# Physical Fitness and Anthropometric Characteristics of Royal Thai Army Personnel

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*The objective of the present study was to determine the relationship between physical fitness and anthropometric characteristics in Royal Thai Army (RTA) personnel. Body weight, height, waist circumference, hip circumference and blood pressure were measured. Body mass index (BMI) and waist-hip ratio (WHR) were calculated. Subsequently, 4,030 males aged 20 to 60 years were field tested using 2-minute push ups/sit-ups and 2-kilometer run to measure muscular strength/endurance and cardiorespiratory endurance, respectively. Data were analyzed for the relationships between BMI and anthropometric variables and blood pressure and physical fitness results. The average BMI for RTA personnel was 24.0 $\pm$ 3.3 kg/m$^2$. Correlation coefficient between BMI and waist circumference ($r = 0.847$, $p < 0.001$) was better than BMI and WHR ($r = 0.553$, $p < 0.001$). Both systolic blood pressure (SBP) and diastolic blood pressure (DBP) had a significant positive correlation with BMI. The numbers of push-ups/sit-ups had a negative correlation with BMI ($r = -0.121$ and $-0.109$, respectively), whereas 2-kilometer run times had a positive correlation with BMI ($r = 0.291$, $p < 0.001$). In conclusion, RTA personnel with increasing BMI tend to have low physical fitness level.*

***Keywords:*** *Body mass index, Physical fitness, Royal Thai Army personnel*

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Physical fitness is defined as an ability to perform physical activity with vigor and alertness. It influences general well-being, health status, military readiness and appearance. The component of health-related physical fitness assessment includes cardio-respiratory endurance, muscular fitness, musculo-skeletal flexibility and body composition. It is well documented that increasing muscular strength, muscular endurance and flexibility is believed to have a positive effect on the cardiovascular system and can reduce musculoskeletal injuries[1-3]. Previous studies also revealed that low cardiorespiratory fitness and physical inactivity were directly associated with cardiovascular disease, type 2 diabetes, obesity and all-cause mortality[4-7]. Moreover, anthropometric parameters have been used extensively to predict health risks[8-10].

The Royal Thai Army (RTA) uses physical fitness test, which consists of 3 items; maximum number of push-ups, sit-ups completed in 2 minutes and time to complete a 2-kilometer run in order to evaluate muscular strength, muscular endurance and cardiorespiratory endurance of RTA personnel semi-annually. The purpose of the RTA physical fitness test is to ensure the maintenance of a base level of physical conditioning essential for RTA personnel, to improve performance efficiency and military appearance and to promote health[11]. However, anthropometric measurement for assessing body composition is not recorded at the time of each physical fitness test. A few military studies also have investigated the relation between physical fitness test as a field test and health problem. Thus, the aim of the present study was to determine the relationship between physical fitness and anthropometric characteristics in RTA personnel, using data

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**Table 1.** Sample scoring standards at 50 points and 100 points for RTA physical fitness test in male

| Age (years) | 2-minute push-ups (repetitions) | | 2-minute sit-ups (repetitions) | | 2-kilometer run (min:sec) | |
|---|---|---|---|---|---|---|
| | 50 points | 100 points | 50 points | 100 points | 50 points | 100 points |
| 17-21 | 32 | 82 | 42 | 92 | 11:00 | 6:50 |
| 22-26 | 30 | 80 | 37 | 87 | 11:25 | 7:15 |
| 27-31 | 28 | 78 | 32 | 82 | 11:55 | 7:45 |
| 32-36 | 23 | 73 | 28 | 78 | 12:25 | 8:15 |
| 37-41 | 22 | 72 | 25 | 73 | 13:00 | 8:50 |
| 42-46 | 18 | 66 | 24 | 69 | 13:35 | 9:25 |
| 47-51 | 17 | 62 | 22 | 67 | 14:10 | 10:00 |
| 52+ | 13 | 56 | 21 | 66 | 14:45 | 10:35 |

**Table 2.** The mean and standard deviation (SD) of characteristics and physical fitness results in RTA personnel

| | Mean | SD |
|---|---|---|
| Age (yr) | 41.5 | 8.5 |
| Weight (kg) | 68.5 | 10.3 |
| Height (cm) | 169.0 | 5.1 |
| BMI (kg/m$^2$) | 24.0 | 3.3 |
| Waist (inch) | 33.2 | 3.6 |
| Hip (inch) | 37.6 | 2.7 |
| WHR | 0.88 | 0.06 |
| SBP (mmHg) | 129.5 | 16.7 |
| DBP (mmHg) | 83.4 | 11.6 |
| 2-minute push-ups (repetitions) | 33 | 10 |
| 2-minute sit-ups (repetitions) | 39 | 11 |
| 2-kilometer run (min:sec) | 11:31 | 1:49 |
| Fitness score (%) | 67.2 | 9.2 |

collected as part of the Royal Thai Army Physical Fitness Test Survey[12].

## Material and Method

A cross-sectional study was performed from January to July 2005 at eleven RTA units. Of approximately 123,286 RTA personnel, the present study included analysis comprised 4,030 males age ranging from 20 to 60 years including commissioned officers and non-commissioned officers. Before the physical fitness test, resting blood pressure was measured in the sitting position. Body weight and height were measured in light clothing without shoes. Body mass index (BMI) was calculated as the weight (kg) divided by the square of the height (m). Waist circumference (inch) was taken with a tape measure at the level of the navel (the smallest diameter between the costal margin and the iliac crest). Hip circumference (inch) was taken at the widest diameter around the greater trochanter. Waist-hip ratio (WHR) was calculated as the waist circumference divided by the hip circumference.

Physical Fitness Test: RTA personnel were field tested as the regulation of the RTA (RTA Directives Number 823/2530, 694/2531and 809/2531), using 2-minute push ups/sit-ups and 2-kilometer run to measure muscular strength/endurance and cardiovascular endurance, respectively. The number of push-ups, sit-ups and the 2-kilometer run time were converted into a score based on a scoring table for each item and the subject's age. Each item of the test was given a maximum score of 100 points for a potential perfect score of 300. Sample scoring standards at 50 points and 100 points for RTA physical fitness test in male are shown in Table 1. The study protocol was ethically approved by the Institutional Review Board, The Royal Thai Army Medical Department.

### *Statistical analysis*

Data were analyzed using SPSS for windows version 11.5 (Chicago, IL). Pearson's correlation and linear regression analysis were used to determine the relationships between BMI and anthropometric variables, blood pressure and physical fitness results. Statistical significance was defined at the 0.05 level (2-tailed).

## Results

The characteristics and physical fitness results in RTA personnel are shown in Table 2. The overall mean age of 4,030 male personnel was 41.5 $\pm$ 8.5 years and the mean BMI was 24.0 $\pm$ 3.3 kg/m$^2$. The

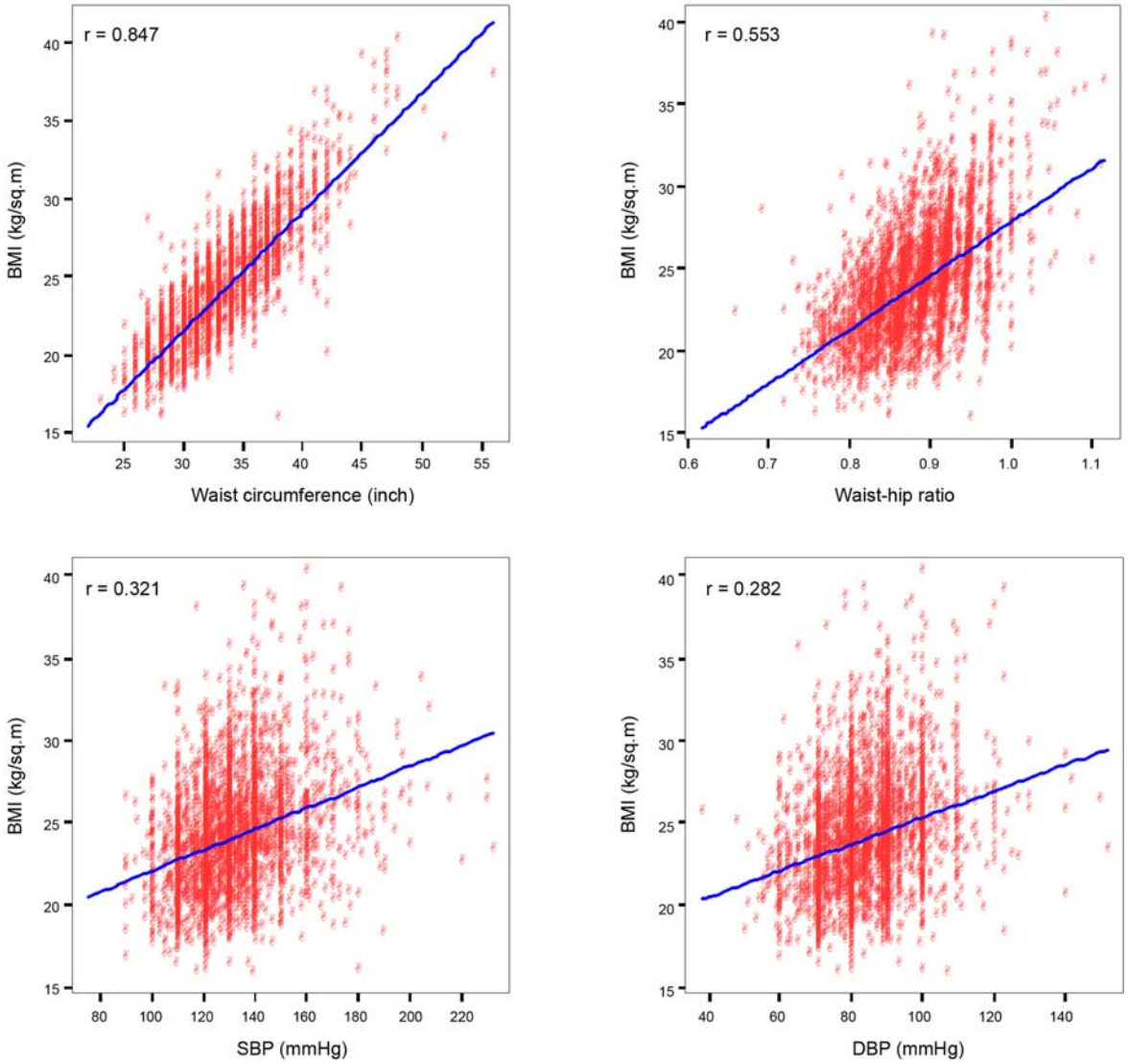


**Fig. 1** Relationship between waist circumference, waist-hip ratio, systolic blood pressure (SBP) and diastolic blood pressure (DBP)with BMI

significant correlations of three indices of obesity and blood pressure are shown in Fig.1. Correlation coefficient between BMI and waist circumference ($r = 0.847$, $p < 0.001$) was better than that between BMI and WHR ($r = 0.553$, $p < 0.001$). Additionally, BMI was positive correlation with systolic blood pressure ($r = 0.321$, $p < 0.001$) and diastolic blood pressure ($r = 0.282$, $p < 0.001$).

Consequently, the present study used BMI as obesity index in the assessment of relationship between physical fitness and anthropometric characteristics, as shown in Fig. 2. The number of push-ups and sit-ups performance were significantly and negatively correlated with BMI ($r = -0.121$ and $-0.109$, respectively), whereas the 2-kilometer run time had a positive correlation with BMI ($r = 0.291$, $p < 0.001$). When physical fitness results were converted to point scores, the correlation between physical fitness score and BMI was $-0.183$ ($p < 0.001$).

## Discussion and Conclusion

Previous studies reported that the average physical fitness test score of the RTA personnel was more than 65% and fitness level decreased with

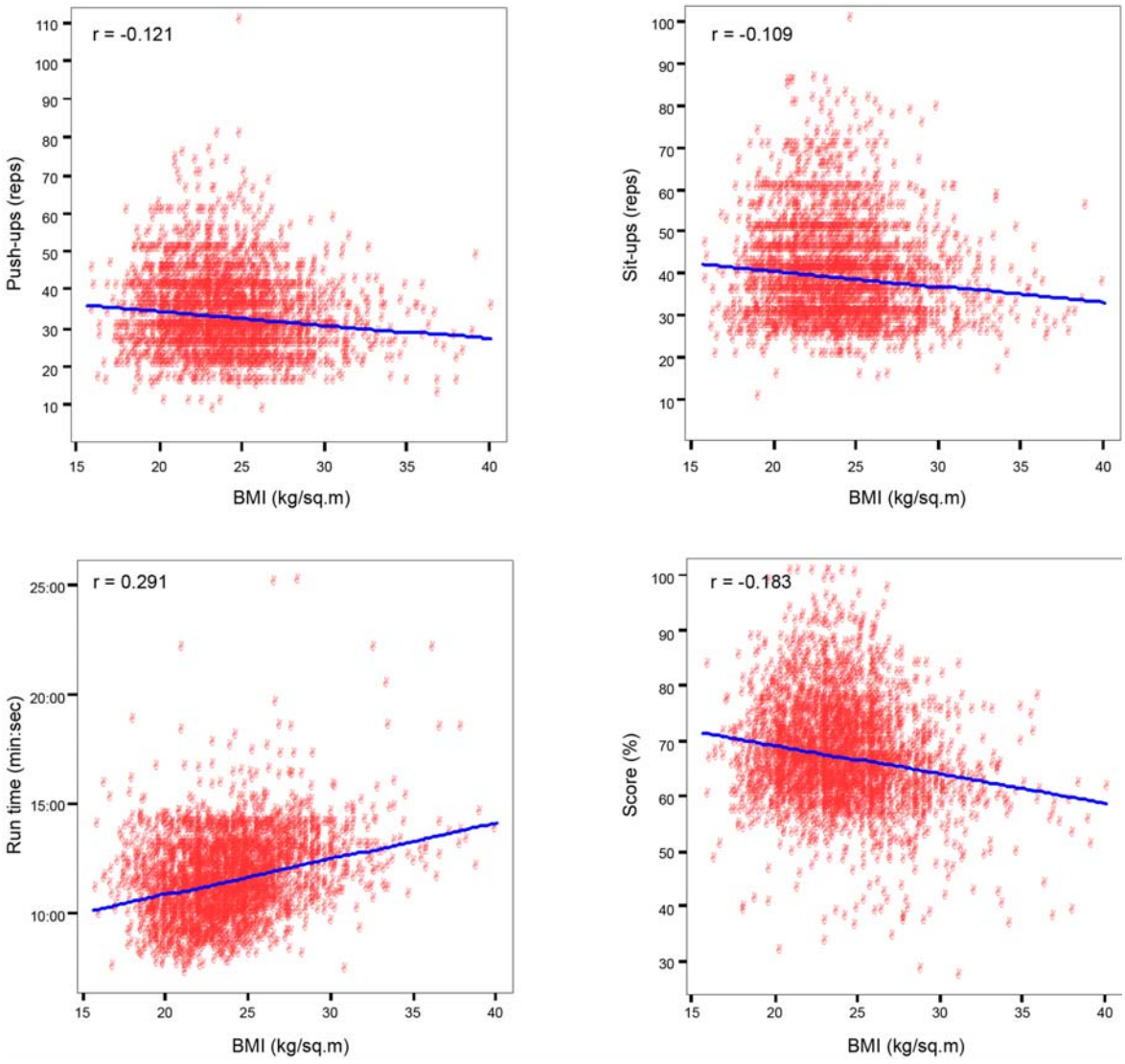


**Fig. 2** Relationship between BMI and physical fitness test

increasing age. Moreover, based on BMI with World Health Organization criteria the prevalence of overweight and obesity were 27.1% and 4.9%, respectively[12,13]. However, it was uncertain whether physical fitness level was associated with that prevalence in RTA personnel.

Commonly, BMI and waist circumference are used as reliable predictors of body fat or adipose tissue stored in the body, which are inexpensive and simple. Excessive weight or high BMI level was associated with hypertension, coronary heart disease, and some metabolic disorder[9,14,15]. A cross-sectional study in healthy Thais indicated that BMI was associated with risk factors for cardiovascular disease[10]. Similarly, the present study demonstrated that increasing BMI was correlated with progressive and significant increase in waist circumference, WHR and blood pressure. Although it was not directly determined, the increase in BMI in the present results was assumed to correlate with an increase in health risks.

Moreover, several researchers investigated the inverse relation between the cardiorespiratory fitness and the health risk. It was also known that physically fit individuals were more resistant to illness and disease and quicker to recover from injury than were unfit people. Wei et al concluded that low

cardiorespiratory fitness using a maximal exercise test on a treadmill was a strong and dependent predictor of cardiovascular disease and all-cause mortality and of comparable importance with that of diabetes mellitus and other cardiovascular disease risk factors[4,7]. In addition, a recent prospective study indicated the inverse association between low fitness estimated by maximal oxygen consumption and anthropometric parameters[5]. In view of the relation between BMI and physical fitness level in RTA personnel, BMI was inversely correlated with physical fitness as measured by 2-kilometer run time and muscular strength as measured by push-ups/sit-ups.

In conclusion, RTA personnel with increasing BMI, waist circumference and WHR tended to have low physical fitness level. In order to promote improvement in physical fitness level, thus, physical training and health promotion should be developed for RTA personnel. In addition, the physical fitness as measured by the RTA physical fitness test and anthropometric measurement may be used to predict health risks. However, further studies are needed to determine the association between low physical fitness level and risk factors in RTA personnel.

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## *สมรรถภาพกายและสัดส่วนร่างกายของกำลังพลในกองทัพบก*

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*การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อประเมินความสัมพันธ์ระหว่างสมรรถภาพกายและสัดส่วนร่างกายของกำลังพลในกองทัพบก กำลังพลชาย อายุ 20-60 ปี จำนวน 4,030 นาย ได้รับการตรวจวัดความดันโลหิต ชั่งน้ำหนัก วัดส่วนสูง เพื่อคำนวณค่าดัชนีมวลกาย วัดรอบเอว รอบสะโพก เพื่อคำนวณค่าสัดส่วนรอบเอวต่อรอบสะโพก ทำการทดสอบสมรรถภาพกายแบบภาคสนามโดยการดันพื้น ลุกนั่งในเวลา 2 นาที และวิ่งระยะทาง 2 กิโลเมตร เพื่อวัดความแข็งแรง ความอดทนของกล้ามเนื้อ และความอดทนของระบบหายใจและไหลเวียนเลือด ผลการศึกษาและวิเคราะห์ข้อมูลพบว่ากำลังพลในกองทัพบกมีค่าดัชนีมวลกายเฉลี่ย 24.0 $\pm$ 3.3 กิโลกรัม/ตารางเมตร ค่าสัมประสิทธิ์สหสัมพันธ์ระหว่างค่าดัชนีมวลกายกับรอบเอว ($r = 0.847$, $p < 0.001$) ดีกว่าระหว่างค่าดัชนีมวลกายกับค่าสัดส่วนรอบเอวต่อรอบสะโพก ($r = 0.553$, $p < 0.001$) ความดันโลหิตเมื่อหัวใจบีบตัว และคลายตัว มีความสัมพันธ์เชิงบวกกับค่าดัชนีมวลกาย จำนวนครั้งของการดันพื้นและลุกนั่งมีความสัมพันธ์เชิงลบกับค่าดัชนีมวลกาย ($r = -0.121$ และ $-0.109$ ตามลำดับ) แต่เวลาในการวิ่งระยะทาง 2 กิโลเมตร มีความสัมพันธ์เชิงบวกกับค่าดัชนีมวลกาย ($r = 0.291$, $p < 0.001$) โดยสรุปกำลังพลกองทัพบกที่มีค่าดัชนีมวลกายเพิ่มขึ้นมีแนวโน้มว่าระดับสมรรถภาพกายลดลง*