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Low Grip Strength and Prediabetes in Healthy Weight Adults

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Abstract

Introduction: Detection of prediabetes is an important step in diabetes prevention in primary care. Risk stratification of healthy weight individuals for detection of prediabetes is necessary to avoid missed opportunities for diabetes prevention.

Methods: Using data from the 2011-2012 National Health and Nutrition Examination Survey, we studied the relationship between combined handgrip strength, a proxy for lean muscle mass, and prediabetes among adults age 20 and older without diagnosed or undiagnosed diabetes who had a healthy weight body mass index (18.5-24.9) (unweighted n=1,340, weighted n=58,360,690). Prediabetes was defined as having a glycohemoglobin level between 5.7% and 6.4%.

Results: 20.5% of the healthy weight adults had prediabetes. Combined mean grip strength was lower for individuals with prediabetes than those with normoglycemia in the full sample (63.8 kg compared to 70.9 kg, p=.004). Similar results were seen among both men (87.9 kg compared to 82.1kg, p=.03) and women (51.8 kg compared to 56.5 kg, p=.001) in subgroup analysis.

Conclusions: Grip strength is associated with prediabetes among healthy weight US adults. Grip strength may have utility as an indicator for screening healthy weight individuals for prediabetes.

Prediabetes is a high risk state for development of diabetes.¹ Over one third of adults in the USA have prediabetes but the majority of these individuals are unaware that they have prediabetes.² Treatment of prediabetes has been associated with delayed onset of diabetes.³ Detection of prediabetes is a fundamental strategy to preventing the transition to diabetes.¹

Recommendations for screening for prediabetes by the American Diabetes Association focus on adults who are overweight or obese and may miss individuals of a healthy weight with “normal weight obesity,” a condition characterized by high body fat and lower lean muscle mass at a healthy BMI.^{1,4} Grip strength, a proxy for lean muscle mass, is predictive of undiagnosed diabetes among patients at healthy BMI.⁵ The objective of this study was to

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CONFLICT OF INTEREST STATEMENT

The authors report no real or perceived conflicting or competing interests.

examine the relationship between grip strength and prediabetes among healthy weight adults.

METHODS

We analyzed the nationally representative National Health and Nutrition Examination Survey (NHANES) data from 2011-2012. The NHANES is a nationally representative survey for the non-institutionalized civilian population of the United States that includes a physical examination an interview covering a broad range of health-related topics, and a variety of laboratory tests. The data is publicly available for secondary analysis from the Centers for Disease Control and Prevention. All of the analyses were conducted using the de-identified data supplied by the National Center for Health Statistics. The current study focused on adults age 20 and older who had a body mass index (BMI) of 18.5 to less than 25, with no reported diagnosis of diabetes, and an HbA1c reading below 6.5% (47.5 mmol/mol) upon examination. A total of 1,340 adults were analyzed, representing 58,360,690 Americans.

Handgrip strength was measured using a Takei digital grip strength dynamometer. Grip strength was measured three times using both hands in a standing position. This analysis utilized combined grip strength in kilograms, calculated as the sum of the highest reading from each hand. Individuals were considered to have prediabetes if they reported a diagnosis by a physician of “borderline diabetes” or prediabetes, or if upon examination, their HbA1c level was between 5.7% (38.8 mmol/mol) and 6.4% (46.4 mmol/mol).

To account for the survey design of the NHANES, we used SUDAAN 11 (Research Triangle Institute, Research Triangle Park, NC) for all analysis. The survey design and weighting variables allowed us to account for survey design in univariate analyses and two-sample t-tests, to make population estimates for the non-institutionalized civilian population of the US.

RESULTS

Among healthy weight adults, 20.5% had HbA1c levels consistent with prediabetes. Grip strength among individuals with prediabetes was significantly lower than in individuals without prediabetes, both among the full sample, as well as among men and women (Table 1). Among Whites, grip strength was significantly lower among individuals with prediabetes (62.2 kg) than among individuals without prediabetes (71.4 kg, $p=.004$). Mean grip strength among non-Whites with prediabetes was 68.9 kg and grip strength among non-Whites without prediabetes was 70.6 kg ($p=.39$). Among individuals age 45 and older, individuals with prediabetes had a mean grip strength of 59.9 kg, and those without prediabetes had a mean grip strength of 65.16 ($p=.07$). The difference in means was significant among women age 45 and older. Women age 45 and older with prediabetes had a mean grip strength of 49.7 kg; those without prediabetes had a mean grip strength of 52.8 kg ($p=.05$). Men age 45 and older with prediabetes had a mean grip strength of 79.7 kg, while those without prediabetes had a mean grip strength of 81.7 kg ($p=.39$).

DISCUSSION

These results show grip strength as a marker for prediabetes in US healthy weight adults. The findings are particularly important because 20.5% of healthy weight adults had prediabetes, and these individuals are not typically screened for prediabetes due to their healthy weight. The association of grip strength with prediabetes among healthy weight individuals indicates the potential utility of grip strength as a pre-screening measure to determine whether an individual should be screened. Interestingly, decreased grip strength was present among Whites with prediabetes, but not for non-Whites with prediabetes. Minorities are known to be at increased risk for diabetes—it may be that grip strength is unrelated to prediabetes in individuals who are already at increased risk.

This is the first study, to our knowledge to evaluate the relationship between grip strength and prediabetes in healthy weight individuals. As such, the results showing the relationship between lower grip strength and prediabetes in this presumed healthy population are intriguing but are currently just a first step. Grip strength has the potential to be a marker of prediabetes among certain populations. The use of grip strength however, needs further research to determine clinical cut off values for the screening, especially given known differences in grip strength between men and women, and for individuals of different ages. Further study can identify the cut off points that might contribute to the utility for implementing grip strength measures in primary care practice to heighten suspicion of prediabetes. The current study might contribute to a more sophisticated, but inexpensive and easily implemented assessment adjunct measure of body composition that seems to be missing when using BMI alone to classify the healthy weight population at risk of prediabetes. Consequently, this strategy could identify more patients with prediabetes who would not have been identified and thereby contribute to preventing prediabetes.

This study has several limitations to the generalizability and interpretation of the results. First, although the data is nationally representative it is cross-sectional data, which means we can only show an association between grip strength and prediabetes, not a causal relationship. However, the utility of grip strength as a potential cue to screen for prediabetes relies only on the association of grip strength with prediabetes, and does not require causal inference as to whether prediabetes causes decreased grip strength or decreased muscle mass led to prediabetes. Second, there might be a potential confounder such as physical activity that is associated with grip strength. While some physical activity can influence strength of forearm (which may be related to grip strength), the data is limited to regarding the type of leisure time and work-related physical activity in the NHANES, so we cannot examine differences in activities that may account for differences in grip strength. In any event, grip strength seems to distinguish individuals with prediabetes at healthy weight, a group that would not be at heightened suspicion for prediabetes. Third, a review of the literature of the use of dynamometers in epidemiological studies found there is evidence that variation in how a dynamometer is used can impact the values recorded,⁶ and has implications for the potential need for standardized protocols for assessment of grip strength in a primary care setting.

In conclusion, considering the substantial proportion of healthy weight adults with prediabetes, strategies for diabetes prevention may benefit from additional risk stratification of these patients. Decreased grip strength may have future utility in increasing suspicion of prediabetes and potentially guiding screening for prediabetes among healthy weight adults.

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Table 1.

Comparison of mean combined grip strength by prediabetes status using t-tests for statistical significance.

Full Sample	Mean (Kg)	Standard Error	p-value
No prediabetes	70.9	1.01	0.004
Prediabetes	63.8	1.43	
Men			
No prediabetes	87.9	1.41	0.03
Prediabetes	82.1	1.76	
Women			
No prediabetes	56.5	0.79	0.001
Prediabetes	51.8	1.03	

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