Validity of Certified Trainer-Palpated and Exercise-Palpated Post-Exercise Heart Rate

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ABSTRACT

Garner RT, Wagner DR. Validity of Certified Trainer Palpated and Exerciser Palpated Post-Exercise Heart Rate. JEPonline 2013;16(6): 31-38. The purpose of this study was to evaluate the ability of certified fitness trainers and exercisers to accurately palpate post-exercise heart rate (HR). Immediately after completing a 3-min step test, 20 trainers (29.4 ± 5.7 yrs; 8 males, 12 females) palpated the radial artery of 20 exercisers (31.8 ± 9.6 yrs; 10 males, 10 females) who simultaneously palpated their carotid artery. The post-exercise HR obtained by the trainers (134.0 ± 38.1 beats·min⁻¹) and the exercisers (140.2 ± 25.2 beats·min⁻¹) were not significantly different (P = 0.224) from the HR monitor (149.7 ± 18.5 beats·min⁻¹). While the post-exercise HR palpated by both the certified fitness trainers and the exercisers were close to the monitored values, the trainers were no more accurate than the exercisers. Moreover, there was substantial variability in accuracy for both the trainers and the exercisers. Due to the large variability in determining HR, the ability of both the certified fitness trainers and the exercisers to accurately assess post-exercise HR is questionable. Thus, we suggest that a HR monitor or an ECG recording should be used when the HR measurement is of paramount importance.

Key Words: Accuracy, Pulse, Fitness Trainer, Heart Rate Palpation
INTRODUCTION

Given that an increase in workload is associated with an increase in heart rate (HR) and oxygen consumption (VO₂), both HR and VO₂ can be used to measure exercise intensity. While the latter method often requires specialized equipment, measuring HR is relatively simple to do. In fact, according to the American College of Sports Medicine (ACSM), the HR reserve \[ \text{HR reserve} = (\text{HR max} - \text{HR rest}) \times \text{percentage of desired intensity} + \text{HR rest} \] is the preferred method for prescribing exercise intensity (1). Hence, exercisers are often given a goal by a fitness trainer to stay within a target HR zone. To do so, exercisers working out at home to exercise videos or in group fitness classes are told to self-monitor their exercise intensity by palpating HR. Of course, the assumption is that exercisers can accurately determine their immediate post-exercise HR.

In addition to being a frequently used method to determine exercise intensity, HR is used to predict aerobic capacity (VO₂ max) during submaximal cycle ergometer (2) and treadmill (10) tests, the one-mile walk test (14), and bench step (17) test. This is especially the case when it is impractical to measure gas exchange. However, it is important to highlight the assumption in the prediction of VO₂ max from submaximal and field-based prediction formulas is that the test administrator or the exerciser is able to accurately determine immediate post-exercise HR.

Wireless HR monitors have been available for about 3 decades. Laukkanen and Virtanen (16) conclude that HR monitors offer a real-time, accurate measure of HR. Hence, given the importance of accuracy in the determination of HR, monitors are preferred rather than palpation. The problem is that not all exercisers can afford to purchase a HR monitor. As such, then, the purchase cost itself is a barrier to exercising safely for some individuals. Also, it may not be financially feasible to simply provide HR monitors to everyone in a group exercise program or when testing many people at one time. No doubt that is why palpation of the carotid artery or the radial artery is still commonly used in many exercise settings.

The accuracy at which exercisers palpate immediate post-exercise HR is questionable. In particular, elementary school children (4) and cardiac rehabilitation patients (12) have demonstrated varying degrees of accuracy with self-palpation. Even after some practice sessions, women in an aerobic dance class significantly underestimated post-exercise HR by 29 ± 26 beats·min⁻¹ (3). Interestingly, though, numerous other studies (7,8,15,19-21) reported that HR palpation does not differ significantly from monitored post-exercise HR.

Although there is a substantial amount of research that has focused on the accuracy of self-palpation, we are unaware of any studies that have evaluated the certified fitness trainer’s ability to accurately palpate the HR of his or her client. Cardiorespiratory fitness assessment is a routine part of a client’s comprehensive fitness evaluation, and the measurement of post-exercise HR is an important part of a cardiopulmonary assessment. Indeed, skill in accurately measuring HR at rest and during exercise is a necessary skill to become an ACSM Certified Personal Trainer or ACSM Certified Health Fitness Specialist (1).

The purpose of this study was to evaluate the accuracy of certified fitness trainers who palpated the immediate post-exercise HR of exercisers while the exercisers simultaneously self-palpated their HR. Given that the trainers should have more experience in palpating HR than novice exercisers, and previous research suggests that the accuracy of HR palpation improves with practice (22), we hypothesized that the certified fitness trainers would possess a higher degree of accuracy than the exercisers.
METHODS

Subjects
This study consisted of 20 certified fitness trainers (29.4 ± 5.7 yrs; 8 males, 12 females) and 20 exercisers (31.8 ± 9.6 yrs; 10 males, 10 females) from the general population. All trainers were certified (Table 1). Recruitment was accomplished by direct contact at local gyms and word of mouth. One trainer and one exerciser from the total group had a random chance to win a $50 cash prize as incentive to participate in the study, which was approved by the university’s institutional review board. All subjects reported to be free of contraindications for exercise. An informed consent was signed prior to testing.

Table 1. Certifying Agency and Trainer Certification (n = 20).

<table>
<thead>
<tr>
<th>Certifying Agency</th>
<th>Certification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerobics &amp; Fitness Association (AFAA)</td>
<td>1 CPT/GFI</td>
</tr>
<tr>
<td>American College of Sports Medicine (ACSM)</td>
<td>1 CPT</td>
</tr>
<tr>
<td>American Council on Exercise (ACE)</td>
<td>1 CPT, 2 GFI</td>
</tr>
<tr>
<td>International Sports Science Association (ISSA)</td>
<td>3 CPT, 1 CFT</td>
</tr>
<tr>
<td>National Academy of Sports Medicine (NASM)</td>
<td>2 CPT</td>
</tr>
<tr>
<td>National Strength &amp; Conditioning Association (NSCA)</td>
<td>4 CSCS</td>
</tr>
</tbody>
</table>

Miscellaneous:
- Free Motion: 1 Master Trainer
- Safax Personal Training: 1 GFI
- Ashtanga: 1 Group Yoga Instr.
- American Sports & Fitness Association: 1 GFI/Boot Camp
- Larry Scott Personal Training: 1 CPT

CPT = Certified Personal Trainer, GFI = Group Fitness Instructor, CFT = Certified Fitness Trainer, CSCS = Certified Strength & Conditioning Specialist

Procedures
Instructions were provided to both the certified fitness trainers and the exercisers on proper steps to palpating HR. Correct palpation of the carotid pulse required the individual to “lightly” press on the artery to avoid triggering the baroreceptor reflex, which has been demonstrated to decrease HR (23). All subjects were given the opportunity to practice locating and counting HR.

Following the brief instruction and practice period, the Queens College step test was administered. This well-known field test of aerobic fitness requires exercisers to step for 3 min on a 16.25 inch bench in cadence with a metronome set at 96 beats·min⁻¹ for men and 88 beats·min⁻¹ for women in an
up-up-down-down sequence (17). This cadence results in the necessary 24 steps·min⁻¹ for the test on men and 22 steps·min⁻¹ for women. At the conclusion of the 3-min step test, exercisers immediately stopped and were allowed 5 sec to obtain pulse, which was counted from 5 to 20 sec post-exercise. The exercisers remained standing for the 15-sec pulse count, which they obtained from the carotid artery while the certified fitness trainers simultaneously obtained the exerciser’s HR from the radial artery.

Specific and clear instructions on timing were given to ensure consistency between each subject (3). At the end of the 3-min step test, the investigator would say “last step,” then after 5 sec said “start.” At the end of the 15-sec pulse count, the investigator said “stop” to complete the process. Following the test, both the certified fitness trainer and the exerciser recorded HR values from the 15 sec pulse counts on a piece of paper, hidden from the other person’s view to ensure that independent pulse counts were recorded. A Polar T31 telemetric HR monitor (Polar Electro Oy, Lake Success, NY) provided the criterion measure, and the Polar HR values were averaged over the 15 sec that the pulse was palpated (12). Subsequently, HR was used in the following prediction equations to estimate VO₂ max (mL·kg⁻¹·min⁻¹) (17): Men, VO₂ = 111.33 – (0.42 x HR); Women, VO₂ = 65.81 – (0.1847 x HR).

Statistical Analyses
A comparison of mean differences in HR between the certified fitness trainers, exercisers, and HR monitor was assessed by a one-way analysis of variance (ANOVA). Statistical significance was set at P≤0.05. All analyses were done with version 21 SPSS software (IBM, Armonk, NY, USA).

RESULTS
Although the difference in HR between the certified fitness trainers (134.0 ± 38.1 beats·min⁻¹), the exercisers (140.2 ± 25.2 beats·min⁻¹), and the HR monitor (149.7 ± 18.5 beats·min⁻¹) was not statistically significant (P = 0.224), individual variability was substantial (Figure 1). Despite the certified fitness trainers having more experience at palpating HR than the exercisers (10.5 ± 19.5 vs. 0.45 ± 1.0 palpation experiences per month, P=0.027), 7 of the 20 trainers differed from the Polar monitor by more than 2 pulse counts over the 15-sec measurement (i.e., a difference >8 beats·min⁻¹). Trainer-reported values ranged from 52 to 212 beats·min⁻¹, resulting in greater variability among the trainers than the exercisers. However, the other 13 trainers were accurate to within ±2 counts with the Polar monitor over the 15-sec palpation period. Exerciser-reported HR ranged from 80 to 176 beats·min⁻¹, with 5 of 20 individuals making errors greater than 2 pulse counts. One certified trainer and one exerciser noted that their HR palpation was a complete guess as they were either unable to palpate the HR or feel the pulse for the full 15-sec count. Table 2 summarizes the VO₂ max predictions from the post-exercise HRs.

| Table 2. Predicted VO₂ max (mL·kg⁻¹·min⁻¹) from the Post-Exercise Heart Rate. |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                 | Men (n = 10)    |                 | Women (n = 10)  |                 |                 |                 |
| **Assessment**  | **Trainer**     | **Exerciser**   | **Polar**       | **Trainer**     | **Exerciser**   | **Polar**       |
| HR (beats·min⁻¹)| 138             | 142             | 151             | 130             | 138             | 149             |
| Predicted VO₂ max | 53.5         | 51.5            | 48.0            | 41.7            | 40.3            | 38.4            |
Figure 1. Relationship of Palpated Heart Rates to Monitored Heart Rates. X-axis = palpated heart rates (beats∙min⁻¹), Y-axis = monitored heart rates (beats∙min⁻¹); ○ = trainer, ■ = exerciser, so 1○ and 1■ refer to the first trainer paired with the first exerciser, respectively.

A correlation coefficient of .230 (P = 0.154) was obtained between the number of times each month the subjects palpated HR and the amount of error in their obtained result. This indicates no relationship between the previous HR palpation experience and accuracy of post-exercise HR determination.

DISCUSSION

The primary finding from this study was that the palpation of post-exercise HR by both the certified fitness trainers and the exercisers were not significantly different from the HR monitor. In an early study to determine if post-exercise HR was a valid estimate of training HR, Pollock and colleagues (19) also mentioned that the mean difference between subject-determined HR and telemetry was not significant. Similarly, other researchers have also reported good agreement between palpation, ECG recordings, and HR monitors (8,15,20,21). These studies and our results suggest that trainers and exercisers can monitor with some degree of accuracy the post-exercise HR. However, even though it was not statistically significant, the palpated HR was lower than the HR monitor. In agreement, Dinesh et al. (9) reported that the palpated HR by females in a group exercise class was 10% lower.
than the measured post-exercise HR. Other researchers have also reported non-significantly lower (7,18) and significantly lower (3,5,6,11,13) palpated HR versus monitored HR.

Despite the non-significant mean differences in palpated HR in the present study and the Polar-monitored HR, individual variability was large (Figure 1). Three certified trainers underestimated the actual HR of the exercisers by 65 beats∙min⁻¹ or more while two exercisers underestimated their own HR by 50 beats∙min⁻¹ or more. Other researchers have also observed large degrees of variability in the palpation of HR. Sharpe (21) reported that 71% of aerobic dance participants were able to palpate HR within ±12 beats∙min⁻¹ while others made sizable errors ranging from -44 to + 26 beats∙min⁻¹. Also, there were twice as many underestimations as overestimations. Bell and Bassey (3) reported that palpated counts by aerobic dance participants significantly and consistently underestimated exercise HR with errors ranging from -9 to -95 beats∙min⁻¹. There have also been reports of substantial variability in the accuracy of self-palpated post-exercise HR by cardiac rehabilitation patients (12,15), elementary school children (4), and middle school children (11).

Aside from using HR to ensure a safe exercise prescription, the palpated post-exercise HR is used to estimate VO₂ max. The authors of the 3-min step test used in this study published gender-specific VO₂ max prediction equations using the post-exercise HR (17). On average, palpation errors resulted in an overestimation of VO₂ max by 1.9 to 5.5 mL∙kg⁻¹∙min⁻¹ (Table 2). McArdle et al. (17) reported the standard error (SEE) of this prediction equation to be ±2.9 mL∙kg⁻¹∙min⁻¹. Thus, the lower palpated HR compared to the observed values resulted in overestimation of VO₂ max similar in magnitude to the SEE. In evaluating the individual data 13 of the 40 subjects (33%) made palpation errors that resulted in a VO₂ max estimation error greater than the reported SEE of ±2.9 mL∙kg⁻¹∙min⁻¹. Greer and Katch (13) evaluated the validity of post-exercise palpation following varying intensities of bench stepping. They concluded that palpation could underestimate the actual HR by 6% to 11%, leading to an overestimation of VO₂ max by as much as 8%.

Although the certified fitness trainers had more experience palpating post-exercise HR than did the exercisers, the trainers were not more accurate than the exercisers. In addition, the number of times that a trainer or exerciser palpated HR in the previous month was not correlated with the magnitude of error. Even though the difference was not significant, the Polar HR measurements were closer to the exercisers’ values than the trainers’ values. This finding was surprising since one would intuitively expect a higher degree of accuracy by the certified trainers, and since research (22) suggests that HR palpation accuracy improves with practice. However, one explanation for the lack of accuracy in the certified fitness trainers may be that the exercisers palpated the carotid pulse while the trainers palpated the radial pulse.

When given the choice between palpating the carotid artery or the radial artery at the wrist, Dinesh et al. (9) reported that the majority of the exercising students chose the carotid artery because they believed it was easier to palpate. Similarly, DeVan et al. (8) commented that at higher exercise intensities it might be more difficult to differentiate pulses at the radial artery due to lower pulsations or the small size of the radial artery compared to the carotid artery. Yet, several research findings (7,8,20) indicate that palpation accuracy is similar when either the carotid artery or the radial artery is used. Regardless of the reason, our data suggest that it may be easier and just as accurate for an individual to palpate his or her own post-exercise HR rather than have a certified fitness trainer do so.
CONCLUSIONS

Post-exercise HR is frequently used to assess exercise intensity and predict aerobic capacity. To our knowledge, this is the first study to evaluate the ability of certified fitness trainers to accurately assess immediate post-exercise HR. On average, HRs palpated by both the trainers and the exercisers were close to the monitored values, but the certified trainers were no more accurate than the exercisers. Furthermore, there was substantial variability in accuracy for both the trainers and the exercisers. Due to the large variability, which included some very large errors, the ability of both the trainers and the exercisers to accurately assess post-exercise HR is questionable. Therefore, we suggest that HR monitors or ECG recordings should be used when the HR measurement is of paramount importance.

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