GeroScience
https://doi.org/10.1007/s11357-024-01335-5

ORIGINAL ARTICLE

Purpose in life and grip strength: An individual-participant meta-analysis of 115,972 participants from 24 countries across four continents

Angelina R. Sutin · Martina Luchetti · Yannick Stephan · Norma Mansor · Tiia Kekäläinen · Antonio Terracciano

Received: 15 April 2024 / Accepted: 28 August 2024

Abstract This research examines the replicability and generalizability of the association between purpose in life and grip strength. An individual-participant meta-analysis of 27 samples (total N=115,972) from 24 countries that spanned four continents (Asia, Europe, North and South America) with self-reported purpose in life and dynamometer-assessed grip strength. Purpose in life was associated with stronger grip strength in every sample and aggregated in a random-effects meta-analysis (meta-analytic estimate=.06, p<.001). The association was similar across samples from different world regions and not moderated by methodological factors (e.g., scale content). The association was apparent across age, sex, race, and education and slightly stronger among males and participants with relatively less education. Every standard deviation in purpose was associated with a 23% lower likelihood of weak grip strength (meta-analytic OR=.81, 95% CI=.79-.84, p<.001) based on a standard threshold. Purpose in life is associated with grip strength, a marker of overall musculoskeletal health. The association replicates across diverse locations around the world and generalizes across sociodemographic groups.

Keywords Grip strength · Meaning in life · Purpose in life · Eudaimonic well-being · Strength

Grip strength has been proposed as a critical biomarker of health [3]. In older adulthood, weak grip strength is a key indicator of frailty and sarcopenia [10, 11] and predicts numerous outcomes, including limitations in activities of daily living [21], risk of myocardial infarction and stroke [18], incident dementia [9], and ultimately premature mortality [5]. Correlates of poor grip strength have focused primarily on clinical and behavioral risk factors. Stronger grip strength, for example, is a reflection of stronger general muscle strength [24], cardiovascular health [17], physical activity [8], and nutrition [12].

Psychological factors have also been associated with grip strength. Individuals higher in conscientiousness and lower in neuroticism, for example, tend to have stronger grip strength [27], and low grip strength may be one marker of elevated depressive symptoms [20]. There are other aspects

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s11357-024-01335-5.

A. R. Sutin (✉) · M. Luchetti · A. Terracciano
Florida State University College of Medicine, 1115 W. Call Street, Tallahassee, FL 32306, USA
e-mail: angelina.sutin@med.fsu.edu

Y. Stephan
Euromov, University of Montpellier, Montpellier, France

N. Mansor
Universiti Malaya, Kuala Lumpur, Malaysia

T. Kekäläinen
Laurea University of Applied Sciences, Vantaa, Finland

Published online: 01 October 2024

of psychological function that may likewise be associated with grip strength. Purpose in life, for example, is a component of eudaimonic well-being that is associated consistently with better health . Purpose in life is the feeling that one's life is driven, future-oriented, and has direction [25]. Individuals who are higher in purpose tend to have fewer chronic diseases [23] and are less likely to develop diseases in older adulthood, such as cardiovascular disease [7] or dementia [30, 33, 34]. And, likely because of these healthier profiles, purpose is associated with lower risk of premature mortality [1].

Purpose in life has been associated with several aspects of physical activity and function. There is a consistent association between purpose and greater engagement in physical activity: Individuals with more purpose tend to be more physically active, measured with an accelerometer [30, 33, 34], as well as with self-report [16], perhaps because of their healthier motivational profiles [31, 32]. Purpose in life is likewise associated with faster walking speed [15], and lower risk of decline in walking speed over time [29]. One study suggested that purpose is also associated with grip strength: Using data from the Health and Retirement Study, Kim and colleagues (2017) found that participants with higher purpose in life had a lower risk of developing weak grip strength over four years.

The present research seeks to build on this evidence to evaluate the replicability and generalizability of the association between purpose in life and grip strength. We assess replicability in 27 samples from 10 cohort studies that span four continents. This association is tested in each sample and then the results synthesized with a random-effects meta-analysis. We evaluate generalizability by testing for moderation by age, sex, race, and education within the individual samples and use meta-regression to identify sources of heterogeneity across samples (e.g., differences across world regions). In addition, we test whether purpose is associated with weak grip strength. We expect that higher purpose in life will be associated with stronger grip strength, that this association will generalize across populations, and that purpose will be associated with lower likelihood of performing below the threshold for weak grip strength.

Method

Participants and Procedure

Ten established cohort studies with relevant data on purpose in life and grip strength were selected for analysis: the Health and Retirement Study (HRS; https://hrs.isr.umich.edu/), the Midlife Development in the United States study (MIDUS; http://midus.wisc.edu/), the National Health and Aging Trends Study (NHATS; https://www.nhatsdata.org/), the Wisconsin Longitudinal Study (WLS; https://www.ssc.wisc.edu/wlsresearch/), the English Longitudinal Study of Ageing (ELSA; https://www.elsa-project.ac.uk/), the Survey of Health, Ageing and Retirement in Europe (SHARE; http://www.share-project.org/), The Irish LongituDinal Study on Aging (TILDA; https://tilda.tcd.ie/), the Brazilian Longitudinal Study of Aging (ELSI; https://elsi.cpqrr.fiocruz.br/en/home-english/), the Japanese Study of Aging and Retirement (JSTAR; https://www.rieti.go.jp/en/projects/jstar/), and the Malaysian Ageing and Retirement Study (MARS; https://swrc.um.edu.my/introduction). The SHARE cohort had samples from 18 countries, and these samples were analyzed individually to evaluate generalizability across countries. The WLS cohort included both a focal graduate and a selected sibling of the graduate in the sample. The focal graduates and selected siblings were analyzed as a single sample because participants were from the same population and were administered the same measures. All other cohorts were analyzed as single samples.

Measures

Purpose in life Purpose in life was measured with a version of the Purpose in Life subscale of the Ryff Scales of Psychological Well-Being (Keyes et al., 2002) in HRS, MIDUS, and WLS. Items were rated on a scale from 1 (*strongly disagree*) to 6 (*strongly agree*) in HRS and WLS and from 1 (*strongly disagree*) to 7 (*strongly agree*) in MIDUS. ELSA, SHARE, TILDA, ELSI, and JSTAR measured purpose with an item ("I feel that my life has meaning.") from the Pleasure scale of the control-autonomy-pleasure-self-realization scale (CASP-19) of quality of life in older adulthood (Hyde et al., 2003) on a 4-point scale in ELSA, SHARE, TILDA, and JSTAR from 1 (*never*) to 4 (*often*) and from 1 (*never*) to 3

(*always*) in ELSI. NHATS measured purpose with a single item ("My life has meaning and purpose.") on a scale from 1 (*agree a lot*) to 3 (*agree not at all*). MARS measured purpose with a single item ("I am leading a meaningful purpose in life.") on a scale from 1 (*strongly disagree*) to 5 (*strongly agree*). In all samples, questions were presented in the local language, items were reverse scored when necessary, and scores were in the direction of greater purpose in life (i.e., higher scores indicated more purpose).

Grip strength In each sample, participants were asked to squeeze a dynamometer with their dominant hand as hard as possible. This measurement was taken three times in MIDUS, ELSA, and ELSI, two times in HRS, NHATS, WLS, SHARE, and TILDA and once in JSTAR and MARS. For samples with multiple trials, the maximum grip strength was used. The main analysis used the continuous measure of grip strength. A supplemental analysis on weak grip strength categorized the continuous measure based on a validated threshold [2, 15]: <26 kg for males and <16 kg for females (coded as 1) and ≥=26 kg for males and ≥16 kg for females (coded as 0).

Covariates Sociodemographic covariates were age in years, sex (0=male, 1=female), race, and education. Race in HRS, MIDUS, NHATS, and ELSI was coded as two dummy-coded variables that compared Black (=1) and otherwise identified (=1) to white (=0). Race in ELSA was coded as white (=0) versus not white (=1); ELSA does not provide more specific information on race. WLS and TILDA were white. SHARE does not collect information on race. JSTAR was Japanese and MARS was Malaysian. Education was measured in years in HRS and WLS and reported on a scale from 1 (*no school/some grade school*) to 12 (*doctorate or professional degree*) in MIDUS, from 1 (*no schooling completed*) to 9 (*master's, professional, or doctoral degree*) in NHATS, from 1 (*no qualification*) to 7 (*NVQ4/NVQ5/Degree or equivalent*) in ELSA, from 1 (*some primary, not complete*) to 7 (*postgraduate/higher degree*) in TILDA, from 1 (*never studied*) to 18 (*doctoral degree/PhD*) in ELSI, from 1 (*elementary/middle school*) to 7 (*graduate school*) in JSTAR, from 1 (*no schooling/kindergarten*) to 8 (*postgraduate/equivalent qualification*) in MARS, and from 0 (*none*) to 6 (*ISCED-97 code 6*) in SHARE. For WLS, a variable that indicated sample (0=graduate, 1=sibling) was included as an additional covariate in all analyses.

Analytic strategy

The same analyses were conducted across all samples with harmonized variables to facilitate comparisons and meta-analysis. The same coding scheme for all dichotomous variables was applied in every sample, and all continuous measures were standardized within each sample to a mean of zero and standard deviation (SD) of one; thus, coefficients can be interpreted as a one-SD difference in the continuous predictor. The association between purpose in life and continuous grip strength was tested with linear regression, controlling for the covariates, and summarized with a random-effects meta-analysis. Meta-regression was used to try to identify sources of heterogeneity across studies. The possible moderators tested using meta-regression were percent of females in the sample, number of items on the purpose scale, whether the scale primarily measured purpose in life or meaning in life, the number of trials for grip strength, sample location (US versus other countries, Europe versus other countries, Asia versus other countries), per capita gross domestic product (GDP), mean grip strength of the sample, and percent weak grip strength in the sample (see Supplemental Table S1 for coding). Within each sample, moderation by age, sex, race, and education was tested with an interaction between purpose and each of these factors, controlling for the main effects and other covariates. As with the main analysis, the moderation analysis was run in the individual samples and then summarized with a random-effects meta-analysis. Finally, the likelihood of weak grip was tested with logistic regression, controlling for the same covariates, and summarized with a random-effects meta-analysis.

Results

Descriptive statistics are in Table 1. The 10 cohort studies included 115,972 participants tested in 24 countries from North America, South America, Europe, and Asia. The forest plot of the association between purpose in life and grip strength across samples from the meta-analysis is in Fig. 1; results of the individual samples are in Supplemental Table S2.

Table 1 Descriptive statistics for all samples

Variable	HRS: United States	MIDUS: United States	NHATS: United States	WLS: United States	ELSA: England	TILDA: Ireland	ELSI: Brazil
Age (years)	68.00 (10.32)	53.73 (12.70)	76.99 (7.60)	70.53 (4.11)	65.63 (9.55)	62.28 (9.01)	62.55 (9.39)
Age range	26-104	25-84	65-105	40-92	37-99	49-80	50-99
Sex (female)	58.8% (7233)	52.7% (940)	56.5% (3345)	53.5% (3961)	54.8% (4017)	55.1% (2985)	56% (4449)
Race (Black)	11.8% (1452)	3.6% (64)	20.0% (1187)	--	--	--	55.5% (4415)
Race (Otherwise identified)	4.3% (528)	11.6% (206)	6.1% (362)	--	2.0% (143)	--	6.9% (552)
Education	12.71 (3.04)	8.01 (2.42)	5.12 (2.22)	13.91 (2.45)	4.03 (2.24)	3.85 (1.57)	6.62 (4.37)
Purpose in life	4.59 (.93)	39.27 (6.66)	2.82 (.43)	27.82 (4.74)	3.51 (.71)	3.74 (.58)	2.77 (.54)
Grip strength	30.92 (11.12)	36.29 (12.06)	26.34 (10.49)	29.82 (10.90)	31.09 (11.65)	27.04 (9.98)	27.32 (10.13)
Poor grip strength (yes)	8.6% (1059)	3.1% (56)	21.8% (1293)	9.3% (687)	10.0% (732)	15.2% (824)	16% (1272)
Sample size	12294	1783	5924	7400	7333	5413	7950
Variable	JSTAR: Japan	MARS: Malaysia	SHARE: Austria	SHARE: Germany	SHARE: Sweden	SHARE: Spain	SHARE: Italy
Age (years)	65.11 (7.00)	57.30 (10.65)	68.32 (9.42)	65.50 (9.69)	69.52 (9.26)	68.17 (10.08)	65.72 (9.71)
Age range	52-78	40-91	34-97	32-95	32-102	31-99	35-97
Sex (female)	48.9% (974)	55.5% (3013)	58.3 (1666)	52.7% (2161)	53.6% (1934)	54.3% (2488)	53.9% (2446)
Race (Black)	--	--	--	--	--	--	--
Race (Otherwise identified)	--	--	--	--	--	--	--
Education	2.27 (1.34)	3.00 (1.50)	3.25 (1.32)	3.57 (1.10)	3.15 (1.55)	1.70 (1.50)	2.09 (1.32)
Purpose in life	2.94 (.80)	4.06 (.66)	3.74 (.56)	3.73 (.61)	3.73 (.58)	3.46 (.76)	3.50 (.71)
Grip strength	28.54 (8.29)	22.52 (10.47)	32.88 (11.76)	34.98 (11.63)	33.78 (11.77)	28.36 (11.02)	31.95 (11.56)
Poor grip strength (yes)	7.2% (144)	40.1% (2177)	6.3% (181)	4.4% (179)	5.5% (199)	17.8% (815)	8.2% (372)
Sample size	1993	5426	2859	4100	3609	4585	4534
Variable	SHARE: France	SHARE: Denmark	SHARE: Greece	SHARE: Switzerland	SHARE: Belgium	SHARE: Israel	SHARE: Czech Rep
Age (years)	66.80 (10.66)	64.72 (10.10)	65.76 (10.16)	67.71 (9.69)	65.21 (10.65)	68.09 (9.37)	67.27 (8.89)
Age range	34-98	32-100	31-94	30-99	24-96	24-98	27-102
Sex (female)	56.8% (2031)	54.2% (1931)	56.2% (2593)	54.8% (1461)	55.1% (2939)	57.3% (856)	59.6% (2611)
Race (Black)	--	--	--	--	--	--	--
Race (Otherwise identified)	--	--	--	--	--	--	--
Education	2.70 (1.66)	3.64 (1.34)	2.45 (1.63)	3.23 (1.13)	3.19 (1.53)	3.28 (1.63)	2.81 (1.14)
Purpose in life	3.52 (.75)	3.84 (.45)	3.31 (.76)	3.76 (.56)	3.56 (.75)	3.43 (.80)	3.53 (.68)
Grip strength	31.76 (11.52)	36.30 (12.45)	31.80 (11.79)	33.43 (11.32)	33.51 (11.82)	27.54 (10.60)	32.80 (10.95)
Poor grip strength (yes)	8.2% (293)	4.0% (144)	8.6% (381)	6.0% (160)	6.3% (335)	15.7% (234)	5.5% (242)
Sample size	3574	3565	4437	2667	5331	1495	4379
Variable	SHARE: Poland	SHARE: Luxembourg	SHARE: Portugal	SHARE: Slovenia	SHARE: Estonia	SHARE: Croatia	
Age (years)	65.18 (9.56)	64.13 (9.33)	66.53 (8.93)	66.63 (9.58)	67.57 (10.50)	64.24 (9.29)	
Age range	40-97	35-96	42-93	42-97	36-97	29-95	
Sex (female)	56.0% (855)	53.7% (765)	55.1% (763)	57.5% (2217)	62.9% (3065)	55.7% (1257)	

Table 1 (continued)

Race (Black)	--	--	--	--	--	--
Race (Otherwise identified)	--	--	--	--	--	--
Education	2.61 (1.26)	2.77 (1.56)	1.71 (1.39)	2.92 (1.22)	3.38 (1.18)	2.82 (1.23)
Purpose in life	3.45 (.75)	3.72 (.60)	3.34 (.79)	3.63 (.64)	3.35 (.85)	3.60 (.64)
Grip strength	32.86 (11.98)	33.71 (11.79)	28.21 (10.26)	33.14 (12.29)	32.05 (12.30)	33.42 (12.36)
Poor grip strength (yes)	7.7% (118)	5.5% (79)	14.8% (205)	8.5% (326)	8.7% (422)	8.3% (187)
Sample size	1526	1425	1386	3854	4875	2255

Note. Numbers are mean (standard deviation) or percentage (*n*). *HRS* Health and Retirement Study, *MIDUS* Midlife Development in the United States study, *NHATS* National Health and Aging Trends Study, *WLS* Wisconsin Longitudinal Study, *ELSA* English Longitudinal Study of Ageing, *TILDA* The Irish LongituDinal Study on Aging, *ELSI* Brazilian Longitudinal Study of Aging, *JSTAR* Japanese Study of Aging and Retirement, *MARS* Malaysia Ageing and Retirement Survey, *SHARE* Survey of Health, Ageing and Retirement in Europe

This association was very consistent: Greater purpose in life was associated with stronger grip strength in all 27 samples.

Even with this consistency, the meta-analysis indicated significant heterogeneity, which suggested that the association was stronger in some samples than in others. This association, however, was not moderated by any of the sample-level factors that we hypothesized could be sources of heterogeneity (Supplemental Table S3): The strength of the association did not vary by percentage of females in the sample, length of the purpose scale, purpose versus meaning, the number of times grip strength was measured, region of the world, GDP, mean grip strength of the sample, and percent of the sample with weak grip strength.

We next evaluated whether the association varied by age, sex, race, or education within each sample (Supplemental Table S4). The meta-analysis of interaction terms indicated that there were differences by sex and education but not age or race. To better quantify the association for sex, we stratified each sample by male and female. The results of the individual samples are in Supplemental Table S5. The meta-analysis indicated that the association between purpose and grip strength was .08 (95% CI=.07-.09; p<.001) for males and .05 (95% CI=.04-.05; p<.001) for females. As such, the association was similar across males and females, but slightly stronger among males. Likewise, the modest effect size for education indicated that the association was slightly stronger among participants with relatively less education. The null association for age and race indicated there were no differences in the strength of the association across either age or race.

Finally, we tested the association between purpose in life and the threshold for weak grip strength. Similar to the continuous analysis, purpose was associated with lower likelihood of weak grip strength (Supplemental Table S6). As summarized in the meta-analysis, every standard deviation higher in purpose was associated with a 23% lower likelihood of weak grip strength (Fig. 2). This association was significant in the meta-analysis and in 24 of the 27 samples.

Discussion

The present research indicated that in each of 27 samples that included participants from North America, South America, Europe, and Asia, purpose in life was associated with stronger grip strength. The association was modest but consistent across samples. The moderation analysis likewise suggested consistency across sociodemographic groups. The only differences that did emerge – for sex and education – were of strength rather than kind. Further, one SD higher purpose was associated with a 23% lower likelihood of weak grip strength. Overall, the findings suggest a replicable and generalizable association between purpose and stronger grip strength.

Kim and colleagues (2017) previously found a positive association between purpose and grip strength in

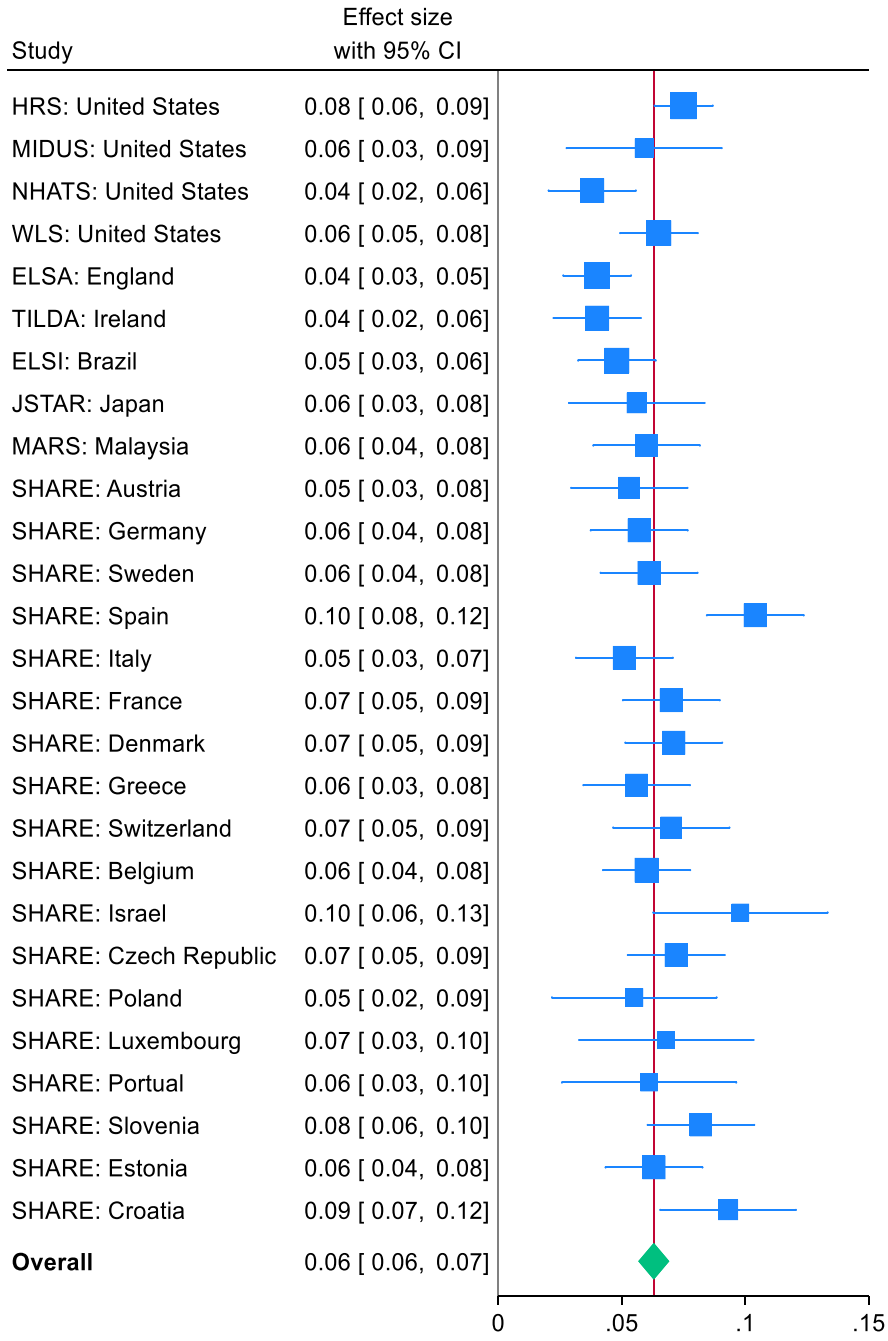

Fig. 1 Forest plot of the association between purpose in life and grip strength as a continuous variable

one sample. The present research builds on this initial finding by replicating the association in 27 samples. Across these individual samples, the association between purpose and grip strength ranged in magnitude from .04 to .10. The association is thus small in magnitude but remarkably consistent across diverse samples with different characteristics.

Despite this relatively tight range of associations, the meta-analysis indicated significant heterogeneity across the samples. We could not identify sources of the heterogeneity. None of the meta-regressions was significant, which indicated that the values did not differ significantly by measurement properties, region of the world, or GDP. The only evidence of moderation

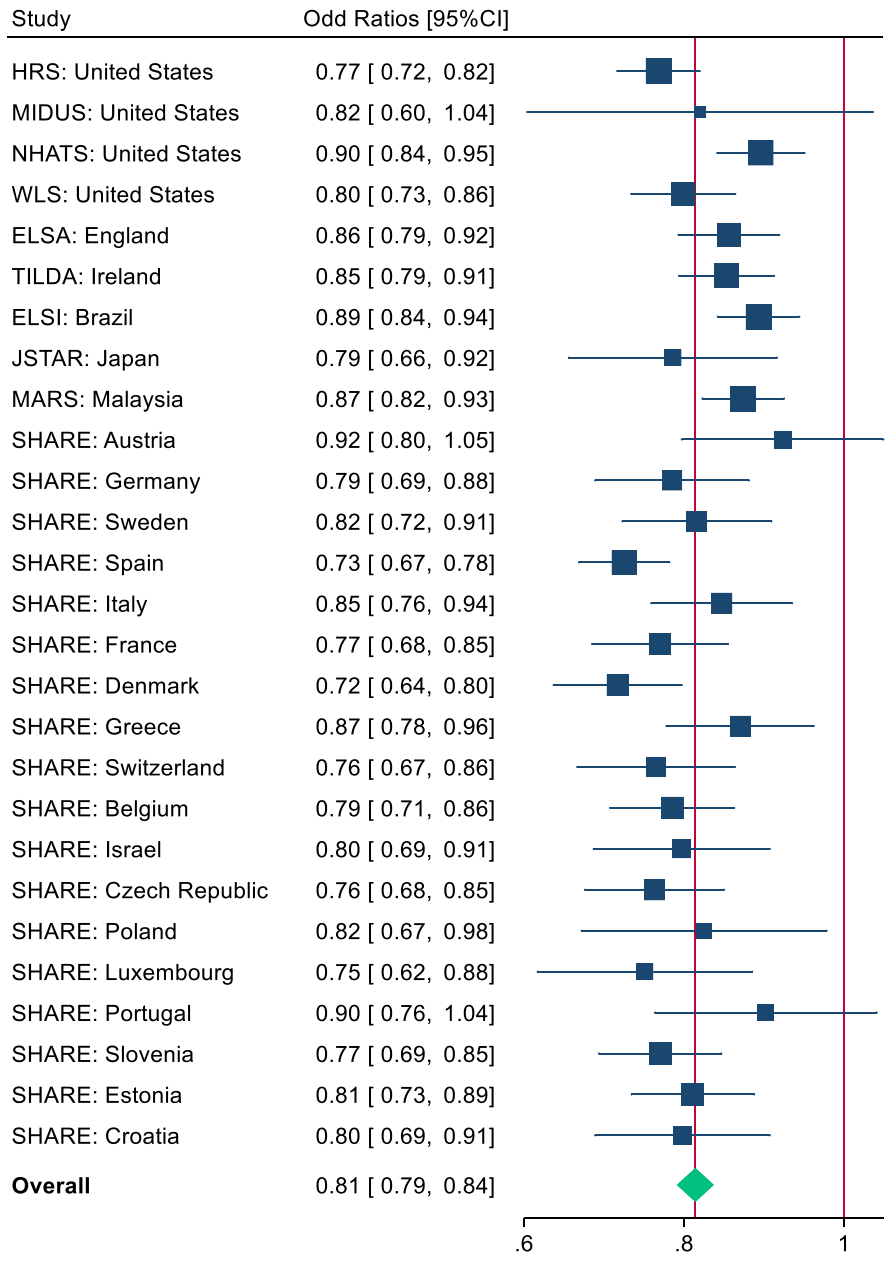

Fig. 2 Forest plot of the association between purpose in life likelihood of weak grip strength

was from the interaction analysis within the individual samples. In this case, the association was slightly stronger among males and among individuals with relatively lower education. There is some evidence that purpose may be a stronger resource for health when economic resources are more scarce: Purpose is more strongly associated with episodic memory in countries with relatively lower GDP [31, 32]. Not all, however, find a similar resource substitution for other health outcomes [26]. Further, in the present study, the modest evidence for education was not replicated with the sample-level analysis that tested GDP as a moderator.

Rather than differences, perhaps the most notable finding was the consistent association across continents and cultures. This similarity suggests that the association is not limited to the United States or Western Europe but extends to South America, East and South East Asia, and the Middle East. Along with geographical diversity, the samples differed on

other important aspects, such as the health care system and religious beliefs and practices (e.g., Islam in Malaysia, Judaism in Israel, Christianity in Poland, and Shinto in Japan). The replicability of the association across regions of the world indicates that the beneficial correlates of purpose may be widely generalizable and not dependent on culture or context. One reason for the broad generalizability may be that the measure of purpose does not assess the content of one's purpose. That is, the scale used in each sample measured feelings of purpose, but not why the individual felt purposeful. The content of purpose may be context-specific (i.e., some activities may be valued as more purposeful in some cultures than in others), but the feeling of being purposeful may be universal and have generalizable health benefits.

There are several pathways through which purpose may be associated with stronger grip strength. There is likely to be a behavioral pathway that is through health-promoting behaviors. Specifically, higher purpose is associated with greater engagement in physical activity [30, 33, 34] and lower likelihood of smoking [22], which are associated with higher grip strength [13]. Weak grip strength may also be due to poor physical health [6, 28]. Individuals who are higher in purpose also tend to have lower morbidity [23], which may be a clinical pathway through which purpose is associated with stronger grip strength. Finally, purpose is associated with healthier inflammatory profiles [30, 33, 34] that also help support grip strength [35]. The present study sought to establish a robust and replicable association between purpose in life and grip strength and evaluate the generalizability across diverse samples around the world. The next step in future research is to test mechanisms that may contribute to this association.

Grip strength itself may be a mechanism in the pathway from purpose to health outcomes. Low grip strength, for example, is a risk factor for dementia [9], cardiovascular disease [19], and premature mortality [5]. Individuals higher in purpose tend to have lower risk of dementia [30, 33, 34], healthier cardiovascular function [14], and live longer [7] than individuals lower in purpose. One mechanism that may contribute to this association is greater body strength, which helps to withstand muscle loss and other vulnerabilities that tend to increase with age. This study adds to the evidence that purpose is associated with better physical function, which has primarily been examined in the context of walking speed: Individuals higher in purpose tend to have faster walking speed and maintain their walking speed over time in older adulthood [15, 29]. This greater body strength may be one reason why purpose helps to delay health declines in older adulthood [4].

The present research had several strengths, including a performance measure of upper body strength in 27 samples from 24 countries that spanned four continents. There are also limitations. First, the analysis was cross-sectional, so it was not possible to test the temporal relations between purpose and grip strength; purpose could support stronger grip strength and stronger grip strength could support greater feelings of purpose. It is also possible that age-related brain pathologies lead to losses in both purpose and strength, but the moderation analysis did not find that the association varied by age. Second, we focused on the replicability and generalizability of the association between purpose and grip strength and did not address the mechanisms that may contribute to this association or adjust the associations for body size. Third, we likewise did not address grip strength as a mechanism for subsequent morbidity and mortality. Finally, although the analysis included samples from 24 countries, few of these countries were middle-income, and none were low-income. Future work would thus benefit from extending this work to a longitudinal context, testing mechanistic models of purpose and health (preferably in a longitudinal context), and including samples from lower- and middle-income countries to further evaluate generalizability.

Despite these limitations, the present research indicates that purpose in life is associated with stronger grip strength, an objectively assessed performance measure of body strength. The association was not limited to a specific population but generalized across sociodemographic populations, regions of the world, and cultures. Purpose in life is a psychological resource associated with greater muscle strength that may help to support healthier aging.

Acknowledgements We gratefully acknowledge the parent studies whose public data made this work possible: The Health and Retirement Study is sponsored by the National Institute on Aging (NIA-U01AG009740) and conducted by the University of Michigan. The Midlife in the United States (MIDUS) is sponsored by the MacArthur Foundation Research Network on Successful Midlife Development (MIDUS I), the National Institute on Aging (P01-AG020166; MIDUS II), and

grants from the General Clinical Research Centers Program (M01-RR023942, M01-RR00865) and the National Center for Advancing Translational Sciences (UL1TR000427). The National Health and Aging Trends Study is sponsored by the National Institute on Aging (grant number U01AG032947) through a cooperative agreement with the Johns Hopkins Bloomberg School of Public Health. The Wisconsin Longitudinal Study (WLS) has been supported principally by the National Institute on Aging (AG-9775, AG-21079, AG-033285, and AG-041868) since 1991, with support from the Vilas Estate Trust, the National Science Foundation, the Spencer Foundation, and the Graduate School of the University of Wisconsin-Madison. Since 1992, data have been collected by the University of Wisconsin Survey Center. The English Longitudinal Study of Ageing is funded by the National Institute of Aging [grants 2RO1AG7644-01A1 and 2RO1AG017644] and a consortium of UK government departments coordinated by the Office for National Statistics. The content is solely the responsibility of the authors and does not represent the official views of the parent studies or funders. The Irish LongituDinal Study on Ageing (TILDA) was supported by the Irish Government, the Atlantic Philanthropies, and Irish Life PLC. We thank TILDA participants and the Irish Social Science Data Archive (ISSDA) at University College Dublin for making the data available. The ELSI-Brazil baseline study was supported by the Brazilian Ministry of Health (DECIT/SCTIE – Department of Science and Technology from the Secretariat of Science, Technology and Strategic Inputs (Grant 404965/2012-1); COSAPI/DAPES/SAS – Healthcare Coordination of Older Adults, Department of Strategic and Programmatic Actions from the Secretariat of Health Care) (Grants 20836, 22566, and 23700); and the Brazilian Ministry of Science, Technology, Innovation and Communication. We thank the Research Institute of Economy, Trade and Industry, Hitotsubashi University, and the University of Tokyo for conducting the Japanese Study of Aging and Retirement and making the data available to researchers. The authors would like to thank the Director of Social Wellbeing Research Centre (SWRC) for her permission to use the data from the Malaysia Ageing and Retirement Survey (MARS) 2018 and to publish this paper. The SHARE data collection has been funded by the European Commission through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812), FP7 (SHARE-PREP: GA N°211909, SHARE-LEAP: GA N°227822, SHARE M4: GA N°261982) and Horizon 2020 (SHARE-DEV3: GA N°676536, SERISS: GA N°654221) and by DG Employment, Social Affairs & Inclusion. Additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the National Institute on Aging (U01_AG09740-13S2, P01_AG005842, P01_AG08291, P30_AG12815, R21_AG025169, Y1-AG-4553-01, IAG_BSR06-11, OGHA_04-064, HHSN271201300071C) and from various national funding sources is gratefully acknowledged (see www.share-project.org).

Author contributions Study concept and design: All authors. Data analysis: Angelina Sutin and Antonio Terracciano. Writing the manuscript: Angelina Sutin. Editing subsequent drafts: All authors. All authors approved submission of this manuscript.

Funding Research reported in this publication was supported by the National Institute on Aging of the National Institutes of Health under Award Number R01AG074573. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health. The funder had no role in study design, analysis, interpretation, preparation of the manuscript for publication, or the decision to publish.

Data Availability Data are publicly available from the parent studies.

Declarations

Conflict of interest The authors have no conflicts of interest to report.

References

1. Alimujiang A, Wiensch A, Boss J, Fleischer NL, Mondul AM, McLean K, . . . Pearce CL. Association between life purpose and mortality among US adults older than 50 years. JAMA Netw Open. 2019;2(5):e194270. https://doi.org/10.1001/jamanetworkopen.2019.4270
2. Alley DE, Shardell MD, Peters KW, McLean RR, Dam TT, Kenny AM, . . . Cawthon PM. Grip strength cutpoints for the identification of clinically relevant weakness. J Gerontol A Biol Sci Med Sci. 2014;69(5):559-566. https://doi.org/10.1093/gerona/glu011
3. Bohannon RW. Grip strength: An indispensable biomarker for older adults. Clin Interv Aging. 2019;14:1681–91. https://doi.org/10.2147/CIA.S194543.
4. Boyle PA, Wang T, Yu L, Barnes LL, Wilson RS, Bennett DA. Purpose in life may delay adverse health outcomes in old age. Am J Geriatr Psychiatry. 2022;30(2):174–81. https://doi.org/10.1016/j.jagp.2021.05.007.
5. Cai Y, Liu L, Wang J, Gao Y, Guo Z, Ping Z. Linear association between grip strength and all-cause mortality among the elderly: results from the SHARE study. Aging Clin Exp Res. 2021;33(4):933–41. https://doi.org/10.1007/s40520-020-01614-z.
6. Cheung CL, Nguyen US, Au E, Tan KC, Kung AW. Association of handgrip strength with chronic diseases and multimorbidity: a cross-sectional study. Age (Dordr). 2013;35(3):929–41. https://doi.org/10.1007/s11357-012-9385-y.
7. Cohen R, Bavishi C, Rozanski A. Purpose in Life and Its Relationship to All-Cause Mortality and Cardiovascular Events: A Meta-Analysis. Psychosom Med. 2016;78(2):122–33. https://doi.org/10.1097/PSY.0000000000000274.
8. Dodds R, Kuh D, Aihie Sayer A, Cooper R. Physical activity levels across adult life and grip strength in early old age: updating findings from a British birth cohort. Age Ageing. 2013;42(6):794–8. https://doi.org/10.1093/ageing/aft124.
9. Esteban-Cornejo I, Ho FK, Petermann-Rocha F, Lyall DM, Martinez-Gomez D, Cabanas-Sánchez V, . . . Celis-Morales C. Handgrip strength and all-cause dementia

incidence and mortality: findings from the UK Biobank prospective cohort study. J Cachexia Sarcopenia Muscle. 2022;13(3):1514-1525. https://doi.org/10.1002/jcsm.12857
10. Fielding RA, Vellas B, Evans WJ, Bhasin S, Morley JE, Newman AB, . . . Zamboni M. Sarcopenia: an undiagnosed condition in older adults. Current consensus definition: prevalence, etiology, and consequences. International working group on sarcopenia. J Am Med Dir Assoc. 2011;12(4):249-256. https://doi.org/10.1016/j.jamda.2011.01.003
11. Fried LP, Tangen CM, Walston J, Newman AB, Hirsch C, Gottdiener J, . . . Group CHSCR. Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci. 2001;56(3):M146-156. https://doi.org/10.1093/gerona/56.3.m146
12. Gedmantaite A, Celis-Morales CA, Ho F, Pell JP, Ratkevicius A, Gray SR. Associations between diet and handgrip strength: a cross-sectional study from UK Biobank. Mech Ageing Dev. 2020;189:111269. https://doi.org/10.1016/j.mad.2020.111269.
13. Hurst C, Murray JC, Granic A, Hillman SJ, Cooper R, Sayer AA, . . . Dodds RM (2021) Long-term conditions, multimorbidity, lifestyle factors and change in grip strength over 9 years of follow-up: Findings from 44,315 UK biobank participants. Age Ageing 50(6):2222-2229. https://doi.org/10.1093/ageing/afab195
14. Kim ES, Delaney SW, Kubansky LD. Sense of purpose in life and cardiovascular disease: Underlying mechanisms and future directions. Curr Cardiol Rep. 2019;21:135.
15. Kim ES, Kawachi I, Chen Y, Kubzansky LD. Association between purpose in life and objective measures of physical function in older Adults. JAMA Psychiatry. 2017;74(10):1039–45. https://doi.org/10.1001/jamapsychiatry.2017.2145.
16. Kim ES, Shiba K, Boehm JK, Kubzansky LD. Sense of purpose in life and five health behaviors in older adults. Prev Med. 2020;139:106172. https://doi.org/10.1016/j.ypmed.2020.106172.
17. Lawman HG, Troiano RP, Perna FM, Wang CY, Fryar CD, Ogden CL (2016) Associations of relative handgrip strength and cardiovascular disease biomarkers in U.S. adults, 2011-2012. Am J Prev Med 50(6):677-683. https://doi.org/10.1016/j.amepre.2015.10.022
18. Leong DP, Teo KK, Rangarajan S, Lopez-Jaramillo P, Avezum A, Orlandini A, . . . investigators, PUREPS (2015) Prognostic value of grip strength: findings from the Prospective Urban Rural Epidemiology (PURE) study. Lancet. 2015;386(9990):266-273. https://doi.org/10.1016/S0140-6736(14)62000-6
19. Liu W, Chen R, Song C, Wang C, Chen G, Hao J, . . . Yu C. A prospective study of grip strength trajectories and incident cardiovascular disease. Front Cardiovasc Med. 2021;8:705831. https://doi.org/10.3389/fcvm.2021.705831
20. Marques A, Gaspar de Matos M, Henriques-Neto D, Peralta M, Gouveia É, Tesler R, . . . Gomez-Baya, D. Grip strength and depression symptoms among middle-age and older adults. Mayo Clin Proc. 2020;95(10):2134-2143. https://doi.org/10.1016/j.mayocp.2020.02.035
21. McGrath RP, Vincent BM, Lee IM, Kraemer WJ, Peterson MD. Handgrip strength, function, and mortality in older adults: a time-varying approach. Med Sci Sports Exerc. 2018;50(11):2259–66. https://doi.org/10.1249/MSS.0000000000001683.
22. Morimoto Y, Yamasaki S, Ando S, Koike S, Fujikawa S, Kanata S, . . . Nishida A. Purpose in life and tobacco use among community-dwelling mothers of early adolescents. BMJ Open. 2018;8(4):e020586. https://doi.org/10.1136/bmjopen-2017-020586.
23. Musich S, Wang SS, Kraemer S, Hawkins K, Wicker E. Purpose in Life and positive health outcomes among older adults. Popul Health Manag. 2018;21(2):139–47. https://doi.org/10.1089/pop.2017.0063.
24. Porto JM, Nakaishi APM, Cangussu-Oliveira LM, Freire Júnior RC, Spilla SB, Abreu DCC. Relationship between grip strength and global muscle strength in community-dwelling older people. Arch Gerontol Geriatr. 2019;82:273–8. https://doi.org/10.1016/j.archger.2019.03.005.
25. Ryff CD. Happiness is everything, or is it? Explorations on the meaning of psychological well-being. J Personal Social Psychol. 1989;57:1069–81.
26. Shiba K, Kubzansky LD, Williams DR, VanderWeele TJ, Kim ES. Associations between purpose in life and mortality by SES. Am J Prev Med. 2021;61(2):e53–61. https://doi.org/10.1016/j.amepre.2021.02.011.
27. Stephan Y, Sutin AR, Canada B, Deshayes M, Kekäläinen T, Terracciano A. Five-factor model personality traits and grip strength: meta-analysis of seven studies. J Psychosom Res. 2022;160:110961. https://doi.org/10.1016/j.jpsychores.2022.110961.
28. Sternäng O, Reynolds CA, Finkel D, Ernsth-Bravell M, Pedersen NL, Dahl Aslan AK. Factors associated with grip strength decline in older adults. Age Ageing. 2015;44(2):269–74. https://doi.org/10.1093/ageing/afu170.
29. Sutin AR, Cajuste S, Stephan Y, Luchetti M, Kekäläinen T, Terracciano A. Purpose in life and slow walking speed: cross-sectional and longitudinal associations. Geroscience. 2024. https://doi.org/10.1007/s11357-024-01073-8.
30. Sutin AR, Luchetti M, Aschwanden D, Stephan Y, Sesker AA, Terracciano A. Sense of meaning and purpose in life and risk of incident dementia: New data and meta-analysis. Arch Gerontol Geriatr. 2023;105:104847. https://doi.org/10.1016/j.archger.2022.104847.
31. Sutin AR, Luchetti M, Stephan Y, Strickhouser JE, Terracciano A. The association between purpose/meaning in life and verbal fluency and episodic memory: A meta-analysis of >140,000 participants from up to 32 countries. Int Psychogeriatr. 2022;34:263–73. https://doi.org/10.1017/S1041610220004214.
32. Sutin AR, Luchetti M, Stephan Y, Terracciano A. Sense of purpose in life and motivation, barriers, and engagement in physical activity and sedentary behavior: test of a mediational model. J Health Psychol. 2022;27:2068–78. https://doi.org/10.1177/13591053211021661.
33. Sutin AR, Stephan Y, Kekäläinen T, Luchetti M, Terracciano A. Purpose in life and accelerometer-measured physical activity among older adults. Psychol Health.

2023;1-15. https://doi.org/10.1080/08870446.2023.2200414.
34. Sutin AR, Stephan Y, Luchetti M, Terracciano A. Purpose in life and markers of immunity and inflammation: testing pathways of episodic memory. J Psychosom Res. 2023;174:111487. https://doi.org/10.1016/j.jpsychores.2023.111487.
35. Tuttle CSL, Thang LAN, Maier AB. Markers of inflammation and their association with muscle strength and mass: a systematic review and meta-analysis. Ageing Res Rev. 2020;64:101185. https://doi.org/10.1016/j.arr.2020.101185.