Summary of grip strength measurements obtained in the 2011-2012 and 2013-2014 National Health and Nutrition Examination Surveys

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\begin{abstract}
Study Design: Cross-sectional and descriptive study.

Introduction: Supported by the Centers for Disease Control and Prevention, the National Health and Nutrition Examination Survey (NHANES) began collecting grip strength data from nationally representative samples in 2011.

Purpose of the Study: To examine the stability of the grip strength values across 2 data release cycles and provide updated US population-based grip strength values for 6 to 80 year olds.

Methods: Handgrip data from 13,676 participants aged 6-80 years were extracted from the NHANES 2011-2014 database. The muscle strength/grip test component measured the isometric grip strength using a Takei digital handgrip dynamometer (Takei Scientific Instruments, Shinagawa-Ku, Tokyo). Grip strength values (best of 3 trials for each hand) were summarized by gender, dominant side, and age group. Grip data from 2 data release cycles (2011-2012 vs 2013-2014) were compared.

Results: Differences between 2 data release cycles were negligible. Hence, we summarize grip strength values across the entire 2011-2014 period. The mean grip strength ranged from 50.3 kg for the dominant hand of 30- to 34-year-old men to 10.0 kg for the nondominant hand of 6-year-old girls.

Discussion: The summary data we present provide relatively current reference values to which tested individuals can be compared. However, clinicians and/or researchers should be aware that the instrumentation and procedures may influence the values.

Conclusions: Results supported the stability of the NHANES grip strength values across data release cycles.

\end{abstract}

Introduction

Grip strength is easy to administer and has been recommended as an indicator of overall muscle strength\textsuperscript{7} and as a biomarker of general health status.\textsuperscript{7} Grip strength demonstrates good test-retest reliability,\textsuperscript{13} validity,\textsuperscript{4,5} and responsiveness.\textsuperscript{5} Consequently, grip strength is often included among the measures used in population-based studies of health, such as the Health, Aging and Body Composition study,\textsuperscript{8} Established Population for the Epidemiologic Study of the Elderly,\textsuperscript{9} Framingham Offspring Cohort,\textsuperscript{10} Canadian Health Measures Survey,\textsuperscript{11} and National Institutes of Health (NIH) Toolbox.\textsuperscript{12} These studies, along with others that consolidate data from various sources, suggest that grip strength is a valid, reliable, responsive, and sensitive measure of overall muscle strength and general health status.
sources, have been used to produce normative reference values for handgrip strength.

The availability of normative reference values and testing protocols notwithstanding, we are not aware of any validation of norms based on study replication. Two successive cohorts of the NHANES study (2011-2012 and 2013-2014) provide data by which such a validation is possible. Our purpose, therefore, was to compare normative grip strength data obtained from an original and an intergroup replicative cohort of the NHANES. Our expectation was that normative reference values stratified by age and gender would not differ between the 2 cohorts. If this was found to be the case, we intended to generate normative reference values derived from the consolidation of data from the 2 cohorts.

### Method

The NHANES providing data for our study was approved by the National Center for Health Statistics Research Ethics Review Board. Further approval was not sought for our study as the data used were free of personal identifiers.

### Participants

The NHANES data we used were from the years 2011-2014. The data were acquired from a stratified multistage probability sample of civilian noninstitutionalized residents of the United States. The NHANES study recruited participants aged 6 years and older. Participants were excluded if they were unable to hold the dynamometer with both hands (eg, missing both arms, both hands, thumbs on both hands, or paralyzed in both hands). Participants who were able to grip the dynamometer with 1 hand still performed the component. Participants who had surgery on either hand or wrist in the last 3 months were not tested on that particular hand.

Of the initial 19,931 data records, 3186 participants were removed because they were younger than 6 years (no handgrip data), and 2340 participants were removed because of missing values (eg, which hand began the test, handedness, height, or weight). In addition, 729 participants were excluded as outliers because their grip strength values were greater than 1.5 interquartile range of the same sex and age group or because their between-side difference in grip strength was >30%. Thus, data from 13,676 remaining participants (aged between 6 and 80 years) were included in the final analysis with a comparable representation of males (49.6%) and females (50.4%). By self-report, 91.4% of the sample was right hand dominant. Most of the sample was white (35.7%), whereas other races were represented as black (24.2%).
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