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Handgrip Strength and Risk of Atrial Fibrillation

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Abstract

Consistent evidence suggests inverse and independent associations between handgrip strength (HGS) and cardiovascular outcomes. However, whether HGS is specifically related to future risk of atrial fibrillation (AF) is uncertain. We sought to assess the prospective association between HGS and risk of AF. Handgrip strength was assessed using a hand dynamometer in a general population-based cohort of 827 men and women aged 61-74 years with no history of AF at study entry. Absolute values of HGS were allometrically scaled to account for the effect of body weight (handgrip strength/body weight$^{2/3}$) and to normalize the data. Hazard ratios (HRs) with 95% confidence intervals (CIs) were estimated for AF. During a median (interquartile range) follow-up of 15.7 (9.5-18.8) years, 265 AF cases were recorded. The HR (95% CI) for AF per 1 standard deviation increase in normalized HGS in age- and sex-adjusted analysis was 0.73 (0.61-0.86). The association remained similar in analyses adjusted for several established and emerging risk factors 0.77 (0.64-0.92). The corresponding adjusted HRs (95% CIs) were 0.53 (0.39-0.73) and 0.60 (0.44-0.83), respectively, when comparing the top versus bottom tertiles of normalized HG. In conclusion, normalized HGS is inversely associated with the future risk of AF in the general population.

Atrial fibrillation (AF) is the most commonly diagnosed arrhythmia in clinical practice and is a leading cause of cardio-metabolic stroke.[1] Major modifiable risk factors that increase the risk of AF include obesity, obstructive sleep apnoea, high blood pressure, smoking, excessive alcohol consumption and physical inactivity. Strategies that target these modifiable risk factors can help lower the burden of AF. Although a significant amount of health resources have been invested in the prevention, detection and management of AF, it is still on the increase, and reasons for this increase remain elusive.[1] Though the increase may partly be due to the aging population and higher detection, it appears there may be other factors that may explain the residual risk of AF. Handgrip strength (HGS) is well known to be a measure of muscular strength and a useful indicator for general health status. Several studies have demonstrated HGS to be inversely associated with the risk of chronic disease outcomes such as cardiovascular disease (CVD), diabetes, osteoporotic fractures, as well as all-cause mortality.[2-5] Additional evidence suggests that HGS improves the prediction of outcomes such as CVD mortality and type 2 diabetes beyond that of conventional risk factors.[4,6] However, no previous study has demonstrated the existence of an association between HGS and AF. Given that AF is a cardiovascular outcome and hence share similar risk factors with CVD, we hypothesized that increased HGS would be associated with a lower risk of AF. In this context, we sought to assess the prospective association between HGS and risk of AF in a general population-based cohort of Finnish men and women with no history of AF at study entry.

We employed the Kuopio Ischemic Heart Disease Risk Factor (KIHD) study, a population-based prospective cohort study designed to investigate potential risk factors for atherosclerotic cardiovascular outcomes and other related chronic disease outcomes. Methods for participant recruitment, baseline physical examinations, blood sampling and measurements have been described in previous reports.[4,6-8] Baseline examinations and measurements were performed between March 10, 1998 and February 2, 2000. A hand dynamometer was used to measure the handgrip strength of the dominant hand for each participant (in kPa; Martin-Balloon-Vigorimeter; Gebrüder Martin, Tuttlingen, Germany). The mean of two measurements was used for analysis. The dynamometers were calibrated at the beginning of each test, and there was a one-minute resting gap between both handgrip measurements. Absolute values of

HGS were allometrically scaled to account for the influence of body weight and to normalize the data (normalized HGS = HGS/body weight$^{2/3}$) [6,9]. All results were multiplied by 100 for easier readability. All incident cases of AF from study entry through to 2018 were included, and no losses to follow-up were recorded. Participants with a baseline history of AF were excluded. The diagnostic classification of AF cases was conducted according to the International Classification of Diseases (ICD)-10 codes (I48.0-I48.9).[8,10,11] Each participant provided written informed consent. The institutional review board of the University of Kuopio and Kuopio University Hospital, Kuopio, Finland, approved the protocol (License number 143/97) in line with the Helsinki Declaration. Hazard ratios (HRs) with their 95% confidence intervals (CIs) for AF were calculated using Cox proportional hazard models. All statistical analyses were conducted using Stata version MP 16 (Stata Corp, College Station, Texas, USA).

The overall mean (standard deviation, SD) age of study participants at study entry was 69 (3) years, and 46% were males. The mean (SD) values of normalized HGS and body weight were 0.48 (0.23) kPa/kg$^{2/3}$ and 75.2 (12.9) kg respectively (**Table 1**). During a median (interquartile range) follow-up of 15.7 (9.5-18.8) years, a total of 265 AF cases (annual rate 23.08/1,000 person-years at risk; 95% CI: 20.47 to 26.04) were recorded. Cumulative hazard curves demonstrated a lower risk of AF among individuals in the top tertile of normalized HGS values compared to those in the bottom tertile (p<.001 for log-rank test; **Figure 1**). The HR for AF per 1 SD increase in normalized HGS in age- and sex-adjusted analysis was 0.73 (95% CI: 0.61 to 0.86), which remained similar on further adjustment for established risk factors and other potential confounders (body height, total cholesterol, high-density lipoprotein cholesterol, systolic blood pressure, history of type 2 diabetes, resting heart rate, smoking status, prevalent coronary heart disease and physical activity) 0.77 (95% CI: 0.64 to 0.92) (**Table 1**). The corresponding adjusted HRs were 0.53 (95% CI: 0.39 to 0.73) and 0.60 (95% CI: 0.44 to 0.83), respectively, when comparing the top versus bottom tertiles of normalized HGS. The HRs were unchanged in a third model that adjusted for alcohol consumption.

To our knowledge, only one prospective study has so far evaluated the association between HGS and risk of cardiac arrhythmias, including AF. Andersen and colleagues using a large Swedish cohort of

military conscriptees demonstrated higher muscle strength (assessed by HGS) to be associated with a lower risk of arrhythmias.[12] However, they found no association with the specific outcome of AF. Furthermore, the study did not account for the effect of body weight on HGS values, given that body size is a key factor that explains muscle strength. Several cohort studies have demonstrated associations between high HGS and lower risk of vascular disease and mortality.[4,5] It has been suggested these effects may be mediated by a reduction in the incidence of vascular risk factors such as chronic inflammation, weight gain, abdominal adiposity, insulin resistance, and inflammation.[13] Hence, given that AF is also a vascular-related outcome, we postulate that similar pathways may explain the relationship between high HGS and lower risk of AF. The current findings are relevant and add to the accumulating literature on the relationship between muscular strength and vascular outcomes.

In conclusion, normalized HGS is inversely associated with the future risk of AF in the general population.

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Disclosures

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Figure Title and Legend

Figure 1. Cumulative hazard curves for atrial fibrillation according to the tertiles of normalized handgrip strength

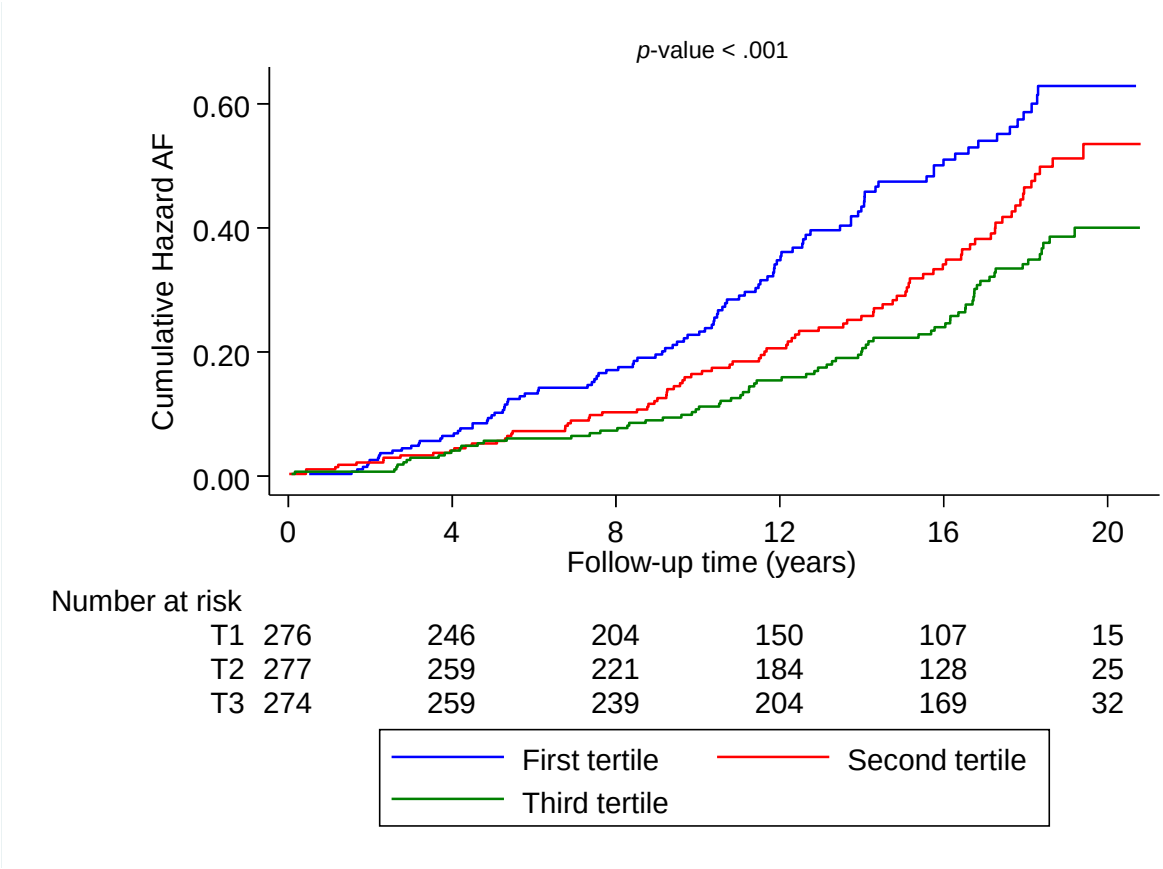

Table 1. Association between normalized handgrip strength and risk of atrial fibrillation

Normalized handgrip strength (kPa/kg$^{2/3}$)	**Events/ Total**	**Model 1**		**Model 2**		**Model 3**	
		HR (95% CI)	*P*-value	HR (95% CI)	*P*-value	HR (95% CI)	*P*-value
Per 1 SD increase	265 / 827	0.73 (0.61 to 0.86)	< .01	0.77 (0.64 to 0.92)	.004	0.77 (0.62 to 0.95)	0.01
T1 (0.12-0.38)	103 / 276	ref		ref		ref	
T2 (0.39-0.52)	87 / 277	0.70 (0.53 to 0.94)	.02	0.75 (0.56 to 1.00)	.05	0.75 (0.49 to 1.13)	.17
T3 (0.53-4.03)	75 / 274	0.53 (0.39 to 0.73)	< .01	0.60 (0.44 to 0.83)	.002	0.61 (0.41 to 0.91)	.02

CI, confidence interval; HR, hazard ratio; ref, reference; SD, standard deviation; T, tertile

Model 1: Adjusted for age and sex

Model 2: Model 1 plus body height, total cholesterol, high-density lipoprotein cholesterol, systolic blood pressure, history of type 2 diabetes, heart rate, smoking status, prevalent coronary heart disease and physical activity

Model 3: Model 2 plus alcohol consumption