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## Article

# Women's spousal choices and a man's handshake: Evidence from a Norwegian study of cohort differences

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## ABSTRACT

Both high grip strength and being married independently relate to better functional capacity and health at older ages, but the combined effect of marital status and strength have not been investigated. Especially at older ages, declining strength can have adverse health and social consequences, where having a spouse could potentially help with everyday support and alleviate some of the negative effects of sarcopenia. We investigate how grip strength relates to being married among two cohorts of 59–71 year olds (born 1923–35 and 1936–48) in the Norwegian city of Tromsø, controlling for a broad set of health variables and sociodemographic characteristics. The baseline included N = 5009 participants of whom 649 died during follow-up. We find that for men, particularly among younger cohorts, the physically stronger are more likely to be married, but no relation is found for women. This is consistent with a hypothesis that women increasingly have selected male marital partners based on preferred individual traits, whereas men do not emphasize strength when selecting women. We find that both marital status and grip strength independently affect mortality, but there is no significant joint effect. However, the distribution of strength and marital status implies that more men than women and increasing shares of later born cohorts have a “double-burden” of low strength and a lack of support from a spouse.

## Introduction

Understanding the relationship between marriage and functional level requires that we can explain how men and women are sorted into marriage as well as how health trajectories may be subsequently affected by the presence or influence of a spouse. Evidence from Norway indicates that mortality risks are elevated for those who are not married, particularly for men (Berntsen, 2011). Researchers generally agree that married people enjoy better health and longevity, although the health ‘premium’ of marriage also appears to be larger for men than women (Aizer et al., 2013; Lamb, Lee, & DeMaris, 2003; Lillard & Waite, 1995; Robles, 2014).

The mechanisms responsible for better health among the married are also thought to differ for men and women. Whereas husbands benefit more from improved behavioral risk profiles, wives benefit from the greater financial security provided by their husbands (Reczek, Pudrovska, Carr, Thomeer, & Umberson, 2016). Wives encourage healthier behaviors and preventive care, while discouraging unhealthy lifestyles and providing social support. In contrast, wives benefit from enhanced economic circumstances and health benefits that stem from

the additional resources that a joint household represents, particularly if they are not employed themselves (Waldron, Hughes, & Brooks, 1996).

Both men and women, however, are likely to benefit from spousal support in the wake of impairments or disability. Studies on the topic generally rely on measures of health that are subjective, such as self-rated health, or are dependent on clinical diagnoses of specific diseases. The risk of early mortality among those with lower levels of social support was, according to a meta-analysis of 50 studies, 30% greater than the risk among those with higher support - and support from family is more beneficial than support given by friends for both men and women, especially at older ages (Shor, Roelfs, & Yogev, 2013).

### Marriage formation along cohort lines

As health and longevity improve and women become more financially independent, partnering trends also appear to be changing. Norwegian women are decreasingly likely to marry for economic reasons or due to social pressure (Toulemon, 2016). The growth in female education and economic activity and rapid cultural change in family

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norms have been taking place alongside a postponement and decline in marriage (Lesthaeghe, 2014). High GDP per capita and extensive social support systems (including lower taxes for those who are single) makes marriage in Norway less of an economic necessity (Baran, Diehnelt, & Jones, 2014). High levels of contraceptive use (the contraceptive pill was legalized 1967 in Norway) have contributed to lower social pressures for marriage, fewer marriages resulting from unplanned pregnancies, and higher proportions of people who choose not to marry (Rijken & Liefbroer, 2016). That marriage in Norway has become an option rather than an expectation makes Norway an appropriate setting in which to assess changing marital behavior and its implications. With often longer dating periods preceding marital decisions, individual traits, including health, are likely to become more important predictors of marital outcomes (Jokela, Rotkirch, Rickard, Pettay, & Lummaa, 2010; Watson & McLanahan, 2011). For instance, personality has become more important among recent cohorts, e.g., the negative association between male neuroticism and the likelihood of family formation has grown stronger among those born more recently (Skirbekk & Blekesaune, 2013).

The potential importance of selection into marriage as a competing explanation for the health advantages of marriage has been recognized for long periods. Those who are ill or have fewer resources are generally less likely to marry (Farr, 1859; Umberson, 1987), suggesting that mortality differences related to marital status also could result from other factors, such as health related selection in terms of who get married (Goldman, 1993). Although some suggest that lower rates of marriage could signal a decline in the strength of the relationship between marriage and health, this is not necessarily the case. The protective association of marriage to mortality has been found to remain high (or increase) even when marriage is becoming less prevalent, as the case has been in Norway (Kravdal, Grundy, & Keenan, 2018; Van den Berg & Gupta, 2015).

#### *Grip strength and health cohort lines*

Grip strength is a central dimension of health and ability to cope independently (Hirsch, Bůžková, Robbins, Patel, & Newman, 2012). Grip strength predicts the risk of cardiovascular diseases and mortality (Hirsch et al., 2012; Strand et al., 2016) and is most important for health at older ages, due to age-related decline and implications for mobility (Alley et al., 2014; Stephan, Chalabaev, Kotter-Grühn, & Jaconelli, 2013). Age-related declines in handgrip-strength are more pronounced when samples of the 65-and-older are adjusted for mortality attrition (Stenholm et al., 2012). However, even among the oldest old, later born cohorts may perform better. Successive cohorts of 90+ year olds Denmark increased their grip strength slightly, from 16.1 to 16.2 kg for the 1905 to the 1915 cohort observed 10 years later at the same age (Christensen, Jeune, Andersen-Ranberg, & Vaupel, 2013). A US based study found that, on average, men and women attain peak grip strength at the same age (36 years). Women's decline in grip strength occurs sooner (age 50 years for women and 56 years for men), but men lose grip strength at a faster rate relative to their peak. There is an increasing secular trend in peak grip strength that is not attributable to concurrent secular trends in body size, and the grip strength trajectory varies with birth weight (men only), smoking (men only), alcohol consumption (men and women), and sports activity (women only) (Nahhas et al., 2010).

Physical grip strength is also associated with social outcomes, including economic activity (Kalwij & Vermeulen, 2008). Higher muscle strength reduces physical disability at older ages and relates to higher levels of overall wellbeing (Cooper et al., 2014). Strength also allows for greater physical mobility, the capacity to be socially active, and to enjoy a good quality of life (Sayer et al. 2006). Greater grip strength is linked to lower risks of heart disease and fractures - especially at older ages (Cooper, Kuh, & Hardy, 2010). Recently a strong association between low grip strength and all-cause as well as cardiovascular

mortality was identified in the Tromsø study, with an equally strong association for men and women and across age groups (Strand et al., 2016). Long term care residents were significantly more likely to die if they had sarcopenia (Landi et al., 2012). Poor grip strength has been found to be associated with an extended length of hospital stay, particularly among patients aged 65 years and above (Sousa, Guerra, Fonseca, Pichel, & Amaral, 2015).

Improvements in grip strength across successive cohorts, as shown in Denmark (Kaare Christensen et al., 2013), could reflect changes in work task demands, mobility requirements and physical activity patterns, as well as the disease burden (Autor, Levy, & Murnane, 2003; Gordo & Skirbekk, 2013). More calorie rich diets and rising birth weights may boost muscle strength along cohort lines (Midthjell et al., 2013), while other factors such as more sedentary lifestyles and growing obesity could potentially lead to lowered strength (Schaap, Koster, & Visser, 2013).

#### *Interaction between spousal support, health related behaviours and low strength*

Spousal support can be particularly important if one partner is frail and requires assistance to remain in the home and have a good quality of life. For men, marital effects on lifestyle can have improve physical strength by increasing the quality and nutritional value of the food they consume - e.g., singles are more likely to consume processed food (Wilson, 2012), and regular meals (Huang et al., 2014). Moreover, those who are married tend to have more sex, which is associated with better health and a higher levels of wellbeing (Müller, Nienaber, Reis, Kropp, & Meyer, 2014).

Examining cohort differences in the association between being married and grip strength can provide new insight into what underlies union formation patterns, and whether grip strength is implied in such decisions across cohorts. Health characteristics of those not married could differ across cohorts - e.g., widowed Swiss men and women reported similar depression levels but fewer social difficulties in 2011 compared to 1979 (Perrig-Chiello, Spahni, Höpflinger, & Carr, 2015). If low grip strength and poor health increasingly characterize the unmarried, this could have important consequences for their ability to live independently (Alley et al., 2014; Thomeer, Mudrazija, & Angel, 2016). Increases in the population share who have both low physical strength (a proxy for health) and at the same time lack spousal support may influence the share of the population who are dependent on health services and care facilities.

#### *Gender differences in partner selection and the relevance of physical strength*

Women and men may seek different traits when searching for a life companion, which could imply different selection mechanisms for those who eventually marry. Analyses of online dating profiles identified certain traits that women and men tend to emphasize when they search for a partner: Men are more likely than women to seek attractiveness, to mention own economic wealth, and to profess an interest in marriage. Women often seek life companions of high socioeconomic status (Greenwood, Guner, Kocharkov, & Santos, 2014), and grip strength may represent one cue to potential status. Women tend to stress own attractiveness and beauty, and many women express a wish to find a companion with sufficient economic means (Strassberg & English, 2015). Recent labour market changes suggest that men's strength may be a declining indicator of work productivity (Gordo & Skirbekk, 2013). Therefore, women may care less about male strength if their goal is to improve financial outcomes. Further, increased female work participation and growing income would suggest that women should be less concerned with income (OECD, 2012). Yet, the positive relationship between health and strength can imply that women may seek stronger men as strength is a cue to longevity and health.

Surveys suggest that men with greater physical strength are

perceived by others to have higher level positions, regardless of their actual situation (Lukaszewski, Simmons, Anderson, & Roney, 2015). Physically stronger men tend to have more sexual partners (Gallup, White, & Gallup, 2007). Moreover – also in the Nordic countries – women perform more of the household chores, while men are often responsible for some of the physically heavy, but more episodic tasks (e.g., house repairs, car maintenance, handling large items and assembling furniture) (Lundberg, 2008). The male ideal may, also among contemporary cohorts of women and men, may still be one who is a provider and protector, who is being both emotionally and physically strong (Powers & Reiser, 2005).

## Data and methods

The current study investigates the relationship of marital status to grip strength as observed in a representative sample. We observe two successive cohorts born 1923–35 and 1936–48. Respondents are from two independent samples drawn at different time points (1994/95 and 2007/08). Data are from a population-based study from the Norwegian city of Tromsø (Tromsø 4 and Tromsø 6) (Jacobsen, Eggen, Mathiesen, Wilsgaard, & Njølstad, 2012). We assess the association between respondents' marital status and grip-strength when respondents were aged 59 to 71. These data were matched with the Norwegian national death registry which includes all deaths for the respondents during 9.1 years of follow-up time for each cohort. Thus, max follow-up was until 2004 for the oldest born cohort and 2016 for the youngest born cohort.

The Tromsø Study is a population based health examination study of Tromsø, the largest city in northern Norway. The study was initiated in 1974, and for our study we used data from its fourth and sixth study wave in 1994–5 and 2007–8 (Jacobsen et al., 2012), respectively. Response rates have remained high and were 75% in Tromsø 4 and 68% in Tromsø 6. To ensure non-overlapping birth cohorts and attendance in grip strength testing, our study population is comprised of two birth cohorts; a) those born during 1923–1935 participating in the Tromsø study wave 4 in 1994–1995 at ages 59–71 years (N = 3576), and b) those born during 1936–1948 participating in the Tromsø study wave 6 in 2007–2008 at ages 59–71 years (N = 1793). Marital status and grip strength for cohort a) was based on data from the Tromsø 4 study and for cohort b) it was based on Tromsø 6 data. Both were assessed for the same age range (59–71 years).

Marital status was self-reported in both Tromsø study waves 4 and 6 using the same question. The four marital states in the study are married, widowed, divorced/separated, and never married - data on individual marital status is collected from the national population registry. We do not use cohabitation as a separate category, as for the period we consider there is a lack of cohabitation data from the national population registry. Moreover, there are often difficulties in producing comparable assessments on cohabitation (Murphy, 2006). In Tromsø 4 there was a separate question on *whether one lives with a partner*, but for the noted problems we do not focus on the cohabitants in this study.

Grip strength was measured similarly in Tromsø 4 and 6 following the same protocol. For the non-dominant hand, it was measured using a Martin Vigorimeter (Sipers, Verdijk, Sipers, Schols, & van Loon, 2016). The Martin Vigorimeter is a device to measure handgrip strength when respondents press a rubber balloon connected to a manometer, which expresses the results in bar. The Martin Vigorimeter comes with three balloon sizes and we used the large sized balloon for men and medium sized for women, as instructed in the manual (KLS Martin Group, 2012). Each participant was allowed two attempts, and the highest score registered was recorded and used in analyses. Grip strength was roughly normally distributed and treated as a continuous variable in analyses.

Although strength tends to decline over the adult life cycle, observed grip strength at later ages is predictive of the rank-ordering of grip strength earlier in life (when the majority of the marriages formed). Early adult grip strength has been found to have a high correlation to one's strength later in life, as evidenced by a 27 year follow-

up in the US (Rantanen et al. 1998). Similar studies from other samples support a relatively high degree of stability over the life course in terms of the rank-ordering of grip strength (Hughes et al., 2001).

## Hypothesis

The research discussed has suggested that women may have more partner selection criteria to be fulfilled than men, and that while male preferences relate to beauty and a pleasant personality, female preferences include provider potential and strength. In this study, we use cohort-by-gender comparisons to examine the association between health and marital status, using grip strength as our proxy measure of global health. If men are chosen as husbands, in part, on the basis of being robust and healthy, then grip strength among married men should be superior to that of unmarried men. Since men use other (and perhaps fewer) criteria to choose wives, we should find no association between grip strength and marital status among women. Finally, if women are becoming more selective, then we would expect a stronger relationship among more recently born cohort than older cohorts.

The association between grip strength and family status and other covariates was analyzed using ordinary least squares regression, with grip strength as the outcome variable. Analyses were adjusted by age as a continuous variable. In addition, we calculated direct age adjusted mean grip strength values, by grouping age in three categories (59–63, 64–67, 68–71 years) with equal weight for each age category.

We adjust for age, and we control for marital status and gender as well as cohort. Our regression also takes into account possible confounding by daily smoking, self-reported general health, self-reported heart disease, systolic blood pressure and leisure physical activity. These factors were selected because they have previously been found to be associated both with marital status and grip strength (see literature discussion).

We do not hypothesize that men have a changing preference for women's grip strength. Our key hypothesis is that marriage shows a stronger association with physical strength among more recent cohorts of Norwegian men. We formulate the following hypotheses:

**H1.** Being never married and having low grip strength will both lead to greater mortality.

**H2.** The effect of grip strength on mortality will be stronger among the never married than among the married in more recent cohorts.

## Results

Table 1 reports the descriptive evidence for the cohorts born 1923–35 and 1936–48 respectively, and reveals that marital status differs between successive cohorts. Among the men in the earliest birth cohort (n = 1691) most were married (77%), while 9% were divorced/separated. In the most recent male birth cohort, the share of married was similar (76%) to the earliest cohort, and the share of divorced/separated was higher (13%). A similar pattern was seen for women. A rising

**Table 1**  
Birth cohort by marital status and gender, numbers and percentages.

	Men		Women	
	Birth cohort 1923-35	Birth cohort 1936-48	Birth cohort 1923-35	Birth cohort 1936-48
Marital status	N (%)	N (%)	N (%)	N (%)
Married	1309 (77)	478 (76)	1153 (61)	735 (63)
Widowed	97 (6)	27 (4)	471 (25)	193 (17)
Divorced/ separated	150 (9)	82 (13)	184 (10)	180 (15)
Never married	135 (8)	40 (6)	75 (4)	58 (5)
Total	1691 (100)	627 (100)	1883 (100)	1166 (100)

**Table 2**

Grip strength by marital status for two cohorts men and women aged 59–71 years. Reference category is married and results are presented as absolute difference in grip strength (measured in bar). Analyses are performed on complete cases with no missing values for included confounders; N = 5009.

	Men		Women	
	Birth cohort 1923-35	Birth cohort 1936-48	Birth cohort 1923-35	Birth cohort 1936-48
<b>Marital status</b>	Model 1.		Model 1.	
	Age-adjusted		Age-adjusted	
Married	Ref	Ref	Ref	Ref
Widowed	0.008, p = 0.674	-0.057, p = 0.116	-0.013, p = 0.189	-0.018, p = 0.264
Divorced/separated	-0.019, p = 0.233	-0.028, p = 0.213	-0.022, p = 0.123	-0.003, p = 0.867
Never married	-0.049, p = 0.004	-0.132, p < 0.001	-0.006, p = 0.786	0.022, p = 0.390
<b>Marital status</b>	Model 2.		Model 2.	
	Fully adjusted*		Fully adjusted*	
Married	Ref	Ref	Ref	Ref
Widowed	0.013, p = 0.494	-0.049, p = 0.178	-0.011, p = 0.275	-0.010, p = 0.511
Divorced/separated	-0.015, p = 0.335	-0.020, p = 0.368	-0.007, p = 0.629	-0.001, p = 0.940
Never married	-0.029, p = 0.078	-0.117, p < 0.001	-0.008, p = 0.705	0.020, p = 0.429

Interaction terms birth cohort by marital status were significant in single men only; p = 0.015 in model 1 and 0.020 in model 2.

\* Adjusted by age, BMI, daily smoking, self-reported general health, self-reported heart disease, educational level, systolic blood pressure, leisure physical activity.

share of divorced occurred in the later born cohort (up from 10% to 15%), while the proportion married was relatively stable (rising from 61% to 63%). The share that were widowed fell strongly for the women from 25% to 17%, but only from 6% to 4% among the men.

Table 2 reveals that never married men had significantly lower grip strength compared with married men (p < 0.01 for both cohorts). This difference was particularly pronounced in the youngest birth cohort (born 1936–48). The interaction term for being never married by birth cohort was significant both in the age-adjusted model 1 (p = 0.015), and in the fully adjusted model 2 (p = 0.020). In the earlier born birth cohort, the difference was only 0.05 bar (p = 0.004) in the age adjusted model 1, (or the equivalent of 3.4 years), and 0.03 bar (p = 0.08) in the fully adjusted model 2. In the later born cohort, in the age-adjusted model 1, never married men had 0.13 bar lower grip strength than married men (p < 0.001), which corresponded to an age difference of 10.8 years given normal age-related decline. Further adjustments (model 2) did not attenuate much this difference between married and never married men (0.12 bar difference, p < 0.001). The other groups (divorced/separated, widowed) did not differ significantly in grip strength from the married men in either of the two cohorts. For women there were no significant differences in grip strength between the marital groups in either of the two cohorts. The difference in grip strength between marital groups is visualized in Fig. 1. This implies that low grip strength among those born in later periods is increasingly related to being never married for the later born cohort of men. No relationship is found for women.

Table 3 shows the relationship between marriage, grip strength and mortality. Possible confounders that were taken into account were the following covariates: body mass index (BMI), current smoking self-reported health, a history of heart disease, education, systolic blood pressure and physical activity. We did a complete case analysis (non-missing values for all covariates). There was N = 5009 participants of whom 649 died during follow-up (out of N = 5367 individuals of whom 693 died in the full sample).

Mortality was lower for the later born versus the earlier born cohort; their HR was 0.45 (95% CI 0.37, 0.56). Grip strength was found to be inversely associated with mortality in both men and women; one SD stronger grip was associated with HR = 0.77 (0.71, 0.84) for both genders.

Compared to the reference category who are married, those who are divorced were at significantly increased death risk; HR = 1.40 (p = 0.01). Also never married had significantly increased HR = 1.40 (p = 0.02). Widows/widower were not at significantly increased risks of mortality. There were no significant gender by marital status

interactions (p = 0.91) or birth cohort by marital status interaction (p = 0.44).

Adjustment for grip strength did not substantially attenuate the association between family situation and mortality (the divorced HR shrunk from 1.40 in the minimally adjusted model to 1.36 in the grip-adjusted model, still being significant (p = 0.01). Corresponding HRs for never married were 1.40 (p = 0.02) and 1.33 (p = 0.056). Further adjustment for the aforementioned covariates attenuated some of the association between family situation and mortality (for divorced HR changed from 1.40 in the minimally adjusted model to 1.18 in the fully adjusted model, and the association was no longer significant (p = 0.19)). Corresponding HRs for never married were similar to those for divorced.

In sum our results lend support to H1; there is an increasing share among men who are both never married and have low grip strength. Yet, H2 is rejected: there is no significant interaction effects from low grip strength and marital status on mortality.

## Discussion and limitations

Ongoing demographic change in terms of changes in family forms combined with population ageing has led to an increase in the share of non-married households as well as rising numbers of suffering from sarcopenia (Chaves, Camozzato, Eizirik, & Kaye, 2009; Cullum et al., 2000). The fact that both low grip strength and lack of a partner can relate to mortality and that these two dimensions are increasingly occurring jointly (among males) can be important for developing an understanding of effective policies. Having a spouse could help one compensate for low physical strength: A couple can divide tasks (or jointly conduct activities), thereby offsetting or reducing limitations caused by lower functional capacities. Being married could help individuals lead healthier lifestyles and decrease negative health effects stemming from low physical strength.

In terms of mortality, the divorced were at significantly 40% increased mortality risk over a 9-year period compared with married, and this held true both for genders and both birth cohorts. This association was robust to adjustment for grip strength, but no longer significant after adjustment for health related variables. Similar associations were observed for the never married.

Family constellations (such as marital and cohabitation status, number of children/childlessness, number of surviving siblings, household type) can affect health through, for instance, its effects on lifestyles, influencing nutrition and activity levels and sanctioning risky behavior. For instance, people are likely to end tobacco smoking when



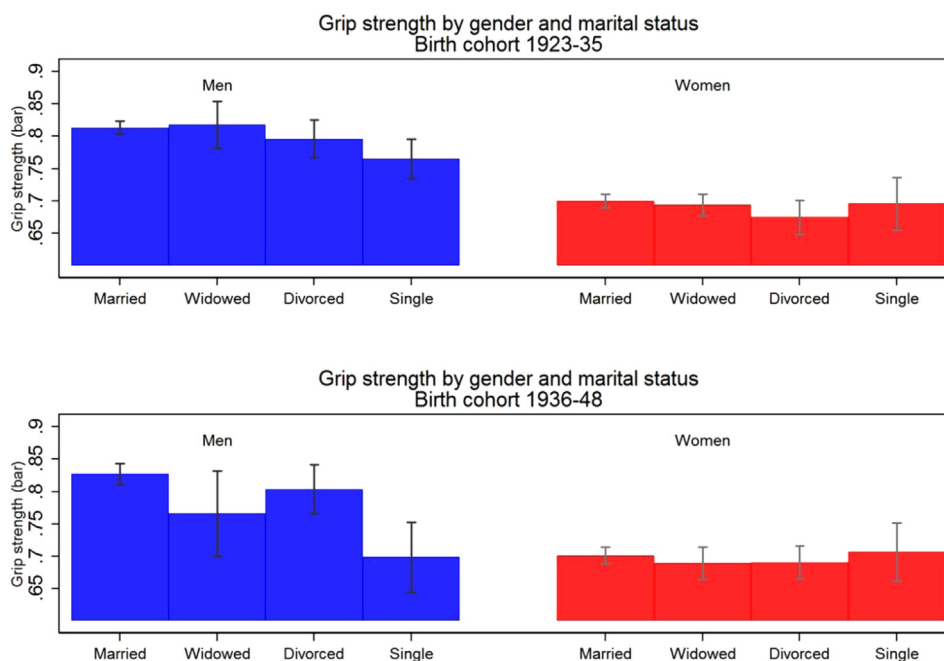


Fig. 1. Grip strength by gender and marital status.

they marry (Graham, 2012; McDermott, Dobson, & Owen, 2006). Spousal support could also be a way of mitigating stress, improving finances, practical support and giving a sense of belonging, meaning and purpose in life (Becker, 1991; Roy, Schumm, & Britt, 2014; Thomeer, Umberson, & Pudrovska, 2013).

The current study identified that physical strength as an indicator of general health is increasingly related to marital outcomes across birth

cohorts. We are not aware of any earlier research looking at cohort variation in determinants of marital outcomes as well as grip strength. Our main goal was not to focus on the direction of causality but rather to reveal that the relationship between grip strength, marital status and health as it has emerged in recent decades is changing. A limitation of this study is that our longitudinal individual analyses follow individuals from ages 59 and older - we do not know how grip strength developed

**Table 3**  
Mortality risk by grip strength and marital status.

Variable (%)	HR, model 1	HR, model 2	HR, model 3	HR, model 4	HR, model 5
<b>Men (N = 2318, #deaths = 399)</b>					
Birth cohort					
1923–1935 (72)	1.00	1.00	1.00	1.00	1.00
1936–1948 (27)	0.38 (0.29, 0.52)	0.39 (0.29, 0.52)	0.38 (0.28, 0.51)	0.38 (0.28, 0.51)	0.41 (0.30, 0.55)
Grip strength (per 1 SD increase)		0.75 (0.67, 0.83)		0.75 (0.68, 0.84)	0.84 (0.75, 0.93)
Marital status					
Married (77)			1.00	1.00	1.00
Widowed (5)			1.12 (0.75, 1.67)	1.12 (0.75, 1.66)	1.04 (0.69, 1.55)
Divorced (10)			1.51 (1.11, 2.06)	1.46 (1.07, 1.99)	1.34 (0.98, 1.83)
Never married (8)			1.37 (0.97, 1.92)	1.27 (0.90, 1.79)	1.18 (0.84, 1.68)
<b>Women (N = 3049, # = 250)</b>					
Birth cohort					
1923–1935 (62)	1.00	1.00	1.00	1.00	1.00
1936–1948 (38)	0.55 (0.40, 0.73)	0.54 (0.40, 0.73)	0.54 (0.40, 0.74)	0.54 (0.40, 0.73)	0.69 (0.51, 0.94)
Grip strength (per 1 SD increase)		0.82 (0.71, 0.94)		0.82 (0.72, 0.94)	0.92 (0.79, 1.06)
Marital status					
Married (62)			1.00	1.00	1.00
Widowed (22)			1.18 (0.88, 1.57)	1.15 (0.86, 1.54)	1.08 (0.81, 1.45)
Divorced (12)			1.25 (0.83, 1.89)	1.23 (0.82, 1.85)	0.99 (0.65, 1.50)
Never married (4)			1.50 (0.86, 2.50)	1.48 (0.85, 2.57)	1.22 (0.69, 2.13)

Interaction terms grip strength by marital status were not significant, neither in men nor women (men: p = 0.72, women: p = 0.64) and therefore not included in the model.

Model 1: Bivariate analyses, one variable entered at the time (only adjusted by age)

Model 2: Grip strength, adjusted by birth cohort and gender (and age)

Model 3: Marital status, adjusted by birth cohort and gender (and age)

Model 4: All variables in models above added

Model 5: Model 4 + adjusted by BMI, daily smoking, self-reported general health, self-reported heart disease, educational level, systolic blood pressure, leisure physical activity

Grip strength in bar measured by a Martin vigorimeter were standardized specifically in four groups by sex and birth cohort.

earlier in life. Hence, low grip strength may have led to lower marriage probabilities, or, alternatively, being married could potentially have improved male physical strength. We further lack data on marital quality, which is another dimension that could relate to health outcomes, including mortality in our study.

Low grip strength among those who lack a partner can imply a lower capacity to cope with everyday challenges and less healthy daily routines, including nutrition and activities. The fact that many are alone with low grip could imply that more attention needs to be given to this group, particularly given their relatively poor health. Even in high income welfare states such as Norway, the provision of care and assistance to disabled older individuals often falls on their spouses (Aronson & Neysmith, 1997; Soma & Yamashita, 2011) — and to wives in particular (Costa-Font, Karlsson, & Øien, 2016; Lee & Tang, 2013). Reliance on this informal network of care assumes that older men who require care in later life will have wives available to provide it. Marriage, particularly when one partner is physically impaired or requires assistance, can be central to the health of the couple.

As women tend to outlive men, albeit often in poorer health, the gender dimension is important to understand health outcomes and marriage (Liu & Waite, 2014; Miller, Hollist, Olsen, & Law, 2013). Trends in gender specific health and marriage could therefore be important determinants of the sustainable of welfare states (Carone et al., 2005; Langer et al., 2015). However, our results hint that women may be favoring partners who signal strength and vigor when they marry. If longer-lived women marry healthier men, then both may avoid or defer the role of caregiver, while less healthy men remain unmarried and must look elsewhere for assistance. Women's economic dependence has been reduced as women have become more educated, more skilled, more experienced, and more inclined towards employment. Men's 'health dependence' may require a different sort of education and experience as well as new housing alternatives that provide more collective in lieu of spousal support.

Our findings increase the importance of identifying policies that could help men with low strength to live independently and alone at later ages – such policies could include housing arrangements that encourage social interaction, or voluntary roles that enables independent living in spite of age-related decline. Potential policies can include counselling of individuals who are not married and with low strength to better prepare for old age and information on how to avoid negative health consequences of independent living. New technologies may potentially offset some of the limitations that low grip strength may imply. Social policies could also consider increasingly target this group by providing financial support for those who suffer a “double burden” of being single and having poor grip strength.

## Ethical approval

The project “A Women's Spousal Choice, a Man's Handshake and Mortality: A Norwegian Study of Cohort Differences” is approved by the Norwegian Regional Ethics Committee REK (code 2011/1659). The project is also approved by the Tromsø Study (code EUTRO 8030 00079).

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