Muscle strength of young male and female adults: Differences between physically inactive and active persons in maximal forces of knee extensors, trunk flexors and extensors, arm flexors and handgrip

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INTRODUCTION:

Muscle strength is an important factor for health, sports performance, and occupational aptitude for physically demanding jobs like firefighting, police or the military. Meeting these demands with adequate strength may already be a problem for young males. Females are further disadvantaged due to well-known sex-related differences [1].

Our aim was to determine maximal isometric strength differences between sexes in inactive (INACT) and active (ACT) groups. With respect to occupational aptitude, we measured strength of arm flexors (AF), handgrip (HG), knee extensors (KE), trunk flexors (TF), and -extensors (TE) in young adults. These data from an epidemiologically relevant sample may also serve as reference points to evaluate fitness promotion focused on load handling tasks.

METHODS:

2.089 males (m) and 702 females (f) (18-25yrs) from the "Fit for life" study were included. Maximal voluntary isometric strength (Fmax) was derived from 15s force-time tracings. Sporting/ physical activity was self-reported via scaled questionnaires.

Set categories "never/rarely" (INACT) and "3x and more/week" (ACT) were used to distinguish inactive from physically active participants in four groups: male inactive (mINACT), male active (mACT), female inactive (fINACT), and female active (fACT).

ANOVA was used to determine significant differences.

RESULTS:

Sex and activity had significant (all p<0.001) effects on Fmax in all muscle groups: (m vs f/mean±SD): 529±90 vs 334±67N(HG); 579±112 vs 382±85N(KE), 209±41 vs 108±26N(AF); 591±122 vs 361±79N(TF); 807±174 vs 514±113N(TE); (INACT vs ACT/mean±SD): 460±131 vs 489±114N(HG); 502±143 vs 541±132N(KE), 168±58 vs 192±57N(AF); 489±151 vs 552±146N(TF); 701±219 vs 748±196N(TE).

Closer inspection of the four groups (mINACT/mACT/fACT/ fINACT) showed Fmax differences to vary between muscle groups: Largest Fmax differences between fINACT/fACT vs mACT were found for arm flexors (44,9%/54,3%), smallest for leg extensors (60,8%/68,1%). Corresponding values of the other muscle groups varied from 54,9% to 66,9%.

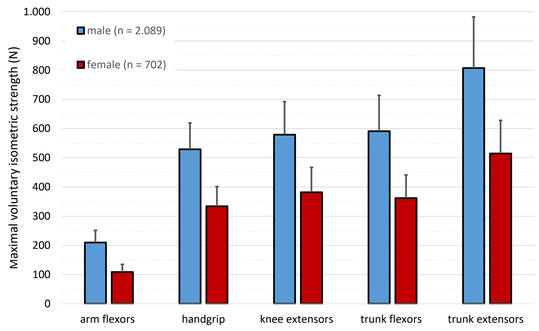


Fig. 1: Sex-related differences in maximal voluntary isometric strength (Newton) by Sex (mean/SD)

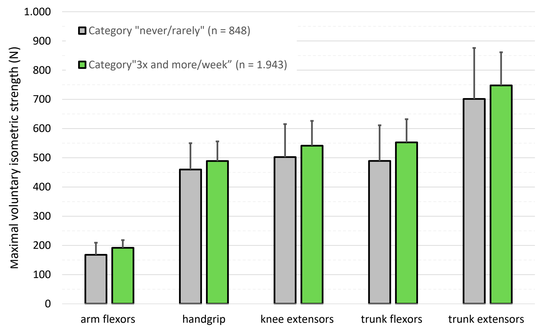


Fig. 2: Differences in maximal voluntary isometric strength (Newton) stratified by activity level (mean/SD) by Activity Level

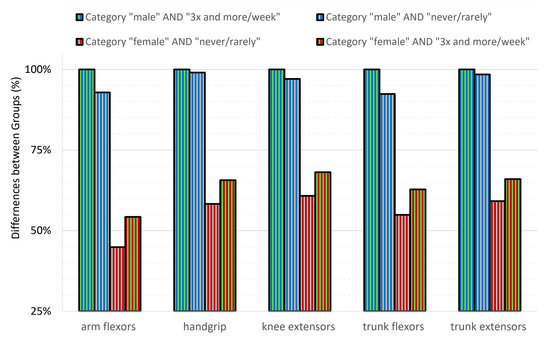
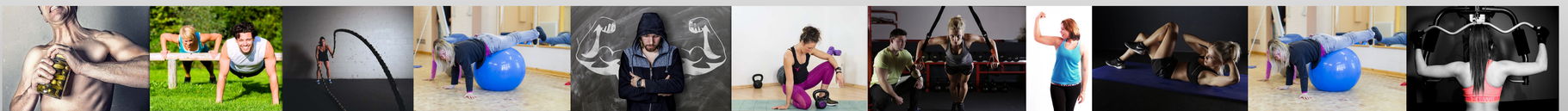


Fig. 3: Differences in maximal voluntary isometric strength (Percent) stratified by sex and activity levels

CONCLUSION:

The cross-sectional approach and limited information about the physical activity engaged in (no information about content/ type of activity, activity duration, activity intensity) are substantial limitations, so causal relations cannot be inferred, but may only be drawn with caution. Nevertheless, our results can serve as sets of reference data for strength in young adults and its general variability in five key muscle groups relevant for sports/ occupational aptitude. Inactive females produced roughly 44-61% of Fmax compared to active males. Moreover, differences persisted when comparing active females (training 3x and more/week) to inactive males: Active females reached only 58-70% of Fmax of inactive males. Largest effects of physical activity were found for arm flexors and handgrip. Our findings underline the results of previous studies postulating higher risks for overload and injury for females in occupations with heavy lifting and carrying tasks or while handling heavy equipment.

Our results also underline the necessity of tailored workplace health promotion. Strength training may reduce the force-load problem for females at work.



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