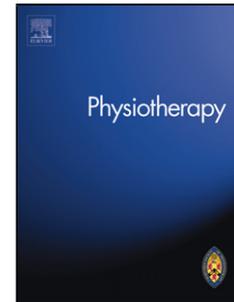


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Updated reliability and normative values for the standing heel-rise test in healthy adults

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Abstract

Objectives The heel-rise test is used to assess the strength and endurance of the plantar flexors in everyday clinical practice. However, several factors may affect outcomes, including sex, age, body mass index and activity level. The aims of this study were to revisit the reliability and normative values of this test, and establish normative equations accounting for several factors.

Design Cross-sectional observational study with test–retest.

Setting Community.

Participants Volunteers ($n=566$, age 20 to 81 years).

Interventions Subjects performed single-legged heel rises to fatigue, standing on a 10° incline. A subset of subjects ($n=32$) repeated the test 1 week later. Reliability was quantified using intraclass (ICC) correlation coefficients and Bland-Altman plots {mean difference [95% confidence interval (CI)]}, whereas the impact of sex, age, body mass index and activity level on the number of heel rises was determined using non-parametric regression models.

Results The test showed excellent reliability (ICC=0.96), with mean between-day differences in the total number of heel-rise repetitions of 0.2 (95% CI -6.2 to 6.5) and 0.1 (95% CI -6.1 to 6.2) for right and left legs, respectively. Overall, males completed more repetitions than females (median 24 vs 21). However, older females (age >60 years) outperformed older males. According to the model, younger males with higher activity levels can complete the most heel rises.

Conclusions The heel-rise test is highly reliable. The regression models herein can be employed by clinicians to evaluate the outcomes of heel-rise tests of individuals against a comparable normative population.

Keywords: Lower extremity; Muscle strength; Physical examination; Regression analysis; Rehabilitation; Reproducibility of results

<A>Introduction

The single-legged heel-rise test (HRT) is often used in clinical practice and research to assess the strength and endurance of the plantar flexors [1]. Among other applications, outcome

scores from this test have been used to determine treatment efficacy following Achilles tendon ruptures [2] and the effects of exercise programmes on the function of elderly individuals [3]. Outcomes from this test have also been associated with survival rates in patients on renal replacement therapy [4], severity of cardiovascular disease [5] and the presence of lower-extremity musculoskeletal injuries [6]. Clearly, the HRT is a valuable tool for clinicians operating in a variety of practical settings.

Although the contralateral limb is often used as the reference for comparison of clinical scores, this does not always reflect optimal function in the presence of bilateral deficits, previous injuries or certain population groups (e.g. athletes and elderly). For these reasons, it is important to have normative values with which clinical outcome scores can be compared. In 1995, Lunsford and Perry [7] recommended that 25 repetitions should be viewed as the criterion for normal HRT performance in both males and females following the testing of 203 healthy adults (age 20 to 50 years). Although their study was considered seminal in the field, it scored poorly on a modified Downs and Black quality assessment checklist [1], and did not report the reliability of their testing procedure. Furthermore, despite investigating sex differences, Lunsford and Perry did not account for potential between-leg differences [8,9], nor the impact of age, body mass index (BMI) and activity levels on heel-rise performance [9,10]. Indeed, previous studies reported decreased HRT performance with increased age by 20 years [9], higher BMI [10] and participation in fewer endurance-based physical activities [11]. Furthermore, sedentary individuals exhibit lesser plantar flexion muscle strength [12] and endurance [13] capacities compared with active individuals during isokinetic dynamometry testing.

To monitor changes over time, the reproducibility of measures is vital so that changes in outcome scores reflect meaningful changes in an individual's function (e.g. improvements in HRT scores reflect improvements in plantar flexor strength and endurance,

and functional abilities of individuals). Overall, the HRT has demonstrated good to excellent reliability [intraclass correlation coefficients (ICC) 0.78 to 0.99] [14–18], with the standard error of measurements ranging from two to six repetitions [14,16–18]. The difference in the reliability of the HRT across studies most likely reflects differences in testing protocols and populations investigated, highlighting the importance of documenting the reliability of specific testing protocols in research to assist readers and test users to interpret data.

The aims of this study were to revisit the reliability of the HRT, re-examine normative test scores in a large sample of healthy adults, and establish normative equations of HRT performance, while taking differences in sex, age, BMI and physical activity levels into consideration. On the basis of previous work [7,9,19,20], minimal side-to-side differences were expected, with older age, female sex, higher BMI and lower activity levels having a negative effect on HRT performance.

<A>Methods

Subjects

Prior to subject recruitment, the Regional Ethical Review Board of **XXXX** approved the research protocol, which adhered to the Declaration of Helsinki. The subjects for this study were recruited from the local community, with the study being advertised through selected e-mail distribution lists, bulletin boards, online fora and word of mouth. Inclusion criteria were good self-reported health and minimum age of 18 years. Subjects with a current or recent musculoskeletal, neurological, cardiovascular or degenerative pathology, or medical contraindications to study participation were excluded. Demographic characteristics were checked to verify that activity levels were represented equally across the range of BMI values.

After providing informed consent, data were collected from 600 volunteers. The study group was diverse in terms of sex, age, physical activity level and BMI, reaching the goal of testing a heterogeneous sample from which normative data could be extracted and generalised to a wider population group. Inspection of scatterplot graphs of the baseline characteristics of the sampled population clearly revealed that not all activity levels were represented across the range of BMI values. Consequently, to further represent a normative population and approach normal distribution, the data set used to determine normative values for the HRT was restricted to subjects with BMI ≤ 30 kg/m² ($n=566$). A random subset of these subjects ($n=32$) also participated in the test–retest reliability component of this project, and volunteered to complete testing on two different occasions. A summary of subjects' baseline characteristics is provided in Table 1.

<insert TABLE 1 near here>

Study design

The repeated-measures design of this study required subjects to take part in a single experimental session during which both right and left legs were tested. To eliminate the potential influence of testing order and fatigue on heel-rise performance, each individual was tested on the right and left leg in a randomised order, decided prior to the test session. For the test–retest reliability component of this study, a subset of subjects was tested 1 week later using the same randomised testing sequence as the first test occasion for each individual. Six trained examiners performed all assessments under the guidance and supervision of the project leader (US).

Procedures

<C>Baseline measures

Age (years), height (m), weight (kg) and BMI (kg/m²) were recorded on the day of testing. Self-reported physical activity levels were also determined using a commonly-used six-grade scale [1 to 6, where 1=hardly any physical activity (i.e. sedentary), and 6=hard or very hard exercise several times per week (i.e. extremely active)] [21–23]. Such types of physical activity scales have been used in several large population studies in the Nordic countries [22], particularly those involving older individuals [21,23]; have shown moderate correlations with physical performance levels in elderly population groups [21]; and have been associated with moderate-to-substantial test–retest agreement when completed 4 to 6 weeks apart [24].

<C>Heel-rise test

Each subject performed a maximal number of single-legged heel rises on an 10° incline (i.e. slight dorsiflexion position) following previously described protocols [5,20]. Subjects were permitted to wear their habitual sporting or walking shoes (i.e. no heels). To assist balance, individuals were permitted to apply fingertip support at shoulder height on a wall in front of them. Heel-rise cycle cadence was controlled at 60 per minute by a metronome, which corresponds to an ankle angular velocity of approximately 60° per second. Subjects were instructed to lift the heel as high as possible for each heel rise until no further repetitions could be performed, keeping the knee and trunk straight. Verbal feedback designed to maintain the test parameters regulating heel excursion, cadence, balance support, trunk position and knee angle was provided at regular intervals during testing. During testing, subjects were also encouraged to continue performing heel rises until exhaustion. The test was terminated when subjects could no longer: (1) lift the stance heel from the incline or repeat a complete heel-rise cycle; (2) maintain the set pace, knee angle or trunk position; or (3) rely on fingertip support for balance and used the wall to assist performance. The number

of correct heel rises completed was counted for each leg and used as outcome score. Subjects were given one verbal reminder to re-establish a correct heel-rise repetition before test termination.

Prior to testing, each subject warmed up for 10 minutes though brisk walking or light jogging, and then performed 10 submaximal bilateral standing heel rises. Subjects went through an individualised familiarisation session during which the examiner provided corrective feedback designed to ensure that the task was performed in an appropriate manner. Following familiarisation, a 2-minute rest was taken, after which subjects performed a maximal number of heel rises on either the right or left leg according to the randomisation. Testing was repeated on the alternate limb after 2 minutes of rest.

Data analysis

<C>Reliability data

To determine test–retest reliability, HRT performance data from the right and left foot on the two different test days were extracted from the 32 subjects participating in this component of the study. To quantify the absolute reliability, the between-day difference in the means was computed (in raw units). To quantify the relative reproducibility, ICC values were computed from the data using a one-way random model. Here, single ICC measures correspond to the reliability of measures at a single time point, and were calculated using the following equation:

$$\rho_{ICC\ single} = \frac{\sigma_b^2}{\sigma_b^2 + \sigma_w^2}$$

where σ_b^2 is the between variance and σ_w^2 is the within variance.

The standard error of measurements (SEM) was calculated as follows:

$$SEM = SD\sqrt{1 - ICC}$$

where SD is the standard deviation of the scores from all subjects.

Bland-Altman plots with the mean difference and 95% limits of agreement [difference (1.96 SD)] were also constructed to graphically represent the agreement between measures from the two test days. The Bland-Altman method was employed to provide an indication of the systematic and random error, and 95% limits of agreement were computed to describe the total between-day error.

<C>Normative data

The data from the 566 subjects used to derive normative performance for the HRT were first inspected using scatterplots to identify outliers, relationships between variables, and interaction effects. Given that the aim was to establish normative equations for heel-rise performance and that the data were skewed, quantile regressions were used for analysis. In contrast to more classical regression models, quantile regressions allow estimations of medians (or any other percentiles) rather than means, and do not make distributional assumptions. In a first instance, bivariate models were constructed for each covariate (age, sex, BMI and physical activity level) using quantile regression for the right and left legs separately. The median (50th), lower (2.5th) and upper (97.5th) percentile values of the coefficients were extracted from the quantile regression analyses. A multiple quantile regression model was then built using the covariates, and interaction effects were found to significantly influence the number of heel-rise repetitions. Coefficients (and 95% confidence limits) were extracted from the regression model to provide estimates of the impact of each covariate on performance.

<A>Results**Reliability**

A descriptive summary of the HRT performance parameters from the 32 subjects collected on the two different test days, as well as their between-day change in scores and reliability metrics, are provided in Table 2. Corresponding Bland-Altman plots are represented in Figure A (see online supplementary material). On average, subjects completed 32 repetitions on their right foot and 34 repetitions on their left foot, with nearly no difference in performance between test days. The ICCs were close to 1, with Bland-Altman plots indicating no systematic bias.

<insert TABLE 2 near here>

Normative values

Bivariate analyses revealed that all parameters analysed had a significant effect on HRT outcomes. The median number of heel rises completed on the right and left side was 24 and 23, respectively. Plotting the number of heel rises against age stratified by sex was suggestive of an interaction effect, whereby males completed a greater number of heel rises than females (across the percentiles) up to approximately 60 years of age, after which females outperformed males (Figure B, see online supplementary material). Therefore, the interaction between age and sex was also included in the final multiple quantile regression model.

The result of the multiple quantile regression model with the parameters of age, sex, interaction between age and sex, BMI and physical activity level is given in Table 3, where male sex and physical activity level of 6 are used as reference for comparison. Based

on the coefficients, older age, female sex and lower physical activity levels have a negative impact on HRT performance, with the interaction effect suggesting that age affects the performance of females to a lesser extent. Although BMI was found to have a negative effect on HRT performance during bivariate analysis, the significance of this effect was not apparent in the multiple quantile model. Physical activity level had the greatest impact on the median number of heel-rise repetitions after taking sex into account. Analyses reveal that the median number of heel rises is 6.8 and 9.4 greater on the left and right foot, respectively, with activity levels of 6 compared to 2.

<insert TABLE 3 near here>

The estimates and normative equations provided in Table 3 can be used by clinicians to evaluate HRT performance of individuals against a comparable normative population, taking sex, age, physical activity level and BMI into account. In Table 4, the median numbers of heel-rise repetitions expected for males and females per decade of life are presented for an individual with a typical physical activity level (i.e. 4) and BMI (24.2 kg/m²) values for the study population (i.e. central tendency measures in Table 1).

<insert Table 4 near here>

<A>Discussion

On the basis of commonly used thresholds [25] and consistent with previous investigations [14–18], the HRT protocol exhibited excellent test–retest reliability when performed 1 week apart. As hypothesised, older age, female sex and lower physical activity level had a negative effect on HRT outcome, with the sampled population of nearly 600 individuals completing a

similar number of median heel-rise repetitions when tested on their left side compared with their right side. Although taken alone, BMI had a negative effect on HRT; the significance of this effect was no longer apparent once integrated within the multiple regression model. This study also found that age influenced HRT performance differently in males and females, with age affecting the performance of females to a lesser extent than males. Consequently, although males generally completed a greater number of heel-rise repetitions than females, older females outperformed males after 60 years of age.

To date, studies addressing the influence of side on repetitive heel-rise performance have provided mixed conclusions. Certain investigations reported no significant between-leg differences in the number of repetitions performed between the left [23 (SD 3)] and right [25 (SD 3)] sides of the body [20], while others reported a significant difference between dominant [\sim 19 (SD 10)] and non-dominant [\sim 21 (SD 10)] sides [26], although cursory inspection of the data [26] suggests no meaningful side-to-side difference. These inconsistent reports reflect those relating to isometric and isokinetic plantar flexor strength, where certain authors reported greater strength in the left [8] and non-dominant [27] plantar flexors, while other authors reported opposing findings [28]. In this study, the normative sample of subjects completed one more heel-rise repetition on their right side compared with their left side when considering the median number of repetitions, which might simply reflect the natural variability in performance and is not necessarily a meaningful difference in functional strength and endurance given that the typical error of measurement for this test is approximately two repetitions [18]. In fact, the subset of individuals investigated for the test-retest component of this study actually completed approximately one to two more repetitions on their left side compared with their right side. With the available evidence, it is difficult to unequivocally claim a side-to-side difference in HRT outcome, which to a certain extent

supports the use of the uninvolved side as a reference for comparison when interpreting HRT outcome in clinical practice.

That said, the present results highlight that several factors have the potential to influence HRT outcome, and the use of population-based normative values provide additional insight on the functional capacity of individuals. Age is clearly an important factor to consider when interpreting HRT outcome in practice. The study data indicate that for each passing decade, individuals complete a median of four to five fewer heel-rise repetitions, with a slightly lower decrement in performance apparent in females than males (approximately two repetitions). With increase in age, there are modifications in musculo-tendon unit stiffness [29], cross-sectional area [30] and contractile properties [31] of the plantar flexors that underpin the deterioration in functional performance observed with ageing. Those individuals with weaker plantar flexors in older age are at greater risk of falls [32], exhibit decreased balance ability [33], and demonstrate greater mobility impairments [34], warranting the use of this test over time.

The estimates provided in Table 3 can be used to determine the median (and upper and lower limits) number of heel rises that can be expected to be performed by healthy males and females of different ages, BMI values and physical activity levels for both the right and left sides separately. The regression models can also be employed to infer the impact of lifestyle changes (e.g. increased physical activity level) on HRT outcome and plantar flexor function. Noteworthy, however, is the presence of relatively wide confidence limits in Table 3, reflecting the large intersubject variability in HRT performance and potential impact of other influential factors that were not considered here (e.g. previous injury). Narrower confidence limits could be achieved with an increased sample size and inclusion of other parameters in the regression model. Although Table 4 provides clinicians with side-, sex- and age-specific HRT reference values, clinicians should bear in mind that these provide

reasonable guidelines for individuals with ‘typical’ physical activity levels and BMI values, and do not consider all potentially influential factors on HRT outcomes.

Over the lifespan, the muscle mass [35] and strength [36] of both males and females decline, with males experiencing a greater absolute loss in muscle mass and strength than females, partly because of their superior baseline values [37]. As can be seen through the intercept lines of the plots in Figure B (see online supplementary material), the male population in this study completed approximately 25% more repetitions than the female population at baseline, and it is therefore not entirely surprising for males to show a steeper decline in performance over time. Furthermore, a few studies have reported that older females have enhanced capacity to store and utilise elastic energy in the lower extremities [38], which can also explain the better maintenance of HRT performance in females with ageing given that this test involves repetitive concentric-eccentric muscle actions of the plantar flexors [1], thereby eliciting the stretch-shortening cycle.

Physical activity level had the greatest impact on the ability of individuals to complete heel-rise repetitions after accounting for sex. Engaging in activities involving mostly sitting, short walks or low-demand household tasks (i.e. physical activity level of 2) compared with being involved in hard to very hard exercises several times per week (i.e. physical activity level of 6) [21] substantially lowered one's ability to perform heel-rise repetitions (seven to nine fewer repetitions). Overall, these results support the importance of physical activity on the functional capacity of the triceps surae muscles, which in turn can reflect health status in certain population groups [32,34]. It is encouraging to consider that, in senior groups, exercise interventions involving strengthening of the triceps surae muscles have been shown to be effective in improving lower-extremity strength and endurance, and functional performance (e.g. walking speed) [3]. The HRT can be used to monitor gains in

plantar flexor function following an intervention and, in combination with the presented regression model, can take covariates such as age and sex into account.

To further represent a normal distribution and since not all physical activity levels were represented across the range of BMI values within the initial population, the regression model presented here was derived from a subset of subjects with BMI ≤ 30 kg/m². This specific cut-off was chosen to reflect the classification scheme set by the World Health Organization [39], whereby individuals above this threshold represent an obese population that is at higher risk of non-communicable diseases and musculoskeletal disorders. Taken alone, BMI had a negative effect on HRT outcomes, but its effect was no longer significant once integrated within the regression model, perhaps due to the other factors impacting outcomes to a greater extent. As such, the estimates provided in Table 3 may not be suitable for use in obese individuals, where BMI could still play an important role in HRT outcomes. Similarly, the study population included adults aged from 20 to 81 years. The study findings should therefore not be generalised to individuals outside of this age group without further investigations. Finally, although the 32 subjects in the reliability analysis were younger and more active than the whole of the sampled population, the reliability estimates should be generalisable across the population group. A previous HRT reliability study performed in 70-year-old individuals reported comparable test–retest ICC values, which were similar in subjects with chronic heart failure (0.94–0.98) and subjects without chronic heart failure (0.93–0.94), despite the former group completing fewer repetitions ($P < 0.01$) [40].

<A>Conclusions

The standing HRT is easy to use and can be employed reliably in clinical settings to assess plantar flexion function. The estimates provided from the quantile regression models can be used to evaluate heel-rise outcomes of individuals against a comparable normative population

group matched for age, sex, BMI and physical activity level. Given this test's high reliability, it can be used to track performance over time whereby changes in HRT outcomes are likely to indicate changes in functional capacity.

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Conflict of interest: None declared.

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Fig. A. Bland-Altman plots representing the agreement between the total number of heel rises completed during the first and second test occasions. The right (above) and left (below) sides are graphed separately.

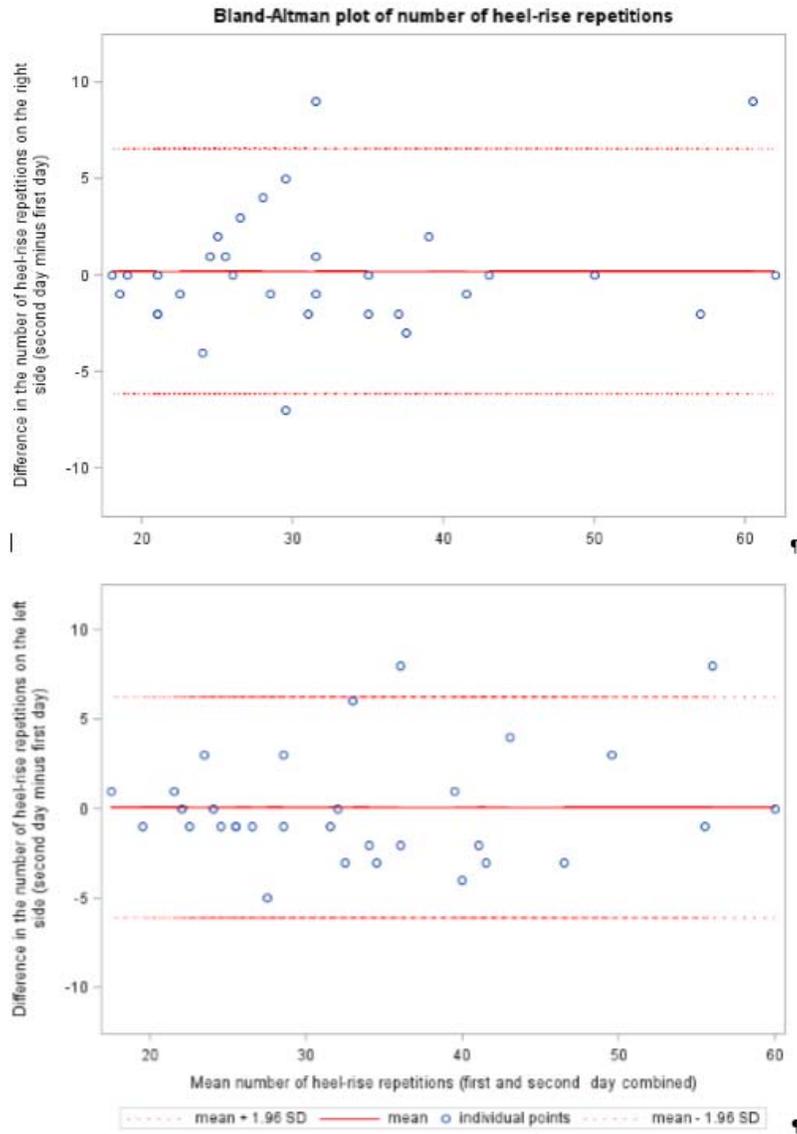


Fig. B. The median (50th, left column), upper (97.5th, right column) and lower (2.5th, right column) percentiles of the number of heel-rise repetitions, stratified by age and sex. The crossing of the lines indicates the presence of an interaction effect. The right (top row) and left (bottom row) sides are graphed separately.

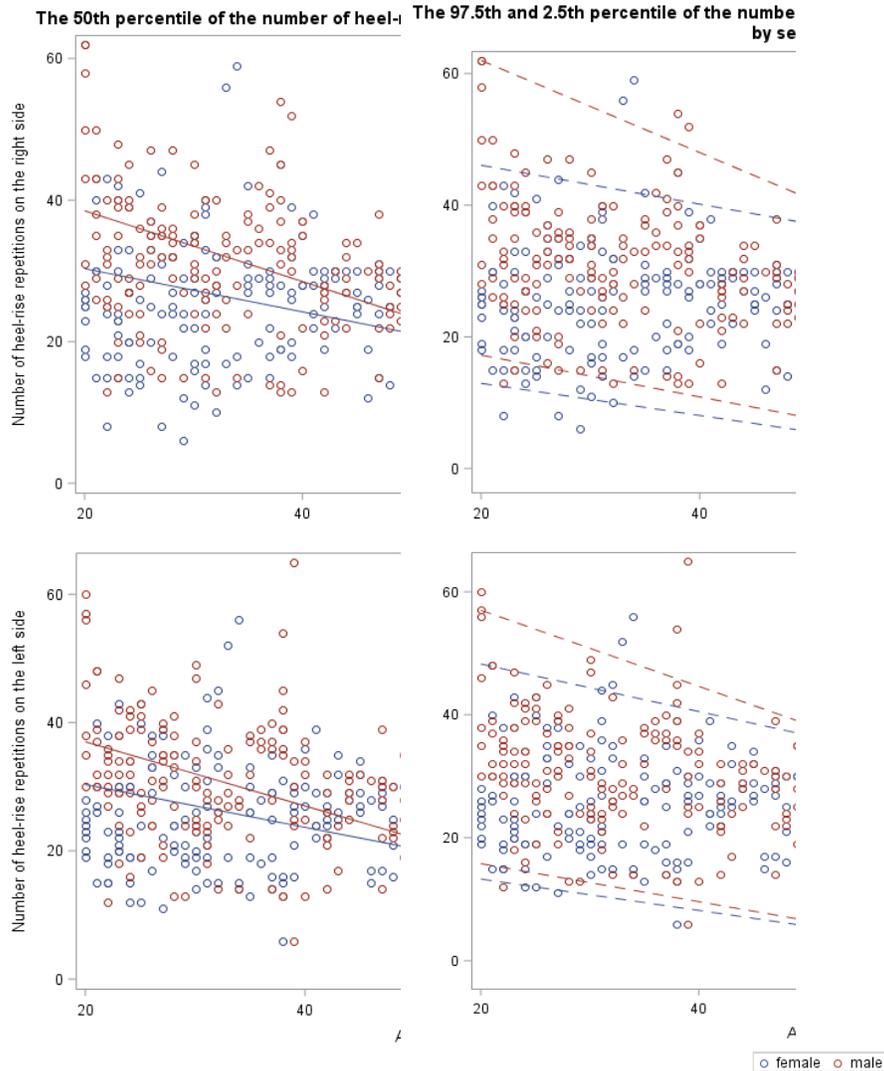


Table 1

Demographic characteristics of all subjects recruited to participate in the heel-rise study ($n=600$) and those from whom normative ($n=566$) and test–retest reliability ($n=32$) values for the heel-rise test were determined

Characteristics	Study component (n of subjects)		
	Data collection ($n=600$)	Normative values ($n=566$)	Reliability ($n=32$)
Proportion of female (%)	46	46	31
Age (years), mean (SD) (min to max)	48.6 (19.3) (20 to 81)	48.1 (19.4) (20 to 81)	27.9 (8.1) (20 to 56)
Body mass index (kg/m^2), mean (SD) (min to max)	24.6 (3.4) (16.5 to 41.0)	24.2 (2.7) (16.5 to 29.9)	23.8 (1.9) (20.8 to 29.4)
Physical activity level (1 to 6), ^a median (min to max)	4 (2 to 6)	4 (2 to 6)	5 (3 to 6)

^aSelf-reported physical activity level, where 1 indicates hardly any physical activity, and 6 indicates hard or very hard exercise several times per week.

Table 2

Standing heel-rise test performance with tests completed 1 week apart by 32 subjects to determine the reliability of measures on the right and left sides

Side	Day 1	Day 2	Δ mean	ICC	SEM
Right	32.1 (11.6)	32.3 (12.2)	0.2 (3.2)	0.964 (0.93, 0.98)	2.2 (1.6, 3.2)
Left	33.7 (10.9)	33.8 (11.5)	0.1 (3.2)	0.962 (0.92, 0.98)	2.2 (1.5, 3.1)

Mean (standard deviation) values for the number of heel-rise repetitions are given for the two test days, as well as for the between-day change in mean (Δ mean). Intra-class correlation coefficients (ICC) with their 95% confidence limits (lower, upper) and the standard error of measurement (SEM) are also provided.

Table 3

Estimates with 95% confidence limits (lower, upper) from the multiple quantile regression analysis on the median number of heel-rise repetitions adjusted for age, sex, interaction between age and sex (age*sex), body mass index (BMI), and physical activity level (PAL) are provided in the top portion of the table. Examples on how to employ the resulting normative equations are provided in the bottom portion of the table

Parameter	Left side	Right side
Intercept	54.0 (44.0, 64.1)	48.1 (39.4, 56.7)
Age	-0.5 (-0.5, -0.4)	-0.5 (-0.5, -0.4)
Sex	-11.4 (-17.5, -5.3)	-10.4 (-16.0, -4.9)
Age*sex	0.2 (0.1, 0.3)	0.2 (0.1, 0.3)
BMI	-0.3 (-0.6, 0.1)	-0.02 (-0.37, 0.33)
PAL 2	-6.8 (-11.9, -1.8)	-9.4 (-16.0, -2.9)
PAL 3	-4.6 (-8.1, -1.0)	-4.3 (-7.3, -1.3)
PAL 4	-1.4 (-4.5, 1.8)	-1.0 (-3.7, 1.7)
PAL 5	-3.0 (-6.6, 0.5)	-1.2 (-4.9, 2.6)
Normative equation ^a	Intercept + age + sex + age*sex + BMI + PAL	
<i>Example A</i>	<i>Female, 45 years, 26 kg/m², PAL 2</i>	
<i>Example B</i>	<i>Male, 22 years, 20 kg/m², PAL 5</i>	
Heel rise (left side)	54.0 – 0.5*(age) – 11.4*(sex) + 0.2*(age)*(sex) – 0.3*(BMI) + (PAL)	
<i>A: 15 repetitions</i>	54.0 – 0.5*(45) – 11.4*(1) + 0.2*(45)*(1) – 0.3*(26) – 6.8	
<i>B: 34 repetitions</i>	54.0 – 0.5*(22) – 11.4*(0) + 0.2*(22)*(0) – 0.3*(20) – 3.0	
Heel rise (right side)	48.1 – 0.5*(age) – 10.4*(sex) + 0.2*(age)*(sex) – 0.02*(BMI) +	

	(PAL)
<i>A: 14 repetitions</i>	$48.1 - 0.5*(45) - 10.4*(1) + 0.2*(45)*(1) - 0.02*(26) - 9.4$
<i>B: 36 repetitions</i>	$48.1 - 0.5*(22) - 10.4*(0) + 0.2*(22)*(0) - 0.02*(20) - 1.2$

Estimates are derived from the regression model, with males and PAL 6 used as a reference.

^aSex: male=0, female=1; PAL 6=0.

Table 4

Estimates of the normative median (50th), lower (2.5th) and upper (97.5th) percentile values (upper, lower) of the median number of heel-rise repetitions completed during the heel-rise test, presented by sex for each decade of life (i.e. 20 to 80 years)

Age (years)	Male		Female	
	Left side	Right side	Left side	Right side
20	37.4 (15.8, 51.1)	37.5 (16.7, 55.3)	29.6 (13.2, 47.2)	30.7 (13.6, 49.4)
30	32.7 (12.7, 47.5)	33.0 (13.7, 50.4)	26.8 (10.6, 44.2)	28.0 (11.1, 46.0)
40	28.1 (9.6, 43.9)	28.5 (10.6, 45.6)	24.0 (8.0, 41.2)	25.3 (8.6, 42.5)
50	23.5 (6.5, 40.4)	24.0 (7.6, 40.7)	21.3 (5.5, 38.3)	22.6 (6.4, 39.1)
60	18.8 (3.4, 36.8)	19.5 (4.5, 35.9)	18.5 (2.9, 35.3)	19.9 (3.5, 35.7)
70	14.2 (0.3, 33.2)	14.9 (1.5, 31.0)	15.7 (0.3, 32.3)	17.2 (1.0, 32.2)
80	9.6 (0.0, 26.6)	10.4 (0.0, 26.2)	12.9 (0.0, 29.4)	14.5 (0.0, 28.8)

Estimates are for individuals with a body mass index of 24.2 kg/m² and a physical activity

level of 4.