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RELATIONSHIPS BETWEEN HAND AND FINGER MUSCLE STRENGTH AND TAPPING ABILITY AMONG WORKERS DURING USING GRINDERS

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ABSTRACT

Analyses of psychomotor changes before and during grinding work of thirty female workers performing a grinding operation with another thirty female office workers as the control group. Hand muscle strength was measured by assessing hand grip strength (HGS) and pinch strength (PS) while hand dexterity was measured by the maximum tapping ability in 10 seconds (MTA). The participants were asked to perform the tests at (1) initial time at 08.00 a.m., (2) before morning rest break at 10.00 a.m., (3) after morning rest break at 10.10 a.m., (4) before lunch at 12.00 a.m., (5) after lunch at 13.00 p.m., (6) before afternoon rest break at 15.00 p.m., (7) after afternoon rest break at 15.10 p.m. and (8) end of work at 17.00 p.m.. In contrast, the control office worker group was measured only at before work (08.00 a.m.). The result showed that the HGS, PS and MTA of the dominant hand were generally stronger than those of the non-dominant hand (p-value <0.05). Several pairs of raw data of the above parameters were computed by SPSS Inc. (2001 program) to find the significant level (p) and correlation coefficients (r). It was found that the MTA was significantly correlated with PS and HGS (r = 0.249 and 0.308, p-value <0.001, respectively). PS and HGS were significantly correlated (r = 0.708, p-value < 0.001). This may show that all tests confirmed the changes of hand strength and dexterity after prolonged grinder using. The result shows that after the workers were exposed to vibration from the grinding process, they were affected by decreased hand muscle strength and decreased hand maximal tapping ability with relatively linear proportion.

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KEY WORDS: correlations / hand muscle strength/ finger strength / grinding / vibration/ tapping speed

INTRODUCTION

There were many reports on correlations of several psychomotor and motor performance parameters such as jumping performance and anaerobic power, reaction time (RT), tapping speed and critical flicker

frequency (CFF) in many athletes (Chentanez et al 2007)(1). and (Chentanez et al 2003)(2). Previous report by Bootsikeaw et al (2012)(3) showed changes of hand grip strength , pinch strength, maximum tapping ability after grinding of the workers and study the magnitude of hand and arm vibration exposure among grinding workers in automobile parts factory. This report will further analyze the relationships between several pairs of parameters during resting, working period and recovery after daily working such as strength and tapping speed of hands and fingers of working for 8 hours using vibration tools. The objectives of this study was to correlate hand grip strength, pinch strength, and maximum tapping ability before ,during and grinding work. The hypothesis of this study was that the correlations of hand grip strength, pinch strength and maximum tapping ability are linearly proportionally positive.

Major scope of this study

was to analyze and compare the correlations of hand grip strength, pinch strength, maximum tapping ability between before and after grinding of the workers and also during resting during 8 hr working.

MATERIALS AND METHODS

The methods of this study were approveol by Committee or Human Right Related to Human Exprimentation, Mahidol University which were published in Bootsikeaw et al (2012)(3). The objectives of this study were to further analyse the hand grip strength, pinch strength, maximum tapping ability between those of before and after grinding of the workers and to find the correlations between hand grip strength , pinch strength , maximum tapping ability. The study group was measured for 8 time intervals as following: (1) initial time at 08.00 a.m., (2) before morning rest break at10.00 a.m., (3) after morning rest break at 10.10 a.m., (4) before lunch at 12.00 a.m., (5) after lunch at13.00 p.m., (6) before afternoon rest break at 15.00 p.m., and (7) after afternoon rest break at 15.10 p.m. and (8) end of work at 17.00 p.m.. In contrast, the control group was measured only at before work (08.00 a.m.). This research study was conducted in female workers of an automobile parts factory in Rayong Province, Thailand. The samples were divided into 2 groups as follows: The study group: 30 female workers who were grinding operators and the control group: 30 female workers who were office workers such as interpreter, accountant, bookkeeper, secretary, stock clerk. The details of materials and methods those carried out to get the correlation data in this report was describe in Bootsikeaw et al 2012(3). Data were analyzed by using the Statistical Package for Social Science version 13.0 (SPSS Inc, 2001). The descriptive statistics were used to describe the general characteristics of the study group and the control group such as percentage, mean ($\overline{X}$), and standard deviation (SD). To describe all measurement by using mean values ± standard error of mean (SEM). Pearson's correlation was used to describe relations between maximum tapping ability , pinch strength and hand grip strength of the pairs of data concerned. The level of significantly at α = 0.05 (p-value $\leq$ 0.05) was considered as statistically significant.

RESULTS

Data were collected from the female workers of an automobile parts factory in Rayong Province, Thailand. Some data of other parameters were presented in Bootsikeaw et al 2012(3). The subjects

comprised 30 female workers from grinding line were selected as the study group and 30 female workers who work in the office were selected as the control group. The study results were presented in 5 main parts as the following.

1.The description analysis of the study group and the control group.

2.The comparison of maximum tapping, pinch strength, ability and hand grip strength between dominant hand and non- dominant hand.

3. The comparison of maximum tapping, pinch strength, ability and hand grip strength between the study group and the control group.

4. Percentage changes (%) of each subject from initial time (08.00 a.m.) of maximum tapping ability /10 sec, pinch and hand grip strength in the study group throughout 8 hours of working day.

The above data(1-4) were presented in Bootsikeaw et al 2012(3). The correlations of hand and finger strength and maximum tapping ability before and during and after grinding work will be reported here. In this study, the correlation between every pairs of the data of hand grip strength, pinch strength and maximum tapping ability in every time point were tested by Pearson correlation.All pairs of correlation was positive and had significant correlation. The correlations coefficients were between 0.236 – 0.710. The data were shown in Table 1, Figure 1, Figure 2 and 3.

Table 1 The correlation of parameters on relationship between maximum tapping ability, pinch strength and hand grip strength of all data.

The relation	r	r^2	p-value
Maximum tapping ability and pinch strength	0.249	0.055	<0.001***
Maximum tapping ability and hand grip strength	0.308	0.084	<0.001***
Pinch strength and hand grip strength	0.708	0.504	<0.001***

Data were analyzed by Pearson Correlation.

, **, * signifies significant level at p < 0.001.*

The median of maximum tapping ability/10sec (MTA) and pinch strength (PS) were 51.85 tap/10 sec and 6.33 kg., respectively. The correlation between maximum tapping ability/10sec and pinch strength can be used to divide the scatter into four quadrants, as shown in Figure 1. Nevertheless, data points that fall into these four quadrants can be interpreted as follow:

Quadrant 1 (upper right): high pinch strength (PS) and high maximum tapping ability/10sec (MTA).

Quadrant 2 (upper left): high pinch strength (PS) but low maximum tapping ability/10sec (MTA).

Quadrant 3 (lower left): low pinch strength (PS) and low maximum tapping ability/10sec (MTA).

Quadrant 4 (lower right): low pinch strength (PS) but high maximum tapping ability/10sec (MTA).

From Table 1 and Figure 1, it can be seen that data of maximum pinch strength of various conditions were positive and significantly correlated with maximum tapping speed ability.

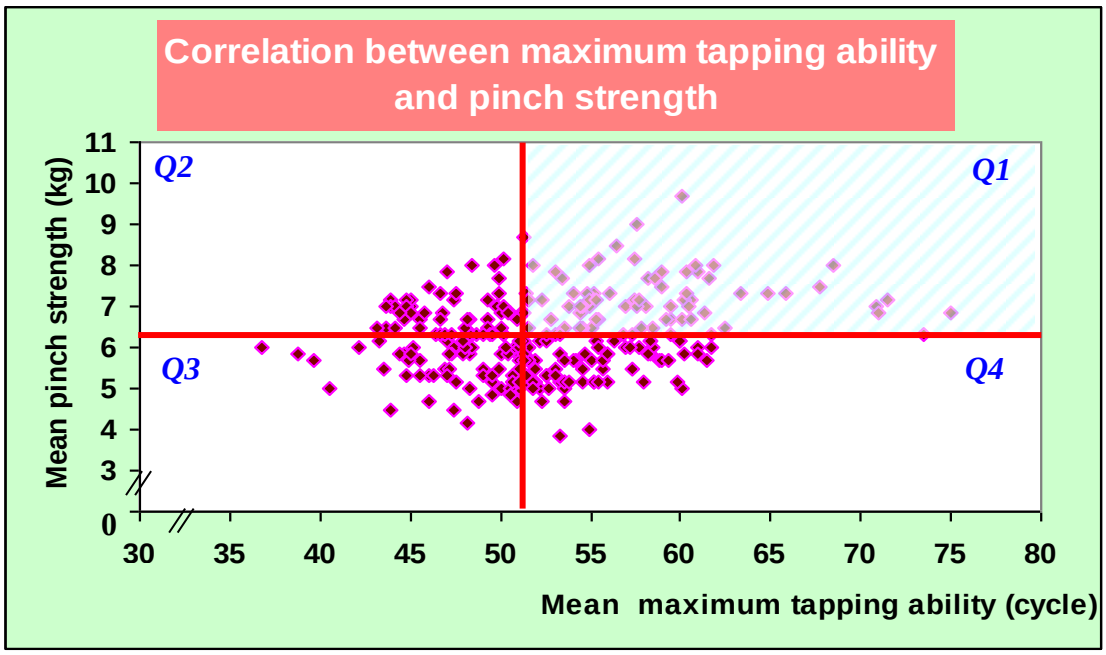

Figure 1 Scatter plot of maximum tapping ability/10sec and pinch strength. Q = guadrant

The median of maximum tapping ability/10sec (MTA) and hand grip strength (HGS) were 51.85 tap/10 sec and 26.45 kg., respectively. The correlation between maximum tapping ability/10sec and hand grip strength can be used to divide the scatter into four quadrants, as shown in Figure 2. Nevertheless, data points that fall into these four quadrants can be interpreted as follow:

Quadrant 1 (upper right): high maximum tapping ability/10sec (MTA) and high hand grip strength (HGS).

Quadrant 2 (upper left): low maximum tapping ability/10sec (MTA) but high hand grip strength (HGS).

Quadrant 3 (lower left): low maximum tapping ability/10sec (MTA) and low hand grip strength (HGS).

Quadrant 4 (lower right): high maximum tapping ability/10sec (MTA) but low hand grip strength (HGS).

From Table 1 and Figure 2, it can be seen that the data of maximum hand grip strength and maximum tapping ability were positively significantly correlated.

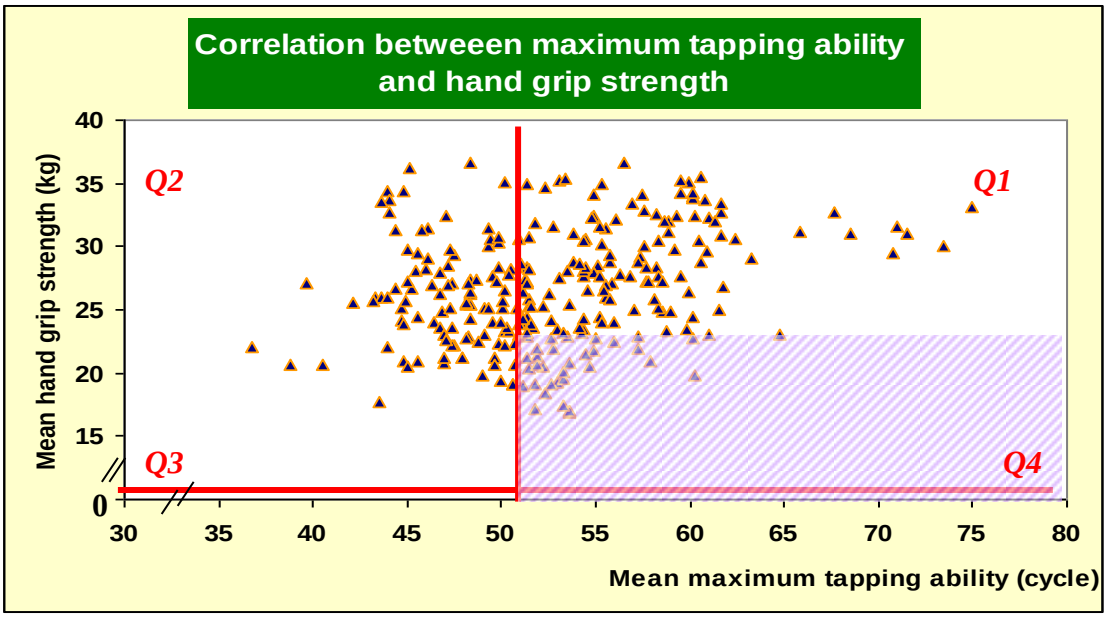

Figure 2 Scatter plot of maximum tapping ability/10sec and hand grip strength. Q = guadrant

The median of pinch strength (PS) and hand grip strength (HGS) were 6.33 kg. and 26.45 kg., respectively. The correlation between pinch strength and hand grip strength can be used to divide the scatter into four quadrants, as shown in Figure 3 . Nevertheless, data points that fall into these four quadrants can be interpreted as follow:

Quadrant 1 (upper right): high pinch strength (PS) and high hand grip strength (HGS).

Quadrant 2 (upper left): low pinch strength (PS) but high hand grip strength (HGS).

Quadrant 3 (lower left): low pinch strength (PS) and low hand grip strength (HGS).

Quadrant 4 (lower right): high pinch strength (PS) but low hand grip strength (HGS).

From Table 1 and Figure 3, it can be seen that the data of maximum hand grip strength of various conditions were positively significantly correlated with maximum pinch strength.

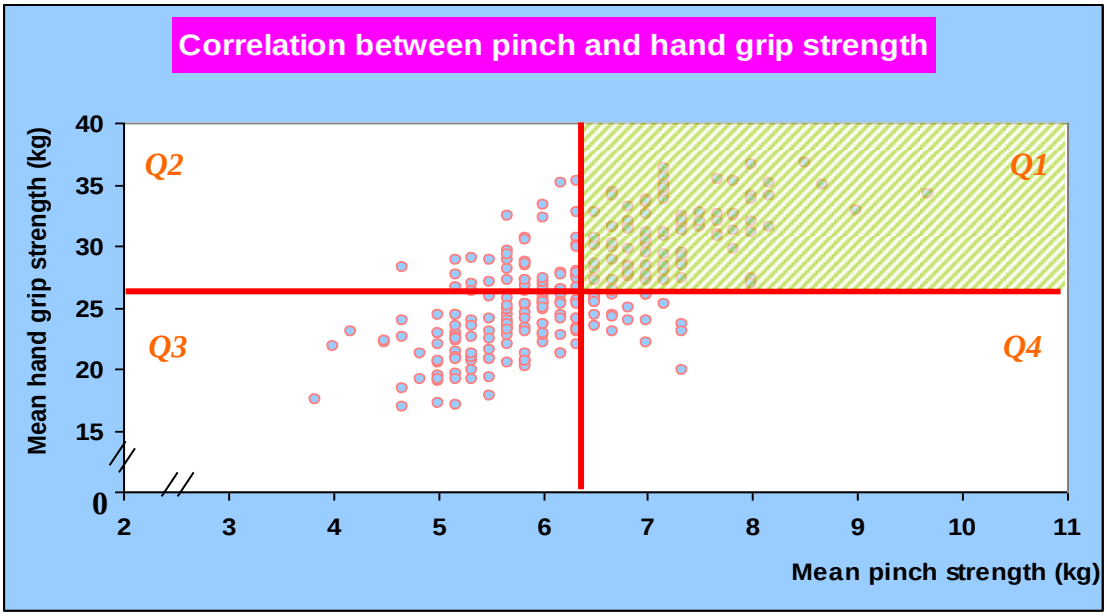

Figure 3 Scatter plot of pinch strength and hand grip strength. Q = guadrant

DISSCUSION

The correlations were found among hand grip strength (HGS), pinch strength (PS) and maximum tapping ability (MTA). In term of the MTA study was positively significantly correlated with PS and HGS with : r =0.249 and 0.308, p-value <0.001, respectively. The correlation between PS and HGS was positively significantly correlated: r = 0.708, p-value < 0.001. This finding is consistent with that of previous studies as Wattanavitthawat and colleagues in 1998 (4) had examined 360 healthy subjects dwelling in Chiang Mai (4). They also demonstrated a moderate correlation between grip and pinch strength (r = 0.50, p = 0.05. Furthermore, this result agreed with Mirbot et al (5) who studied on motor function capacities, during the 4 year follow-up period, the diminution of hand grip force, pinching power (kg) and tapping ability. It was also agree with report of Chentanez et al 2007(1) who showed correlations of many psychomotor parameters in hands and legs of athletes. The correlations of the maximum tapping ability/10 sec, pinch strength and hand grip strength were positive and had significant correlation. even though the correlation corffcients were low (r = 0.249 - 0.308). Moreover, the correlation between pinch strength and hand grip strength had highest correlation coefficient (r = 0.708) among pairs of parameters analyzed here. The above positive correlations of many psychomotor speeds of body parts may imply that there are parallel physiological adaptations possibly in the central nervous system or peripheral organs or both in similar directions. Therefore, some parameters may be used in replace of other in the study of fatigue or neuromuscular functional changes in the future. This speculation is reasonable basing on several reports on significant correlations among several psychomotor parameters which had closely selated mechamisms. (1, 2 and 6).

REFFERENCE

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