cm in female, and is 40cm in male.

4. Endurance

The step test has been well known as a test for measuring endurance. 40cm high steps used to be used for both females and males until 1995 in HGU (Tsunoda, et al., 2010). Therefore, the clear differences could be observed in the result of the test between males and females during those years. However, the step test results are largely influenced by the ratio between the step's height and body height, and it should be taken into consideration in using the test. Since 1996, when we started using the 36cm high steps, the difference between genders has been no longer observed. According to the data since 1996, the similar changes in the step test by both genders have been observed. The average points of the step test increased from 1975 to 1996. However, the test point has begun to fall since 1996 in both genders.

On the other hand, the results of step test have turned upward during the last two years. The physical fitness class has become an elective class in HGU since 2007. As a result, since 2007, only students who have confidence in the physical strength have been registered for sports or fitness class. In addition, more than 40% students of the whole, who are possibly not confident in their physical strength, have not taken such classes. That may explain the rise of the test after 2007.

5. Flexibility

The trunk extension (Figure 7) and the forward flexion of trunk (Figure 8) have been used as the test of flexibility. The results of these items have decreased continuously since the beginning of this study. After the 1995 the mean values have converged at the lowest level in both genders. The flexibility of the forward flexion requires the slackness of muscles. On the other hand, students have to raise the trunk by contracting back muscles in the trunk extension. Trunk extension requires the muscle strength. Therefore, naturally, this category must be strongly related to muscular power used for a vertical jump. Oppositely, the trunk forward flexion should be relaxed. In the Figure 8, the results of forward flexion

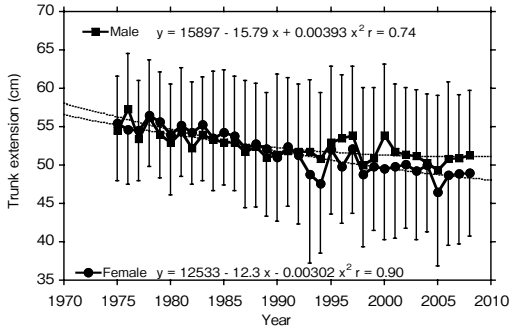

Figure 7. Changes of mean values of the trunk extension in both genders over a period of thirty years: Fitting curves indicate the result of parabolic regression analysis

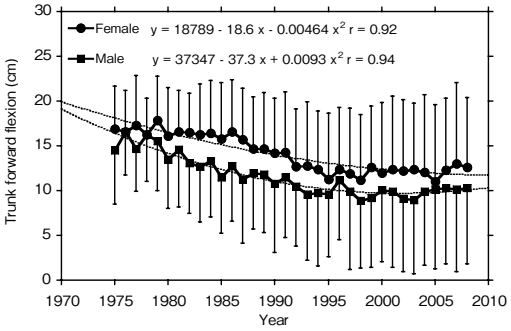

Figure 8. Changes of mean values of the trunk forward flexion in both genders over a period of thirty years: Fitting curves indicate the result of parabolic regression analysis

have also decreased continuously since the beginning of this study.

6. Power production

Vertical jump measures the ability related to human power production (see Figure 9). The values have not substantially changed in both genders. The difference between the male students and female students is approximately 20cm. The human power production depends on the abilities of both the muscle strength and contraction speed. In other words, the vertical jump is closely related to the contraction of back muscle which can be represented by the back strength and trunk extension.

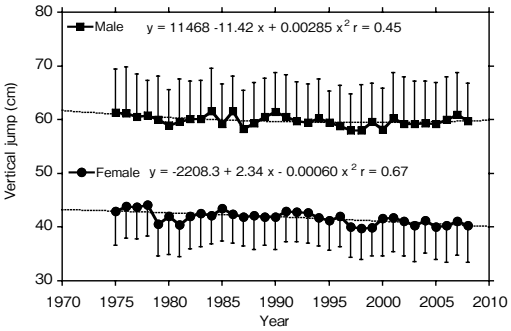

Figure 9. Changes of mean values of the vertical jump height in both genders over a period of thirty years: Fitting curves indicate the result of parabolic regression analysis

Higher vertical jump can be attained due to stronger muscle contraction speed and muscle strength. Therefore, the improvement of the vertical jump test means the improvement of the muscle strength and contraction speed as a result of power training.

Discussion

As the trend after World War II, it is well known that height of Japanese has continuously improved. An important question is why the physical strength should have decreased. It is natural that for the physical strength to increase along with the improvement of height. The current physical condition of young adult will affect the quality of life during their rest of life. As a physical education teacher or health scientist, we would like to propose the guideline to promote physical activities while they are students. University should be not only the place to accumulate knowledge, but also should be the place to be engaged in physical activities.

Figure 10 can be used to roughly grasp the trend of the physical strength in each item.

Though anthropometry and side step test result in male students and step test result in both genders have increased during the last thirty years, a clear negative trend can be observed in all other categories. Discussion on each category is as follows;

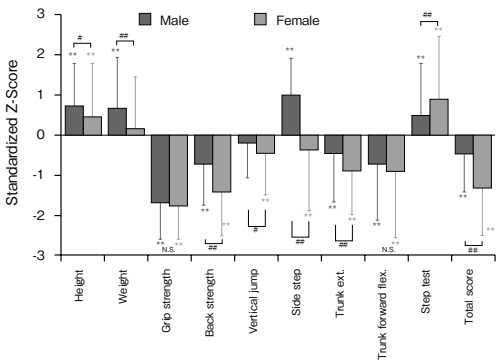

Figure 10. Trend graph of all the data standardized by the initial score while three decades; Positive area indicates increase of the date, Negative area indicates increase of the data in each category.

1. Anthropometry

The parabolic regression analyses are adopted in Figure 2. Regression coefficients of those equations are nearly one. It is the most noticeable that it reached the current level in 1995.

2. Strength

Figure 3 indicates the changes of back strength. Figure 4 shows the frequency distribution of standardized grip strength. Thanks to regression equations, it is known that the peak of female students appeared in 1982, and the one of the male students appeared later, in 1985. In both genders, the decrease of the back strength had begun in 1980s. Trend of the decrease in the back strength has continued until present.

The difference of mean value in grip strength between the data of the beginning and the most current of this study is substantial (11.6kg in male students and 8.5kg in female students). Mean values significantly decreased in both genders. Standard deviation became narrow (see Figure 4). On the contrary, the frequency distribution of mean value is high in the most current data than the first data of this study in both genders.

3. Agility

Muscle strength and contraction speed are important factors for agility. In addition, it is important to control the production of muscle strength during the test, which lasts 20sec. Therefore, it requires active use of the central nerve system. The lowest data had occurred around 1990 in male students. The data have clearly increased since 1990. However, it is noted that the ability of agility have merely fluctuated and no clear negative or positive trend could be observed. There is the large fluctuation of mean value across three decades. Regression coefficient is low (0.5 in male and 0.57 in female). Therefore, these regression analyses cannot provide an adequate explanation regarding the change of agility ability.

4. Endurance

The physical education has become an elective class in HGU since 2007. Only students who have confidence in their physical strength have been registered for sports or fitness class. More than 40% students of the whole have not been registered for those classes. In other

words, the policy has been contributing to the continuation of downward trend of the physical strength or health of many students. Especially, the students who need to be engaged in physical activities dare not to take the physical education class. This study strongly supports the hypothesis that the endurance should be enhanced such classes. HGU are doing more harm than good for the students.

5. Flexibility

The trunk extension (Figure 7) and the forward flexion of trunk (Figure 8) are used as the test of flexibility. The flexibility of the forward flexion requires the slackness of muscles. Students have to raise the trunk by contracting back muscles in the trunk extension. Flexibility can be attained by combining two factors; the muscle strength and contraction. This test not only measures flexibility, but also reveals contraction ability of the muscle. Thus, this is one of the important factors in the physical fitness. The decrease of mean value in the flexibility becomes a serious problem in the physical strength of young adults. Mean value of forward flexion converged at the lowest level in both genders. The width of standard deviation has also become larger in the recent years than the beginning of this study.

6. Power production

Figure 9 shows the result of vertical jump. This measures the ability to produce the power. The power production depends on the abilities of both the muscle strength and contraction speed. Therefore, it is an anatomical fact that the vertical jump performance is closely related to the back strength and trunk extension. Therefore, obtaining better vertical jump height requires both the muscle strength and fast contraction speed simultaneously.

Conclusion

These are suggestions obtained by analyzing the data of physical performance by students at Hokusei Gakuen University during the past three decades to improve physical strength and health of students. Suggestions are as follows;

1. It is emergently necessary to stop the downward trend of the physical strength and health of current students. The current health and physical strength will directly affect the quality of life for the rest of their life.

2. It is important for schools to prepare some opportunities to be engaged in physical activities for students and physical education classes should be a strong candidate to realize it. Making physical education requirement courses should be discussed seriously.

3. Hokusei Gakuen University should be engaged more in offering physical education to enrich the life of the students even after their graduation.

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[Abstract]

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For human beings, a healthy and active life is most important. Physical strength of our students has been measured for many years in physical education class. The purpose of this study is to clarify the annual trend of physical capacity in the first year students in Hokusei University. Items of physical fitness test are: (1) back strength, (2) grip strength, (3) side step, (4) a modified Harvard step test for Japanese, (5) forward flexion, (6) back extension, and (7) vertical jump. Physical fitness tests have been performed from 1975 to 2008. For human beings, a healthy and active life is most important. Analyses have performed for the 18-years-old students. The results of average score in physical capacity are as follows: (1) Back strength and grip strength increased from 1975 until 1985. (2) The agility in males has slightly increased from 1998 to 2008. However, female data have trended to keep a low score. (3) The result of step test increased from 1975 to 1996. However, the average score decreased from 1985 until 2005. (4) Flexibility has decreased continuously since beginning this fitness test. After 1995 the mean value has converged at the lowest level in both genders. (5) Vertical jumps (human power) of both genders have not changed practically in most cases of both genders. The difference between the males and females is approximately 20 cm. It is a major problem in physical strength that endurance has especially decreased. Therefore, in conclusion, it is important to adopt better educational policy for physical fitness of Hokusei Gakuen University students.

Key words : Physical Fitness, Thirty Years, Freshman Year