

BIROn - Birkbeck Institutional Research Online

Kouvonen, A. and de Vogli, R. and Stafford, M. and Shipley, M.J. and Marmot, M.G. and Cox, Tom and Vahtera, J. and Väänänen, A. and Heponiemi, T. and Singh-Manoux, A. and Kivimaki, M. (2012) Social support and the likelihood of maintaining and improving levels of physical activity: the Whitehall II Study. *The European Journal of Public Health* 22 (4), pp. 514-518. ISSN 1101-1262.

Downloaded from: <https://eprints.bbk.ac.uk/id/eprint/7218/>

Usage Guidelines:

Please refer to usage guidelines at <https://eprints.bbk.ac.uk/policies.html>

or alternatively

contact lib-eprints@bbk.ac.uk.

Social support and the likelihood of maintaining and improving levels of physical activity: the Whitehall II Study

Anne Kouvonen¹, Roberto De Vogli², Mai Stafford³, Martin J. Shipley⁴, Michael G. Marmot⁴, Tom Cox⁵, Jussi Vahtera⁶, Ari Väänänen⁷, Tarja Heponiemi⁸, Archana Singh-Manoux^{4,9}, Mika Kivimäki^{4,10}

1 Warsaw School of Social Sciences and Humanities, Wrocław Faculty, Wrocław, Poland

2 Department of Health Behaviors and Health Education, School of Public Health, University of Michigan, Ann Arbor, MI, USA

3 MRC Unit for Lifelong Health and Ageing, London, UK

4 Department of Epidemiology and Public Health, University College London, London, UK

5 Institute of Work, Health and Organisations, School of Community Health Sciences, The University of Nottingham, Nottingham, UK

6 Department of Public Health, University of Turku and Turku University Hospital, Turku, Finland

7 Finnish Institute of Occupational Health, Helsinki, Finland

8 National Institute for Health and Welfare, Helsinki, Finland

9 INSERM, U1018, Centre for Research in Epidemiology and Population Health, Hôpital Paul Brousse, Villejuif Cedex, France

10 Institute of Behavioral Sciences, University of Helsinki, Helsinki, Finland

Correspondence: Anne Kouvonen, Warsaw School of Social Sciences and Humanities, Wrocław Faculty, ul. Grunwaldzka 98, 50-357 Wrocław, Poland, tel: +48 71 328 69 19; fax: +48 71 327 08 61; e-mail: anne.kouvonen@gmail.com

Background: Evidence on the association between social support and leisure time physical activity (LTPA) is scarce and mostly based on cross-sectional data with different types of social support collapsed into a single index. The aim of this study was to investigate whether social support from the closest person was associated with LTPA. **Methods:** Prospective cohort study of 5395 adults (mean age 55.7 years, 3864 men) participating in the British Whitehall II study. Confiding/emotional support and practical support were assessed at baseline in 1997–99 using the Close Persons Questionnaire. LTPA was assessed at baseline and follow-up in (2002–04). Baseline covariates included socio-demographics, self-rated health, long-standing illnesses, physical functioning and common mental disorders. **Results:** Among participants who reported recommended levels of LTPA at baseline, those who experienced high confiding/emotional support were more likely to report recommended levels of LTPA at follow-up [odds ratio (OR): 1.39, 95% confidence interval (CI): 1.12–1.70 in a model adjusted for baseline covariates]. Among those participants who did not meet the recommended target of LTPA at baseline, high confiding/emotional support was not associated with improvement in activity levels. High practical support was associated with both maintaining (OR: 1.34, 95% CI: 1.10–1.63) and improving (OR: 1.25, 95% CI: 1.02–1.53) LTPA levels. **Conclusion:** These findings suggest that emotional and practical support from the closest person may help the individual to maintain the recommended level of LTPA. Practical support also predicted a change towards a more active lifestyle.

Introduction

Regular physical activity can have a beneficial effect on up to 20 chronic diseases or disorders.¹ Physically active adults have 20–30% reduced risk of premature death and up to 50% reduced risk of developing major chronic diseases.¹ The current recommendation is that adults should take part in physical activities of at least moderate intensity for at least 30 min on most days (at least 5 days a week).²

Social support, a potential correlate of leisure time physical activity (LTPA), can broadly be defined as resources provided by other persons.³ It is a multidimensional concept; emotional support provides love and caring, whereas practical support provides tangible assistance with a task or goal.³ Lack of social support has repeatedly been associated with higher morbidity and mortality.^{4,5} It is possible that part of this relationship is attributable to the association between social support and LTPA, mental health being a plausible intermediary factor. For example, social ties and integration in social networks play a role in the maintenance of psychological well-being, which in turn might motivate self-care in individuals, including regular physical exercise.⁶ High levels of social support are also assumed to increase self-esteem, self-efficacy and perceptions of control over the environment,⁷ all of which can potentially help an individual to adopt a proactive lifestyle and to resist unhealthy behaviours, such as sedentariness. Furthermore, indirect evidence is consistent with a causal

chain linking low social support to an increased risk of psychiatric morbidity^{8,9} and psychiatric morbidity to lower physical activity.¹⁰ On the other hand, it can also be argued that people with fewer social ties have more time to exercise.

Empirical evidence on the association between social support and physical activity is scarce. In the Health Survey for England, lack of social support was associated with lower levels of physical activity.¹¹ Higher social support measured as a single index of emotional, financial and practical support was associated with a higher likelihood of meeting physical activity guidelines in working-class multi-ethnic adults.¹² In another study, there was a relationship between higher practical and emotional social support and higher physical activity.¹³ In addition, meeting often with family members predicted becoming physically active in initially sedentary participants.¹⁴ In the study by Kanu *et al.*,¹⁵ an association was found between church-based practical support and performing some amount of physical activity, but not with meeting physical activity guidelines. There are also a number of studies that have shown that physical activity-related social support is associated with higher levels of physical activity.^{16–18}

Social support and physical activity have been operationalized in different ways in different studies and some of the studies have not differentiated between emotional and practical support. In addition, the analyses have seldom examined social support from the closest person specifically nor ruled out the possibility of reverse causation, as the data

are mostly cross-sectional (apart from Zimmermann *et al.*¹⁴). Thus, the purpose of this study was to determine whether confiding/emotional support and practical support from the closest person predicted maintaining or improving LTPA levels using a prospective study design.

Methods

Study sample and design

The data were derived from the Whitehall II Study of which target population was all office staff aged 35–55 years based in London, UK, in 20 civil service departments. With a participation rate of 73%, the baseline cohort (1985–88) consisted of 10 308 civil servants aged 35–55 years. Further details about the cohort can be found elsewhere.¹⁹ The present study uses data from Phases 5 (1997–99) and 7 (2002–04) of the study. Seventy-six percent of eligible Phase 1 respondents responded at Phase 5 ($n=7870$) and the corresponding figure at Phase 7 was 68% ($n=6967$).

The median length of the follow-up from Phases 5–7 was 5.4 years; 278 individuals died during this period. The analyses for the present study were based on 5395 participants with no missing data on any of the study variables.

Ethical approval for the Whitehall II study was obtained from the University College London Medical School Committee on the ethics of human research. Informed consent was obtained from the study participants.

Social support

Social support was measured at Phase 5. From the Close Persons Questionnaire,²⁰ we derived two types of social support from the person nominated as the closest by the respondent. Confiding/emotional support in the past 12 months was assessed with a seven-item scale measuring wanting to confide, confiding, sharing interests, boosting self-esteem and reciprocity relative to the first close relationship ($\alpha=0.85$). Practical support in the past 12 months was assessed with a three-item scale that measures major and minor practical help or support received from the closest person ($\alpha=0.82$).²⁰ Each item was evaluated on a Likert-scale from 1 to 4. The Likert-scaled responses for the items of each social support scale were summed. The final scores were then grouped into tertiles representing different levels of confiding/emotional support and practical support, respectively. The reliability and validity of the Close Persons Questionnaire was examined in detail by Stansfeld and Marmot.²⁰ A re-test reliability study of 4-week intervals showed high agreement for confiding/emotional support ($r=0.88$) and moderately high agreement for practical support ($r=0.71$).

LTPA

At Phases 5 and 7, physical activity was measured by asking the respondents the 'number of occasions' they had undertaken a range of different activities during the previous four weeks, and the 'total hours spent' on each of these activities. The activities were presented under four main headings and specific examples were given for each category. In addition, a final category of 'other activities' allowed respondents to provide information on physical activities not included in the main headings. A metabolic equivalent was allocated to each physical activity using the values developed by Ainsworth *et al.*²¹ For each respondent the total number of hours spent on moderate or vigorous activities was calculated. This was used to identify individuals whose levels of moderate and/or vigorous physical activity approximately met or exceeded the 1996 recommendations of the UK Department of Health, i.e. ≥ 2.5 h or more of moderate/vigorous physical activity per week.²²

Covariates

Besides sex and ethnicity, which were measured at Phase 1, all covariates were assessed at Phase 5. Socio-demographic covariates included age, sex, ethnicity (white vs. non-white) and employment grade, a measure of

socio-economic position strongly correlated with income (Pearson $r=0.90$, $P<0.0001$) and Registrar's General social class ($r=0.73$, $P<0.0001$) and moderately correlated with education ($r=0.43$, $P<0.0001$).²³ As in earlier studies in this cohort, employment grade was grouped into high (administrators, the top seven unified grades), middle (executives, professionals and technical staff) and low (clerical and office support staff).¹⁹

Self-rated health status was assessed with the question 'In general, would you say your health is very good, good, fair, poor, or very poor?'.²⁴ Long-standing illnesses were measured by asking the person if they had a long-standing illness at the time of the survey (yes vs. no).²⁵ The short-form 36 health survey (SF-36) physical component score (PCS) was used as a measure of physical function. The SF-36 is a 36-item questionnaire that measures functioning on eight scales and is one of the most widely used measures of quality of life.²⁶ The PCS is standardized to the general population (mean score 50; standard deviation 10), with high scores representing higher levels of functioning. Common mental disorder was defined as the General Health Questionnaire 'caseness', as previously detailed.²⁷

Statistical analyses

Logistic regression models were used to analyse the relationships of confiding/emotional support and practical support with achieving recommended levels of LTPA. Because the longitudinal analyses addressed in maintaining recommended levels of LTPA and improving LTPA (from insufficient to sufficient), they were conducted separately for those who reported recommended amount of LTPA at Phase 5 and for those who reported lower than recommended levels of LTPA at Phase 5. Statistical models were first adjusted for sex, age, ethnicity and employment grade; then additionally for self-rated health, long-standing illness and physical functioning. The final models included further adjustment for common mental disorders to investigate their role as a possible mediator.²⁸ The factors selected in the models have been associated with physical activity in previous studies.^{29–33} We conducted the analyses in the combined sample of men and women since the sex interactions were not significant (all $P>0.05$ in the final longitudinal models). Analyses were performed using the SAS 9.2 software (SAS Institute, Cary, NC, USA).

Results

The non-respondents at Phase 7 differed on the level of practical social support and physical activity from those who participated at Phase 5 and were thus included in the analytic sample for this study. At Phase 5 they were more likely to experience low practical support (35.2% in excluded participants vs. 34.2% in the included sample; $P=0.039$) and less likely to report taking the recommended amounts of LTPA (42.8% vs. 55.9%; $P<0.0001$). The participants lost to follow-up were also more likely to be women and from lower employment grades.

Table 1 shows the characteristics of the participants by the levels of social support at Phase 5. High confiding/emotional support and practical support were more often experienced by participants in the highest employment grade, those with good self-rated health and those without any common mental disorder. In addition, high practical support was more frequently reported by men, those with a long-standing illness, and those with poorer physical functioning. After adjustment for all covariates, low confiding/emotional support [odds ratio (OR) = 1.27, 95% confidence interval (CI): 1.07–1.51] and low practical support (OR = 1.21, 95% CI: 1.03–1.42) were cross-sectionally associated with a higher likelihood of common mental disorder at Phase 5 (data not shown). Furthermore, in a model including all covariates, confiding/emotional support, practical support and not having a common mental disorder were cross-sectionally associated with a higher likelihood of meeting the recommended levels of LTPA at Phase 5 (OR = 1.21, 95% CI: 1.05–1.39) (data not shown).

Table 2 presents the cross-sectional relationship between social support and recommended amount of LTPA at Phase 5. After adjustment for sex, age, ethnicity and employment grade, intermediate and high confiding/

Table 1 Characteristics of participants by levels of social support at Phase 5 (1997–99), the Whitehall II Study, UK (*n* = 5395)^a

Characteristic	<i>n</i> (%)	Confiding/emotional support (%)				Practical support (%)			
		Lowest tertile (<i>n</i> = 1806)	Middle tertile (<i>n</i> = 1885)	Highest tertile (<i>n</i> = 1704)	<i>P</i> -value ^b	Lowest tertile (<i>n</i> = 1845)	Middle tertile (<i>n</i> = 1647)	Highest tertile (<i>n</i> = 1903)	<i>P</i> -value ^b
Men	3864 (71.6)	72.8	71.0	71.0	0.35	65.0	76.1	74.2	<0.001
Age, mean (SD)	55.7 (6.0)	55.7	55.6	56.0	0.10	55.9	55.8	55.5	0.14
White	5070 (94.0)	93.9	94.1	94.0	0.96	93.2	94.5	94.2	0.23
Highest employment grade	2452 (45.5)	42.8	45.2	48.6	0.008	38.3	47.8	50.3	<0.001
Middle employment grade	2392 (44.3)	46.7	43.9	42.3		50.1	42.7	40.2	
Lowest employment grade	551 (10.2)	10.5	10.9	9.1		11.7	9.5	9.5	
Poor self-rated health	615 (11.4)	14.7	9.9	9.6	<0.001	12.6	8.7	12.6	<0.001
Long-standing illness	2666 (49.2)	49.5	48.5	50.3	0.57	47.2	48.2	52.6	0.002
Common mental disorder	1144 (21.2)	23.5	21.4	18.5	0.001	23.9	18.2	21.1	<0.001
SF-36 physical functioning, mean (SD)	51.1 (7.9)	50.8	51.3	51.3	0.07	51.5	51.8	50.3	<0.001

a: Only participants with no missing data on social support variables at Phase 5, LTPA at Phases 5 and 7 and any of the other study variables were included.

b: *P*-values from χ^2 -tests apart from age and physical functioning, which *P* are from ANOVA models.

Table 2 Cross-sectional association at Phase 5 (1997–99) between confiding/emotional and practical support and taking the recommended amount of LTPA, the Whitehall II Study, UK (*n* = 5395)

Social support	Prevalence of taking recommended amount of LTPA (%)	OR (95% CI)		
		Model 1 ^a	Model 2 ^b	Model 3 ^c
Confiding/emotional support				
Lowest tertile	964 (53.5)	1.00	1.00	1.00
Intermediate tertile	1077 (57.1)	1.20 (1.05–1.37)	1.16 (1.01–1.33)	1.16 (1.01–1.33)
Highest tertile	972 (57.0)	1.15 (1.00–1.32)	1.12 (0.97–1.28)	1.11 (0.96–1.27)
Practical support				
Lowest tertile	986 (53.4)	1.00	1.00	1.00
Intermediate tertile	972 (59.0)	1.16 (1.01–1.33)	1.14 (1.00–1.32)	1.14 (0.99–1.31)
Highest tertile	1055 (55.4)	1.01 (0.89–1.16)	1.05 (0.92–1.21)	1.04 (0.91–1.19)

a: Model 1: adjusted for sex, age, ethnicity, and employment grade.

b: Model 2: Model 1 + adjusted for self-rated health, long-standing illness and physical functioning.

c: Model 3: Model 2 + adjusted for common mental disorders.

emotional support and intermediate practical support were associated with a higher likelihood of achieving the recommended levels of LTPA. These associations were slightly attenuated after further adjustment for self-rated health, long-standing illness, physical functioning and common mental disorders.

Table 3 summarizes the results from the logistic regression analyses on the associations between social support at Phase 5 and recommended levels of LTPA at Phase 7 in analysis stratified by LTPA levels at Phase 5. Among the participants who reported recommended levels of LTPA at Phase 5, those who experienced high confiding/emotional support were more likely to maintain sufficient LTPA level at Phase 7 (OR = 1.42, 95% CI: 1.16–1.73), compared with those with low confiding/emotional support, in a model adjusted for sex, age, ethnicity and employment grade. This relationship remained significant after further adjustment for self-rated health, long-standing illness, physical functioning and common mental disorders. High confiding/emotional support was not associated with improvement in LTPA levels (from insufficient to sufficient) among the participants who reported lower than recommended levels of LTPA at Phase 5.

Table 3 also shows that, after adjustment for all covariates, including common mental disorders, high practical support was associated both with maintaining (OR = 1.34, 95% CI: 1.10–1.63) and improving (OR = 1.25, 95% CI: 1.02–1.53) LTPA levels. Having a common mental disorder was not associated with maintaining (OR = 1.10, 95% CI: 0.89–1.36) or improving (OR = 0.89, 95% CI: 0.73–1.09) in a model including all covariates) LTPA (data not shown). Thus, there was no evidence that common mental disorders mediated the associations between social support and LTPA.

Discussion

The multiple health benefits of regular physical activity are widely recognized,³⁴ but little is known about its social determinants. Our longitudinal analyses demonstrate for the first time that high confiding/emotional and practical support from the closest person may slightly increase the likelihood of maintaining recommended levels of LTPA. High practical support was also associated with an increase in LTPA levels among those participants who did not initially meet the recommended LTPA levels. In contrast, we found little evidence to suggest that high confiding/emotional support would contribute to increases in LTPA levels among initially less active men and women.

The association between social support and LTPA is consistent with earlier cross-sectional studies,^{11–15} which have similarly shown small or modest effect sizes.

The mechanisms explaining these associations remain unclear. A positive role identity and feelings of being useful provided by nurturing close social relationships can lead to greater motivation to take care of oneself and maintain a physically active lifestyle. High social support may also indicate positive involvement and active influence of a close person, which can encourage the individual to maintain health-promoting behaviours, such as regular exercise.³⁵ In addition, it is possible that higher social support is associated with better access to resources and may help to buffer the impact of daily stressors and life events and thereby reduce the likelihood of unhealthy coping behaviours such as discontinuing LTPA.³⁶

We examined poor mental health (common mental disorders) as a potential mediator in the association between social support and LTPA

Table 3 Longitudinal association between confiding/emotional and practical support at Phase 5 (1997–99) and taking the recommended amount of LTPA at Phase 7 (2002–04) the Whitehall II Study, UK

Social support	Prevalence of taking recommended amount of LTPA at Phase 7 (%)	OR (95% CI)		
		Model 1 ^a	Model 2 ^b	Model 3 ^c
Participants taking recommended amount of LTPA at Phase 5 (n = 3013)				
Confiding/emotional support				
Lowest tertile	651 (67.5)	1.00	1.00	1.00
Intermediate tertile	773 (71.8)	1.24 (1.02–1.50)	1.22 (1.01–1.48)	1.22 (1.01–1.48)
Highest tertile	731 (75.2)	1.42 (1.16–1.73)	1.39 (1.14–1.71)	1.39 (1.12–1.70)
Practical support				
Lowest tertile	662 (67.1)	1.00	1.00	1.00
Intermediate tertile	731 (75.2)	1.28 (1.10–1.52)	1.28 (1.05–1.56)	1.27 (1.04–1.55)
Highest tertile	780 (73.9)	1.33 (1.06–1.56)	1.34 (1.10–1.64)	1.34 (1.10–1.63)
Participants taking less than recommended amount of LTPA at Phase 5 (n = 2382)				
Confiding/emotional support				
Lowest tertile	290 (34.4)	1.00	1.00	1.00
Intermediate tertile	306 (37.9)	1.18 (0.97–1.45)	1.16 (0.90–1.38)	1.17 (0.95–1.43)
Highest tertile	272 (37.2)	1.14 (0.92–1.40)	1.12 (0.95–1.43)	1.13 (0.91–1.40)
Practical support				
Lowest tertile	296 (34.5)	1.00	1.00	1.00
Intermediate tertile	245 (36.3)	1.06 (0.86–1.31)	1.05 (0.85–1.31)	1.06 (0.85–1.31)
Highest tertile	327 (38.6)	1.17 (0.96–1.44)	1.24 (1.01–1.52)	1.25 (1.02–1.53)

a: Model 1: adjusted for sex, age, ethnicity and employment grade.

b: Model 2: Model 1 + adjusted for self-rated health, long-standing illness and physical functioning.

c: Model 3: Model 2 + adjusted for common mental disorders.

by conducting multivariable adjustments. There was very little change in the associations after adjustment for common mental disorders, suggesting that the link between high social support and maintaining recommended levels of LTPA is not mediated through this pathway. Further research is needed to explore other potential pathways, including those related to self-esteem, self-efficacy and access to resources. There is some previous evidence to link self-esteem and self-efficacy with both physical activity (or change in physical activity)^{18,37,38} and social support.³⁹

Methodological considerations

Our study is based on a large well-characterized cohort of British employees and a prospective study design with a median follow-up of 5.4 years. Further strengths of this study include repeat assessments of LTPA and simultaneous inclusion of a number of covariates. In particular, we adjusted for self-reported health, long-standing illness and physical functioning. Being ill in the first place can affect physical activity and also the quality of the closest relationship.⁴⁰ Furthermore, health-related factors may potentially influence reporting of social support or limit the availability of social support data by a process of selection subsequent to ill health.⁷ Adjustments for baseline health strengthens our results by eliminating important confounding factors but it could be argued that these analyses represent an over adjustment. In this case, we may have underestimated the strength of the association between social support and recommended levels of LTPA.

Our study is subject to a number of limitations. First, LTPA was measured by self-reports that may cause recall and response bias. People tend to over-report the frequency and time spent in LTPA.⁴¹ Observation and biomechanical measurements might be more accurate in measuring physical activity. Secondly, although the relationships of interest were adjusted for a range of variables, there are other possible confounders and mediators not included in this study such as neighbourhood-level characteristics, self-esteem and access to resources. Finally, the Whitehall II study is based on white-collar employees, and hence the results may not apply to blue-collar workers or those not in the work force.

Conclusions

Our results suggest that high levels of confiding/emotional and practical support might help individuals to keep physically active. High practical

support also contributed to a favourable change in physical activity. These findings can be important in the design and implementation of health promotion interventions aiming at promoting LTPA. They are also significant in increasing our scientific understanding of one mechanism through which high-quality, supportive social relationships can improve population health.

Acknowledgements

We thank all participating civil service departments and their welfare personnel, and establishment officers; the Occupational Health and Safety Agency; the Council of Civil Service Unions; all participating civil servants in the Whitehall II study; all members of the Whitehall II study team. The Whitehall II Study team comprises research scientists, statisticians, study coordinators, nurses, data managers, administrative assistants and data entry staff, who made the study possible.

Funding

The Whitehall II Study was supported by grants from the Medical Research Council (grant number G0902037); British Heart Foundation (grant number RG/07/008/23674); Health and Safety Executive; Department of Health; National Heart, Lung and Blood Institute (grant number R01HL036310), US, NIH; National Institute on Aging (grant numbers R01AG013196, R01AG034454), US, NIH; Agency for Health Care Policy Research (grant number HS06516); and the John D and Catherine T MacArthur Foundation Research Networks on Successful Midlife Development and Socio-economic Status and Health. A.K. and T.C. were supported by a grant from the Economic and Social Research Council (ESRC) (grant number RES-000-22-3489). T.C. is also supported by grants from the Health and Safety Executive (HSE), UK; Sheffield Hallam University, UK; Yorkshire & Humberside SHA, UK; Babcock International Group plc., UK; and the European Agency for Health and Safety at Work. R.D.V. is partially supported by the Economic and Social Research Council (ESRC RES 070-27-0034). M.J.S. is supported by a grant from the British Heart Foundation. M.G.M. is supported by a MRC Research Professorship. J.V. and M.K. are supported by the Academy of Finland (grant numbers 124 322, 124 271, 132 944). M.K. is also supported by the EU New OSH ERA research programme, the BUPA Foundation, UK (grant number 22094477) and the National Heart, Lung and Blood Institute (grant number R01 HL036310-20A2) and the

National Institute on Aging, NIH, US (grant number R01AG034454). A.V. is supported by the Finnish Work Environment Fund (grant number 109395) and the Academy of Finland (grant number 128089). T.H. is supported by the Finnish Work Environment Fund (grant number 107154) and the Academy of Finland (grant number 128002). A.S.-M. is supported by a 'European Young Investigator Award' from the European Science Foundation and the National Institute on Aging, NIH (grant numbers R01AG013196, R01AG034454). The researchers are all independent of the funders.

Conflicts of interest: None declared.

Key points

- Our longitudinal analyses demonstrate for the first time that high confiding/emotional and practical support from the closest person may slightly increase the likelihood of maintaining recommended levels of LTPA.
- High practical support also contributed modestly to a favourable change in physical activity.
- These findings can be important in the design and implementation of health promotion interventions aiming at promoting LTPA.
- They are also significant in increasing our scientific understanding of one mechanism through which high-quality, supportive social relationships can improve population health.

References

- Department of Health, UK. At least five a week: evidence on the impact of physical activity and its relationship to health. A report from the Chief Medical Officer. 2004. Available at: http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_4080994 (25 October 2010, date last accessed).
- Department of Health, UK. *Strategy Statement on Physical Activity*. London: Department of Health, 1996.
- Cohen S, Syme SL. Issues in the study and application of social support. In: Cohen S, Syme SL, editors. *Social Support and Health*. San Francisco: Academic Press, 1985:3–20.
- House JS, Landis KR, Umberson D. Social relationships and health. *Science* 1988;29:540–5.
- Berkman LF. The role of social relations in health promotion. *Psychosom Med* 1995;57:245–54.
- Kawachi I, Berkman LF. Social ties and mental health. *J Urban Health* 2001;78:458–67.
- Stansfeld SA, Bosma H, Hemingway H, Marmot MG. Psychosocial work characteristics and social support as predictors of SF-36 health functioning: the Whitehall II study. *Psychosom Med* 1998;60:247–55.
- Alexandrino-Silva C, Alves TF, Tófoli LF, Wang YP, Andrade LH. Psychiatry: life events and social support in late life depression. *Clinics* 2011;66:233–8.
- Barnett PA, Gotlib IH. Psychosocial functioning and depression: distinguishing among antecedents, concomitants, and consequences. *Psychol Bull* 1988;104:97–126.
- Kopp M, Fleischhacker WW, Stürz K, Ruedl G, Kummig M, Rumpold G. Poor health behaviour and reduced quality of life of people treated with psychotropic drugs. *Hum Psychopharmacol* 2011;26:161–7.
- Poortinga W. Perceptions of the environment, physical activity, and obesity. *Soc Sci Med* 2006;63:2835–46.
- Emmons KM, Barbeau EM, Gutheil C, Stryker JE, Stoddard AM. Social influences, social context, and health behaviors among working-class, multi-ethnic adults. *Health Educ Behav* 2007;34:315–34.
- Fischer Aggarwal BA, Liao M, Mosca L. Physical activity as a potential mechanism through which social support may reduce cardiovascular disease risk. *J Cardiovasc Nurs* 2008;23:90–6.
- Zimmermann E, Ekholm O, Grønbaek M, Curtis T. Predictors of changes in physical activity in a prospective cohort study of the Danish adult population. *Scand J Public Health* 2008;36:235–41.
- Kanu M, Baker E, Brownson RC. Exploring associations between church-based social support and physical activity. *J Phys Act Health* 2008;5:504–15.
- Litt MD, Kleppinger A, Judge JO. Initiation and maintenance of exercise behavior in older women: predictors from the social learning model. *J Behav Med* 2002;25:83–97.
- McAuley E, Jerome GJ, Elavsky S, Marquez DX, Ramsey SN. Predicting long-term maintenance of physical activity in older adults. *Prev Med* 2003;37:110–8.
- Ayotte BJ, Margrett JA, Hicks-Patrick J. Physical activity in middle-aged and young-old adults: the roles of self-efficacy, barriers, outcome expectancies, self-regulatory behaviors and social support. *J Health Psychol* 2010;15:173–85.
- Marmot M, Brunner E. Cohort profile: the Whitehall II study. *Int J Epidemiol* 2005;34:251–6.
- Stansfeld S, Marmot M. Deriving a survey measure of social support: the reliability and validity of the Close Persons Questionnaire. *Soc Sci Med* 1992;35:1027–35.
- Ainsworth BE, Haskell WL, Whitt MC, et al. Compendium of physical activities: an update of activity codes and MET intensities. *Med Sci Sports Exerc* 2000;32:S498–504.
- Mein GK, Shipley MJ, Hillsdon M, Ellison GT, Marmot MG. Work, retirement and physical activity: cross-sectional analyses from the Whitehall II study. *Eur J Public Health* 2005;15:317–22.
- Elovainio M, Ferrie JE, Singh-Manoux A, et al. Socioeconomic differences in cardiometabolic factors: social causation or health-related selection? Evidence from the Whitehall II cohort study, 1991–2004. *Am J Epidemiol* 2011;174:779–89.
- Idler EL, Benyamini Y. Self-rated health and mortality: a review of twenty-seven community studies. *J Health Soc Behav* 1997;38:21–37.
- Singh-Manoux A, Martikainen P, Ferrie J, Zins M, Marmot M, Goldberg M. What does self rated health measure? Results from the British Whitehall II and French Gazel cohort studies. *J Epidemiol Commun Health* 2006;60:364–72.
- Hemingway H, Stafford M, Stansfeld S, Shipley M, Marmot M. Is the SF-36 a valid measure of change in population health? Results from the Whitehall II Study. *Br Med J* 1997;315:1273–9.
- Kivimäki M, Lawlor DA, Singh-Manoux A, et al. Common mental disorder and obesity: insight from four repeat measures over 19 years: prospective Whitehall II cohort study. *Br Med J* 2009;339:b3765.
- Baron RM, Kenny DA. The moderator-mediator variable distinction in social psychological research: conceptual, strategic, and statistical considerations. *J Pers Soc Psychol* 1986;51:1173–82.
- Lahelma E, Rahkonen O, Berg MA, et al. Changes in health status and health behavior among Finnish adults 1978–1993. *Scand J Work Environ Health* 1997;23:85–90.
- Teychenne M, Ball K, Salmon J. Sedentary behavior and depression among adults: a review. *Int J Behav Med* 2010;17:246–54.
- Trost SG, Owen N, Bauman AE, Sallis JF, Brown W. Correlates of adults' participation in physical activity: review and update. *Med Sci Sports Exerc* 2002;12:1996–2001.
- Plotnikoff RC, Mayhew A, Birkett N, Loucaides CA, Fodor G. Age, gender, and urban-rural differences in the correlates of physical activity. *Prev Med* 2004;39:1115–25.
- Burton NW, Turrell G. Occupation, hours worked, and leisure-time physical activity. *Prev Med* 2000;31:673–81.
- Wannamethee SG. Exercise really is good for you. *Heart* 2006;92:1185–6.
- Umberson D. Gender, marital status and the social control of health behavior. *Soc Sci Med* 1992;34:907–17.
- Berkman LF, Glass T. Social integration, social networks, social support, and health. In: Berkman LF, Kawachi I, editors. *Social Epidemiology*. New York: Oxford University Press, 2000: 137–73.
- Bobbio A. Relation of physical activity and self-esteem. *Percept Mot Skills* 2009;108:549–57.
- Miller YD, Trost SG, Brown WJ. Mediators of physical activity behavior change among women with young children. *Am J Prev Med* 2002;23:98–103.
- Symister P, Friend R. The influence of social support and problematic support on optimism and depression in chronic illness: a prospective study evaluating self-esteem as a mediator. *Health Psychol* 2003;22:123–9.
- DesRosier MB, Catanzaro M, Piller J. Living with chronic illness: social support and the well spouse perspective. *Rehabil Nurs* 1992;17:87–91.
- Health Survey for England. <http://www.ic.nhs.uk/statistics-and-data-collections/health-and-lifestyles-related-surveys/health-survey-for-england/health-survey-for-england-2008-trend-tables> (16 November 2010, date last accessed).