Contribution of house and garden work to the association between physical activity and well-being in young, mid-aged and older women

Original article

CONTRIBUTION OF HOUSE AND GARDERN WORK TO THE ASSOCIATION BETWEEN PHYSICAL ACTIVITY AND WELL-BEING IN YOUNG, MID-AGE AND OLDER WOMEN

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Physical activity and well-being in women

Key words: physical activity domains, mental well-being, physical well-being, women

Word count: 3341 (max 3000)

Abstract

Objective

Although physical activity occurs in leisure, transport, occupational, and domestic domains of life, the contribution of house and garden work to the association between total physical activity and well-being is not clear. The aim was to describe the contribution of house and garden work (HGW) to total physical activity (TPA) in association with well-being in younger, mid-age and older women.

Design

Younger (25-30 years), mid-age (50-55 years), and older (76-81 years) participants in the Australian Longitudinal Study on Women's Health completed a mailed survey with questions about leisure, transport, and house and garden activities. Well-being was assessed using the physical and mental components scores of the SF-36. Cross-sectional associations between the physical activity variables and well-being were modelled using General Additive Modelling.

Results

Correlations between HGW and leisure/transport activity (LTA) were low ($r<0.3$, $p<0.001$). Positive curvilinear associations were found between LTA and physical and mental well-being in all three cohorts, and between HGW and physical and mental well-being in mid-age and older women. In the younger women, an inverse relationship was found between HGW and well-being. When HGW and LTA were summed (TPA), the associations between TPA and well-being were attenuated compared with those for LTA alone and well-being.

Conclusion

In mid-age and older women, relationships between HGW and well-being were similar to, but weaker than seen for LTA and well-being. In young women, well-being declined with increasing HGW. Summing HGW to LTA led to attenuated relationships, suggesting that domains of physical activity should not be summed when studying relationships with well-being.

INTRODUCTION

Physical activity is known to have a major impact on health. It protects against a range of health problems, including cardiovascular diseases, type 2 diabetes, some cancers, musculoskeletal and mental health problems, and has a positive influence on well-being across the adult life-span [1-3].

Although physical activity can occur in four key domains of life, i.e. leisure, transport, occupational and domestic, most literature focuses on the health impact of leisure time activity. Domestic activity, including house and garden work, may however constitute a sizeable proportion of daily activity [4] and energy expenditure [5], and may have a positive impact on health, particularly in older women [6, 7]. The impact of house/garden work on physical and mental well-being is, however, unclear. As time spent in leisure activities declines, and time in house and garden activities increases with age, activity patterns vary at different life stages [8-10]. As the contexts of these activities also differ, it is likely that their impact on well-being may also differ in adults at different life stages.

The aim of this study was to describe the contribution of house and garden work to the association between total physical activity and physical and mental well-being in younger, mid-age and older women. Cross-sectional associations between physical activity and well-being were examined for three definitions of physical activity, ie. house and garden work (HGW), leisure and transport activity (LTA), and total physical activity (TPA).

METHODS

Participants

Data were from the Australian Longitudinal Study on Women's Health (ALSWH), a population-based prospective study of factors affecting the health and well-being in three generations of women born in 1921-1926, 1946-1951, and 1973-1978 [11]. Ethical clearance was awarded by the Universities of Newcastle and Queensland. All participants signed informed consent. Detailed information on design, recruitment, and attrition are reported elsewhere [11, 12]. In short, samples were randomly drawn from the national Medicare health insurance database, which includes all Australian citizens and permanent residents. Women from rural and remote areas were intentionally overrepresented. Since 1996, mailed surveys have been administered to each cohort every 3 years on a rolling basis. For this study, we used data from the third wave of surveys, conducted in 2003 for the younger women (25-30 years, n=9,081), in 2001 for the mid-age women (50-55 years, n=11,226), and in 2002 for the older women (76-81 years, n=8,646).

Well-being

Well-being was assessed with the Australian version of the 36 Item Short-Form Health Survey (SF-36), which has established measurement properties [13-15]. The SF-36 measures physical, mental, and social health and well-being over the previous four weeks. For this article, we used the physical and mental component summary scores which are standardised to a mean (SD) score of 50 (10) and range from 0 to 100, with higher scores indicating better well-being. Factor weights for the Australian adult population were used to calculate the summary scores to allow direct comparison of physical and mental component scores for the three cohorts [16]. In the literature, differences in scores of 3, 5 and 10 points have been interpreted as clinically meaningful [17].

Physical activity

Physical activity was assessed using a modified version of the Active Australia questionnaire, which has acceptable measurement properties [18]. Participants were asked to report the duration of walking briskly (for recreation, exercise or transport), moderate leisure-time activities (e.g., social tennis, recreational swimming, dancing) vigorous leisure-time activities (activities that make you breathe harder or puff and pant, e.g. aerobics, competitive sport, vigorous cycling), and vigorous household and gardening chores during the last week (no examples given). Time spent in each activity (minutes/week) was multiplied by a metabolic equivalent (MET) score to reflect the average intensity of the activities in that category: 3.0 for walking briskly, 4.0 for moderate leisure time activities, 7.5 for vigorous leisure time activity, and 4.5 for vigorous house and garden work [19, 20]. Outliers were truncated at 14 hours/week per category [21]. To estimate Leisure and Transport Activity (LTA), MET-min/week spent walking briskly, and doing moderate and vigorous leisure time activities were summed. Outliers for this summary score were truncated at 28 hours/week, [21] which applied to 1.1%, 1.1%, and 0.7% of the younger, mid-age and older women, respectively. House and Garden Work (HGW) was defined as MET-min/week spent in vigorous household and gardening chores. Among the younger, mid-age and older women, 2.2%, 4.5%, and 4.0% reported more than 14 hours/week of HGW, respectively, these data were truncated at 14 hours/week. Total physical activity (TPA) was defined as the sum of LTA and HGW.

Confounders and sociodemographic characteristics

Sociodemographic indicators, including age, area of residence, country of birth (as a marker of ethnicity), highest level of education and marital status were based on self-report. Body mass index (BMI) was calculated using self-reported weight and height (kg/m^2). Chronic conditions was defined as having reported 1 or more self-reported diagnoses from a list of generation-specific conditions (e.g. gestational diabetes was included for the younger women only, whereas arthritis was included for the mid-age and older women only). Depressive symptoms were measured using continuous scores from the 10-item Center for Epidemiologic Studies Depression scale (CES-D) for the younger and mid-age women (range 0-30) [22, 23] and with the Goldberg Anxiety and Depression Scale (GADS) for the older women (range 0-18) [24].

Statistical analyses

Sociodemographic characteristics are presented for the three cohorts as means and standard deviations for normally distributed variables, medians and interquartile ranges for skewed variables, and percentages for categorical variables. Correlations between HGW and LTA were estimated using Spearman correlation coefficients. Associations between the physical activity variables (LTA, HGW and TPA) and physical and mental well-being, were modelled using General Additive Modelling using the "gam" function available for STATA 11 (StataCorp LP, College Station, TX) [25]. The gam function fits a generalized additive model for the outcome as a function of the predictors by maximizing a penalized log likelihood function. Each component of the resulting estimated function is a cubic smoothing spline. The smoothness of each component function is determined by the degrees of freedom of the corresponding predictor. This method allows for modelling associations without a priori assumptions about the shape of the relationships. Explorative analyses revealed that a model with 2 degrees of freedom adequately represented the data with a levelling off in gain (a measure for non-linearity) when more degrees of freedom were allowed. The gam function created a new variable with the fitted values, which was used to graph the associations. Graphs were created using the total range of activity levels, then enlarged to show the range of 0-5000 MET-min/week (which included data from >95% of the women), so that physical and mental component scores for specific physical activity levels could be established (by interpolation). The analyses were run with and without adjustment for age, BMI, depression, and chronic conditions and for the three cohorts separately.

RESULTS

Of the 9,081 younger, 11,226 mid-age and 8,646 older women who returned their surveys, 339 (3.7%), 1,073 (9.6%) and 1,945 (22.5%) women, respectively, had missing values for physical activity or well-being and were excluded from the analyses. In all three cohorts, women who were excluded reported lower levels LTA ($p<0.001$) and HGW ($p\leq0.005$) and had lower levels of education ($p<0.001$) than women who were included in the analyses. In addition, younger women who were excluded were more likely to live in rural or remote areas ($p=0.001$); mid-age women who were excluded had lower scores for mental well-being ($p<0.02$) and were older ($p=0.01$); and older women who were excluded had higher scores for physical well-being ($p<0.001$), were older ($p=0.003$), and were less likely to be partnered ($p=0.01$).

Younger women

In the younger cohort, complete data were available for 8,742 women with a mean age of 27.6 (standard deviation (SD) 1.5) years (Table 1). The women had an average physical well-being score of 52.6 (SD 8.0) and mental well-being score of 45.0 (SD 11.2). Approximately two thirds of the younger women reported doing at least some HGW (>0 MET-min/week) and HGW contributed 34.0% of TPA. There was a very weak but statistically significant correlation between HGW and LTA ($r=0.05$, $p<0.001$).

There was a positive curvilinear association between LTA and well-being (Figure 1). In contrast, there was an almost linear inverse association between HGW and well-being: younger women with higher levels of HGW had lower levels of physical and mental well-being. The variation in **physical**

Table 1. Sociodemographic characteristics of the women in each cohort

Cohort	Younger	Mid-age	Older
N	8,742	10,153	6,701
Age-range (years)	23-31	47-56	74-82
Mean age (SD)	27.6 (1.5)	52.5 (1.5)	78.2 (1.5)
Area of residence (%)			
Urban	58.0	37.9	43.0
Rural	38.3	56.9	54.8
Remote	3.6	5.2	2.2
Country of birth (%)			
Australian born	93.0	77.5	78.4
Other English speaking countries	3.6	13.7	13.2
Europe	0.9	5.8	6.9
Asia	1.8	2.1	0.9
Other	0.8	0.8	0.6
Marital status (%)			
Married/De facto	61.1	81.6	45.4
Separated/divorced/widowed	3.8	15.4	51.7
Never married	35.1	2.9	2.9
Level of education (%)			
Did not complete high school	10.0	47.7	69.1
High school certificate	19.4	16.9	13.6
Trade/apprentice ship/certificate	25.8	20.2	12.6
University or higher degree	44.8	15.2	4.6
Body Mass Index (mean (SD))	24.7 (5.4)	26.7 (5.4)	25.3 (4.5)
Depressive symptoms (mean (SD))	6.9 (5.3)	6.1 (5.3)	5.4 (4.0)
Chronic conditions (% yes)	46.5	75.6	88.7

and mental well-being was approximately 2 points across the full range of HGW. When HGW was added to LTA, the relationship with well-being was attenuated, with lower maximum values for the physical and mental component scores, than for LTA alone. Adjustment for the confounders led to a 1-2 points upward shift of the curves with greater fluctuations for higher activity values, but the trend of the curves remained the same (Figure 2). Closer examination of total activity in the range of 0 to 5000 MET-min/week (Figure 3) suggested that the associations seemed to level off at approximately 3000 MET-min/week. Women who reported a total of 3000 MET-min/week or more scored 2.3 and 1.4 points higher on physical and mental well-being than the most inactive women (Table 2).

Mid-age women

In the mid-age cohort, complete data were available for 10,153 women with a mean age of 52.5 (SD 1.5) years. The women had an average score for physical well-being of 48.6 (SD 9.6) and an average score for mental well-being of 48.6 (SD 11.0). About 70% of the mid-age women reported doing at least some HGW (>0 MET-min/week), and HGW contributed 43.2% of TPA in this cohort. There was a weak but significant correlation between HGW and LTA (r=0.17, p<0.001).

The positive curvilinear associations between LTA and physical and mental well-being were almost identical to those seen in the younger women, but with lower scores for physical and mental well-being across the entire range of MET-min/week values. In contrast with the patterns seen in the younger women, there were positive parabolic associations between HGW and physical and mental well-being. The association between TPA and well-being was attenuated when compared with that for LTA and well-being. Adjustment for the confounders led to a 1-2 points upward shift of the curves with greater fluctuations for higher activity values, but the trend of the curves remained the same. Women who spent a

Table 2. Reference values (and 95% confidence intervals) for the associations between total physical activity (MET-min/week) and well-being in younger, mid-age and older women

Total physical activity	Younger		Mid-age		Old	
	SF-36 Physical component score	**SF-36 Mental component score**	**SF-36 Physical component score**	**SF-36 Mental component score**	**SF-36 Physical component score**	**SF-36 Mental component score**
0	51.3 (51.1-51.5)	44.2 (43.9-44.5)	46.6 (46.4-46.8)	47.3 (47.0-47.5)	34.5 (34.2-34.7)	51.6 (51.3-51.8)
300	51.6 (51.4-51.8)	44.4 (44.2-44.7)	47.0 (46.8-47.2)	47.6 (47.4-47.8)	35.8 (35.7-35.9)	52.0 (51.8-52.2)
600	51.9 (51.8-52.1)	44.6 (44.4-44.8)	47.6 (47.5-47.8)	48.0 (47.8-48.1)	37.2 (37.1-37.3)	52.4 (52.3-52.5)
1200	52.6 (52.5-52.7)	45.0 (44.9-45.1)	48.6 (48.6-48.8)	48.6 (48.5-48.7)	39.6 (39.4-39.8)	53.1 (52.9-53.3)
3000	53.6 (53.4-53.8)	45.6 (45.2-45.9)	50.3 (50.0-50.5)	49.8 (49.6-50.1)	43.9 (43.5-44.3)	54.3 (54.0-54.6)
4000	53.7 (53.4-53.9)	45.6 (45.2-46.0)	50.6 (50.3-50.9)	50.1 (49.7-50.4)	44.9 (44.4-54.4)	54.6 (54.1-55.0)
5000	53.5 (53.1-53.9)	45.5 (44.9-46.1)	50.8 (50.3-51.2)	50.2 (49.6-50.7)	45.5 (44.8-46.2)	54.7 (54.0-55.2)

total of 3000 MET-min/week or more scored 3.7 and 2.5 points higher on physical and mental well-being than inactive women.

Older women

In the older cohort, complete data were available for 6,701 women with a mean age of 78.2 (SD 1.5) years. The women had an average score for physical well-being of 38.6 (SD 11.7) and an average score for mental well-being of 52.8 (SD 9.4). Approximately half the older women reported doing at least some HGW (>0 MET-min/week), which accounted for 44.9% of TPA. There was a stronger correlation between HGW and LTA ($r=0.27$, $p<0.001$) than in the younger and mid-age cohorts

As seen in the younger and mid-age women, there were positive curvilinear associations between LTA and well-being in older women, but the increase in physical well-being with higher levels of LTA was greater in older women than in the two younger cohorts. In contrast with the younger and mid-age women, there were quite marked positive curvilinear associations between HGW and well-being: older women with higher levels of HGW had higher levels of physical and mental well-being. The pattern of the association between TPA and well-being was similar to that for LTA and well-being, but with lower scores for physical and mental well-being. Adjustment for the confounders led to a 1-2 points upward shift of the curves with greater fluctuations for higher activity values, but the trend of the curves remained the same. Figure 3 shows that the association between TPA and physical well-being did not level off after 3000 MET-min/week, but gradually increased with higher levels of TPA. Older women who spent a total of 3000 MET-min/week scored 9.4 and 2.7 points higher on physical and mental well-being than inactive women.

DISCUSSION

This study explored the contribution of house and garden work to the associations between total physical activity and well-being. The nature of the associations between HGW and physical and mental well-being differed in the three cohorts: the association appeared to be weak but inverse in younger women, positive parabolic in mid-age women and positive curvilinear in older women. When house and garden work was added to leisure/transport activity, the associations between total physical activity and well-being showed similar patterns to those for leisure/transport activity, but with attenuated physical and mental component scores across the physical activity range.

In agreement with other research, we found positive relationships between LTA and physical and mental well-being [17]. Most previous studies have assumed linear relationships [26] or used dichotomized derivatives of physical activity and well-being.[27] The results of our additive modelling suggest, however, that the relationship is curvilinear and does not level off until approximately 3000 MET-min/week. This is equivalent to 12.5 hours/week or 1.8 hours/day of moderate intensity (4 MET) activity. Note that few women had values for LTA over 5000 MET-min/week resulting in wider confidence intervals (Figure 1) for LTA values of 5000 and higher.

To enhance comparability between cohorts, we used the same MET values across the three generations. We acknowledge however, that older adults may do these activities at a lower intensity than younger adults [28-30]. Hence, lower MET values may be more accurate in older adults. Sensitivity analyses with lower MET values (3.0 for walking, 3.0 for moderate leisure activity, 6.0 for vigorous leisure activity, and 4.0 for vigorous HGW) in the older women showed that the curves pulled-in slightly to the left, but that their shape was not altered (data not shown).

To our knowledge, only two other studies have examined the relationship between HGW and well-being. In both the Croatian study (504 women, 15+ years) [26] and the Brazilian study (271 women, 60+ years) [31] no significant associations were found between domestic activities and any of the quality of life subscales. Lack of significant associations in these studies may be due to the small sample size. Alternatively, since we found negative associations between HGW and physical and mental well-being in the younger women and positive associations in the mid-age and older women, the lack of significance in the Croatian sample may be due to the wide age-range of participants in their study, and the cancelling out of effects from women of different ages. The cohort differences in our study for the relationship between HGW and *mental* well-being may reflect different perceptions of house and garden work at different life stages. Older women may value house and garden work as an indicator of continued functional capacity, ability to live independently, or self-worth, and therefore derive more psychological benefits from this. In contrast, younger women may perceive these activities as chores compared with more appealing leisure activities, and derive little pleasure from them. The negative relationship between HGW and *physical* well-being among younger women may reflect that domestic activities are insufficient for physical well-being benefits in younger adults, while high levels of domestic activity result in less discretionary time for leisure activities that can enhance well-being. Alternatively, this may reflect a bidirectional relationship; those with poor physical well-being may spend longer in domestic activities because of increased physical demand, or a reluctance or inability to engage in other types of activity. A similar mechanism may explain why, in mid-age and older women, well-being decreased with high levels of HGW (ie. greater than 2000 MET-min/week). Given the variations shown here future studies should stratify for age when studying the health effects of HGW in women.

The shapes of the associations between physical activity and well-being differed for LTA and HGW in each cohort. When LTA and HGW were summed, the association between TPA and well-being was attenuated when compared with that for LTA and well-being, with lower peak values for physical and mental well-being at higher activity levels. The lower values for physical and mental well-being in the association with TPA are explained by the inverse associations between HGW and well-being for the younger women, and by weaker associations between HGW and well-being for the mid-age and older women. Contrasting directions of associations between domains of activity and health outcomes also have been found in other studies [26, 31, 32]. Differences in the measurement of physical activity and well-being, statistical analyses, and sample characteristics hamper direct comparison of the results. Given that the direction of the association between physical activity and health outcomes appears to differ across domains of activities, it is recommended that domestic activity should not be summed with leisure and transport activity when studying associations with health outcomes.

Younger, mid-age and older women who spent 3000 MET-min/week scored 2.3, 3.7, and 9.4 points higher on physical well-being than inactive women, respectively. Other physical activity and wellbeing researchers have used differences of 3, 5 or 10 points to indicate meaningful differences in SF-36 summary scores [17]. Using a threshold of 3 points, the difference in physical well-being across this range of total physical activity is associated with a clinically meaningful difference in physical well-being in mid-age and older women, but not in younger women. Differences in scores for mental well-being did not exceed the threshold of 3 points.

A major strength of this study is its large sample size, which provides sufficient power to reliably analyse data from the three different age cohorts separately. A second strength is the statistical analysis used: generalized additive modelling enabled us to model the relationships without a priori assumptions regarding their shapes [33]. Instead of forcing the data into a predefined model, the model follows the data. Some limitations need to be taken into account when interpreting the current results. First, the results are only from women, and cannot be generalized to men. In addition, analyses showed that non-responders were less educated and reported lower levels of LTA and HGW. As people with lower levels of education (or socio-economic status) score lower on well-being [34, 35], non-response from this cohort may have resulted in an overall overestimation of the mean scores for well-being, especially in the older cohort, in which there were more missing data and therefore probably a greater bias towards inclusion of women with better heath. This is however unlikely to have influenced the shape of the associations. Secondly, the measurement of physical activity is based on self-report, which can be vulnerable to bias. However, unlike objective measurement of physical activity, self report data allowed us to distinguish between the domains of physical activity. A third limitation is the subjective interpretation of vigorous HGW. The Active Australia survey items provide examples for moderate and vigorous LTA to help respondents identify types of activities to report, but no examples are provided for vigorous HGW. The wide range of MET-min/week spent on HGW suggests variation among the participants in their perceptions of what constitutes vigorous HGW. We recommend providing examples of vigorous HGW in future research. Finally, although we acknowledge that the relationship between physical activity and well-being is bi-directional, the focus in the current paper was that of physical activity as a factor of well-being. However, the cross-sectional design of the current study does not allow us to draw cause-effect conclusions.

In conclusion, in mid-age and older women, there is a positive relationship between HGW and well-being, which is similar to, but weaker than, that seen for LTA and well-being. However, well-being declines with increasing HGW in younger adult women. When HGW is included in estimates of TPA, the relationships between physical activity and well-being are attenuated compared with those seen for LTA and well-being. The findings have implications for which domains should be counted in physical activity when studying relationships with well-being.

WHAT THIS STUDY ADDS

- House and garden activities are positively associated with physical and mental well-being in mid-age and older women.
- In young adult women, well-being declines with increasing house and garden work.
- Activity reported in the house and garden domain should not be summed with activity from the leisure and transport domains when studying associations with well-being.

COMPETING INTERESTS

None declared

FUNDING

GP, YvG, JvU, and NB were supported by a National Health and Medical Research Council (NHMRC) Program grant (ID569940). The Australian Longitudinal Study on Women's Health (ALSWH), which was conceived and developed by groups of interdisciplinary researchers at the Universities of Newcastle and Queensland, is funded by the Australian Government Department of Health and Ageing. The funding sources had no involvement in the research presented in this manuscript.

CONTRIBUTION STATEMENT

WB was involved with the initiation and development of the ALSHW, and conceptualised this paper with GP. GP and YvG developed the analysis plan and conducted the data analysis. All authors were involved with the interpretation and review of the results. GP drafted the manuscript and revised it according to feedback from all authors, who were involved in critical revisions and provided important intellectual content. We would like to thank Gita Mishra for her advice on the statistical methods.

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FIGURE LEGENDS

Figure 1. Associations between three definitions of physical activity and physical and mental well-being in younger, mid-age and older women.

The associations are presented for younger (light gray), mid-age (dark gray) and older women (black) with the solid lines representing the mean summary scores of the physical and mental components of the SF-36 and the dashed lines representing the 95% confidence intervals. The rug plots indicate the distribution of physical activity.

Figure 2. Associations between three definitions of physical activity and physical and mental well-being in younger, mid-age and older women, after adjustment for confounders

The adjusted associations are presented for younger (light gray), mid-age (dark gray) and older women (black) with the solid lines representing the mean summary scores of the physical and mental components of the SF-36 and the dashed lines representing the 95% confidence intervals. The rug plots indicate the distribution of physical activity. Adjustment was made for age, BMI, chronic conditions and depressive symptoms.

Figure 3. Associations between total physical activity –ranging from 0 to 5,000 MET.minutes/week– and well-being in younger, mid-age and older women

The associations are presented for younger (light gray), mid-age (dark gray) and older women (black) with the solid lines representing the mean summary scores of the physical and mental components of the SF-36 and the dashed lines representing the 95% confidence intervals. The rug plots indicate the distribution of physical activity.