Exploring the interrelationship between sport, health and social outcomes in the UK: Implications for health policy

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Abstract

Background: Policy agencies are now re-visiting early aspirations that sport, as a form of physical activity, can be an instrument to foster general health and also subjective well-being (SWB). Both of these concepts capture physical and mental health states. SWB also encompasses broader psychological and life satisfaction as well as mood and affect. Past and current policies also identify a link between sport, social capital and SWB.

Methods: Structural Equation Modelling (SEM) is undertaken on data from the UK's Taking Part survey to investigate the interrelationships between sport, general health, social capital and SWB.

Results: The SEM shows a simultaneous relationship between sport and SWB. The effect is mediated through general health. The results also show that there is no relationship between social capital and sport but a clear relationship between SWB and social capital.

Conclusions: From a health policy perspective there should be an emphasis on encouraging greater sport participation, despite the difficulties that this poses, because there is a potential 'multiplier' effect on SWB and on general health through mediation. The multiplier effect occurs because once someone engages in sport and has their general health and SWB enhanced, then even further sport participation becomes likely, and subsequent general health and SWB, which would comprise both physical and mental health benefits. To target traditional non participants the research suggests that physical activity should be promoted for enjoyment, with health benefits subsequently following.

Key words

Sport, General Health, Subjective Well-Being, Social Capital, Health Policy

Introduction

Sport has long been a policy instrument aimed at improving the overall quality of life. In 1966, the Council of Europe implemented the 'Sport for All' policy to achieve physical and mental health and social benefits (1). These sentiments were consolidated in 1975 by the European Sport for All Charter, and in 1991 and 2001 by the European Sports Charter in which sport is defined as 'all forms of physical activity which, through casual or organised participation, aim at expressing or improving physical fitness and mental well-being, forming social relationships or obtaining results in competition at all levels' (2). Such broader European policy initiatives have been reflected in the UK. There is now a long standing policy focus on countering the rising level of physical inactivity. It has been estimated that the health cost of physical inactivity is between £2 billion (3) and £3 billion (4) in the UK, with the British Heart Foundation National Centre (5) estimating that increases in physical activity would generate £900m per year in health cost savings.

HM Government (6), in their new 'Sporting Future' policy strategy, has also emphasised that sport can not only achieve physical and mental health, but also, symbiotically, individual, social and economic development. This reflects an environment in which there is now increased international policy emphasis on promoting general quality of life through the enhancement of subjective well-being (SWB). In the economics literature SWB is described as utility (7) but amongst other factors contains an indication of an individual's health (SWB; 6, 8). In the UK this has manifested itself in official data being collected on SWB (9) and the recognition that social capital as well as general health requires to be measured as part of SWB (10). Despite these policy initiatives, however, the collective interrelationships between sport, general health, social capital and SWB are not analysed in the literature. It has tended to focus on subsets of the interrelationships between the variables, which means that policy is based on partial insights.

As Dolan, Peasgood, and White (11) indicate there used to be a gap in the literature exploring the effects of exercise on health and SWB based on large-scale data. This is opposed to large medical and physical activity literatures drawing upon smaller scale randomised control trial and intervention studies (12). The same is also the case in examining the role of sport in the development of social capital (13).

Nonetheless literature based upon large scale data has now emerged. A positive relationship between physical activity and health conditions has been identified by Humphreys et al. (14) and Lechner (15) though subject to some challenge for specific health conditions by Sarma et al. (16). Sports participation, has also been shown to increase SWB by Becchetti et al. (17), Dolan et al. (18), Downward and Dawson (19), Huang and Humphreys (20) and Rasciute and Downward (21).

In contrast, the literature based on large-scale data identifies opposing relationships between sport and social capital. For example, a positive association between sport and social capital, based on sports-club membership promoting social contacts is identified by Bakken Ulseth (22). Delaney and Kearney (23) also show that sports can facilitate social capital through socialising with friends. However, Downward et al. (24) show that sport can reduce generalised trust in others, with trust identified as a central characteristic of social capital.

The literature finds more consistent evidence that social capital has a positive association with SWB through voluntary work, being more trusting (25) and engaging in social networks (25). Oishi, Diener and Lucas (26) also conclude that individuals with high levels of SWB are more successful in developing close relationships and are more likely to volunteer. Finally, sport participation is associated with an increase in SWB (27, 28), particularly in groups or teams (13).

In summary, the literature has distinct strands which tend to focus on sport as the key determining factor in seeking to achieve either SWB, or social capital, or physical and mental

health policy objectives. There is no exploration of the collective interrelationships between these sets of variables. It is important to recognise that this is often the case because studies focus on isolating causal effects between sport and the specific outcomes of health (9, 14), social capital (24) or SWB (19, 20) as it is recognised that sport and these outcomes might be simultaneously determined. For example, from a health economics perspective, sport can be seen as an investment in health, and potentially a flow of activity facilitated by an accumulated stock of health (19, 29).

Significantly, the literature also identifies that the outcomes of health, social capital and SWB are also likely to be related. A relationship between social capital and health is postulated because of the impacts of loneliness and mental health (30), and Borghesi and Vercelli (31) argue that it is important to study SWB and health jointly since they observe that the two literatures examining them have similar policy implications. Consequently in this paper we seek to explore the set of interrelationships between all of the variables sport, social capital, health, and SWB further. Framed by economic theory, in which the outcome of behaviour is SWB (7), we postulate that sport will directly contribute to this outcome, but also to Health and Social Capital, and these variables will also have a mediating influence on SWB. Moreover, as established in the literature we also postulate that these outcomes will, in turn, also influence participation in sport (19) . Our research questions are, thus, exploratory in seeking to identify to what extent the relationship between sport and SWB is influenced by effects on health and social capital as well, and to what extent these relationships are simultaneous. The focus lies on the testing of a network of interconnected relationships through structural equation modelling to inform health policy more fully. Although we do not focus on the identification of specific causal effects this approach allows us to outline and explore the simultaneity that is implied in the relationship between sport and SWB and to explore the mediating role of health and social capital in these relationships.

Methods

Data

The data employed draw upon the large-scale Taking Part Survey (TPS), commissioned by the Department for Culture, Media and Sport (DCMS) in the UK. The TPS began in 2005 as a cross-sectional national survey investigating sport, cultural, heritage, media and other leisure in England. Each wave comprises approximately 14,000 individuals. Data were originally collected by Computer Assisted Personal Interviewing (CAPI), but since 2016 this method has only applied to half of the sample, which remains a rolling cross-section sample, with the other half being collected as part of a longitudinal web-based survey. Waves 4 and 6 of the Taking Part Survey covering years 2008-09 and 2010-11 respectively were used in this paper as they provide the last options of having large samples on each of the variables of interest, the investigation of which varies over the survey. Accordingly the complete sample sizes for waves 4 and 6 were 14,452 and 14,102 observations respectively. However, while the social capital variable was asked of 12,615 respondents in wave 4, it was not asked in wave 5, asked of 6,926 respondents in wave 6, and only 1,134 respondents in wave 7 before being dropped from the survey.

The data allow for the measurement of sport, general health, social capital and SWB as manifest variables through a single question investigating each of them. Consequently , sport was measured by the total minutes of sports activity per week undertaken over the last four weeks; health was measured by a five point subjective health status variable investigating ‘How is your health in general?’ with very good to very poor as the scale end points (e.g., 30). Trust is a key component of any contemporary definition of social capital (32) . It was measured by a general perception of trust, with respondents replying to the question 'Would you say that most people are trustworthy?’ on a three point scale ranging from ‘you cannot be too careful’ to ‘most people can be trusted’ (e.g., 27). Subjective well-being was measured by

a single item measuring happiness through a question ‘Taking all things together how happy would you say you are?’ with a 10 point scale ranging from extremely unhappy to extremely happy. This scale is thought to capture positive emotions (33) and is a life evaluation measure (8).

Statistical analysis

Structural equation modelling (SEM) was employed allowing for multiple mediation paths between the variables. Relative goodness of fit was then assessed by the proximity of the variance-covariance matrix of the sample observed data and that of a particular model. No significant difference in a chi-square test between the matrices implies that the model exactly represents the data (35). More generally movement in the direction of accepting the null hypothesis indicates better fit. As the chi square statistic is inflated by sample size (39), additional fit indices were also employed to qualitatively assess the models. These include , the root mean square error of approximation (RMSEA), which indicates a good fit if it has values smaller than .05 (36) and the comparative fit index (CFI) which indicates likewise if exceeding 0.9 (37). The models were estimated using a weighted least squares estimator. The bootstrap method with 1,000 re-samples was used to deal with the ordered measures of social capital, health and SWB.

For each wave of data two models are estimated (as indicated in Figure 1 in the online appendix). The first model represents the case in which SWB is the outcome variable from sport, but the influence is also mediated through social capital and health. To explore the simultaneity between the variables a further model is proposed in which the relationship is reversed, and sport is the outcome variable. The models were estimated on the whole sample for each wave and for males and females. Gender has been shown to be an important factor influencing sport and health (38). The models were also estimated on samples from each

wave that excluded those aged 75 years or more, as a robustness check to explore if outliers might influence the results.

Results

Table 1 provides an overview of the key variables for each sample

INSERT TABLE 1

Tables 2 to 4 display all of the SEM results for each wave of data for the whole sample and for males and females. Results for those aged less than 75 years are presented in the online appendix. Each table contains results for Model 1 in which SWB is the outcome variable and Model 2 in which Sport is the outcome variable. For each model regression coefficients are displayed for all pairs of variables in the pathways outlined in Figure 1 that capture the total effect (TE) between the variables and also the direct effect (DE) and indirect effect (IE). The TE and DE are the same for each variable other than when examining relationships between sport and SWB. In this case as mediation is possible the IE measures the mediation of the relationship between sport and SWB through health and social capital. At the bottom of each table and for each model are the chi square, CFI and RMSEA goodness of fit statistics.

Overall the goodness of fit statistics suggest that the models in which sport is the outcome fit the data better as indicated by lower chi-square statistics, higher CFI values and lower RMSEA values. The latter statistic is more likely to indicate less of a good fit when SWB is the outcome and for wave 6 data covering 2010-11. These results suggest that the feedback from SWB to sport is better explained in the data than examining the pathways from sport to SWB.

Reviewing the significance of the regression coefficients in the pathways explored in the models yields a general pattern in which sport has a direct and indirect effect on SWB and this is mediated through health, as indicated by the significant pathways between sport and

health; and then health and SWB in model 1. These pathways are also mirrored in the opposite direction as indicated by the results for model 2. In contrast there is a general lack of pathway identified between sport and social capital in either direction. The only exceptions to these results are that for females (and for the sample including those less than 75 years of age) in the earlier wave 4 covering 2008-09 a significant influence is identified between sport and social capital. In the same data no association between health and SWB is identified for females. This might be further evidence of historic results found in Downward and Rasciute (38) suggesting a challenge in raising the intensity of female sports participation for health, but satisfaction with the provision of sport can raise the intensity of participation. In this regard model 2 for this data still reveals a positive association between SWB and health and health and sport.

INSERT TABLES 2-4

Discussion

The analysis highlights a network of relationships between sport, general health, social capital and SWB, with the suggestion of a more robust association stemming from SWB to sport. The results also indicate that the pathways between these variables are most closely tied to mediating effects through general health. A clear relationship between SWB and social capital is identified as noted in the literature (26, 27, 30).

From a health policy perspective this suggests that potential multiplier effects on SWB and on general health through mediation are possible if sport is used as a policy tool. This is because of the confirmed simultaneity. Consequently if engagement in sport raises general health and SWB, then further sport participation becomes likely, and then subsequent general health and SWB. This is suggestive of a virtuous circle of behaviour through experience. This might explain why it has proved difficult for policy makers to encourage a more active lifestyle as evident in the persistent sedentary nature of the population. In contrast it might

also explain why research such as Downward and Riordan (39) has shown that participation in sport and physical activity can strongly promote further participation because of, for example, the consumption capital developed from the acquisition of skills and capabilities to engage in sport.

The implication is that policy makers should continue to promote sport. This is needed because the mean value of sport in the data of 424 minutes in wave 4 covering 2008-09 and 466 minutes in wave 6 covering 2001-11 equates to approximately two hours per week. This is below the recommendations of the World Health Organisation (WHO) which suggest 150 minutes per week of moderate intensity for adults required for physical health benefits (40). The data are also highly skewed which suggests that this mean value overstates typical participation. As the analysis confirms that sport can contribute to SWB and health, and that this can, in turn, enhance participation in sport further, this suggests that it may be important to target sport participation through the perspective that sport can be enjoyable rather than healthy directly. Recent research has shown that most sport is more likely to achieve this objective (12). Health outcomes would then subsequently follow indirectly. Nonetheless, overall the results also suggest that linking sport to general health and SWB, and consequent mental health benefits as well as physical health benefits, which is a current health policy objective, is more likely to be effective than promoting SWB and health through claims that sport raises social capital, which has been suggested as equally plausible in current UK policy in ‘Sporting Futures’ (6). This is not to say that social capital is unimportant to SWB. The above analysis simply suggests that this influence is more remote. Sport by itself may fail to promote social capital as has been indicated in some of the literature (e.g., 24).

This study naturally has some limitations. First, the chi square statistic is significant for all models but this may be partially explained with the very large sample size (35). Finally, although this study analyses behaviour at distinct points in time, it is not a

longitudinal study and this is needed to help to unpick the temporal development of behaviour and also how the simultaneous outcomes emerge as part of a causal chain.

Despite these shortcomings, however, this paper has for the first time analysed the interrelationships between the complete set of variables sport, general health, social capital and SWB, all of which are currently seen as important to public policy. The research confirms that sport and SWB are simultaneously related and particularly mediated through general health. This suggests that policy makers' current emphasis on using sport to influence general health and well-being as a means of promoting greater physical and mental health is apposite, though emphasis on well-being could also be prioritised to meet the challenge of attracting new participants.

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Conflicts of Interest

None are declared

Key points

- Large-scale data analysis of the interrelationships between sport, health, social capital and overall subjective well-being confirms that sport participation is more likely to improve subjective well-being directly and mediated through health.
- The paper adds the insight that stronger associations are identified in paths from subjective well-being to health and participation. Simultaneity suggests the potential for ‘multiplier’ effects from greater participation in sport on SWB and on general health through mediation.
- Unlike active participants, targeting a sedentary population may require health policy promoting sports participation through enjoyment and contribution to well-being from which health benefits will subsequently follow.

References

1. McInstosh P. Sport for All' Programmes Throughout the World, A Report for the International Council of Sport and Physical Education for UNESCO 1980 [Available from: http://unesdoc.unesco.org/images/0005/000500/050052eb.pdf.

2. Council of Europe. Revised European Sport Charter 2001 [Available from: https://wcd.coe.int/ViewDoc.jsp?Ref=Rec(92)13&Sector=secCM&Language=lanEnglish&Ver=rev&BackColorInternet=9999CC&BackColorIntranet=FFBB55&BackColorLogged=FFAC75.

3. DCMS/Strategy Unit. Game plan: A strategy for delivering government's sport and physical activity objectives. London: DCMS/Strategy Unit; 2002.

4. Sport England. Engaging inactive people 2015 [Available from: http://www.sportengland.org/research/benefits-of-sport/health-benefits-of-sport/case-study-engaging-inactive-people/.

5. British Heart Foundation National Centre. Economic Costs of Physical Inactivity Evidence Briefing. Loughborough: Loughborough University; 2013.

6. HM Government. Sporting Future: A New Strategy for an Active Nation London: Cabinet Office; 2015 [Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/486622/Sporting_Future_ACCESSIBLE.pdf.

7. Stiglitz JE, Sen A, Fitoussi JP. Report by the Commission on the Measurement of Economic Performance and Social Progress 2008 [Available from: www.stiglitz-sen-fitoussi.fr/documents/rapport_anglais.pdf.

8. OECD. OECD Guidelines on Measuring Subjective Well-being 2013 [Available from: http://www.oecd-ilibrary.org/economics/oecd-guidelines-on-measuring-subjective-well-being_9789264191655-en

9. ONS. Measuring social capital 2014 [Available from: http://www.ons.gov.uk/ons/rel/wellbeing/measuring-national-well-being/measuring-social-capital--july-2014/art-measuring-social-capital.html#tab-Personal-Relationships.

10. ONS. How does ONS measure personal well-being? 2014 [Available from: http://www.ons.gov.uk/ons/guide-method/method-quality/specific/social-and-welfare-methodology/subjective-wellbeing-survey-user-guide/subjective-well-being-frequently-asked-questions--faq-s-.html#6.

11. Dolan P, Peasgood T, White M. Do we really know what makes us happy? A review of the economic literature on the factors associated with subjective well-being. Journal of Economic Psychology. 2008;29(1):94-122.

12. Downward P, Dawson P. Is it Pleasure or Health from Leisure that We Benefit from Most? An Analysis of Well-Being Alternatives and Implications for Policy. Social Indicators Research. 2015:1-23.

13. Downward P, Rasciute S. Does sport make you happy? An analysis of the well-being derived from sports participation. International Review of Applied Economics. 2011;25(3):331-48.

14. Humphreys BR, McLeod L, Ruseski JE. Physical activity and health outcomes: Evidence from Canada. Health Economics. 2014;23(1):33-54.

15. Lechner M. Long-run labour market and health effects of individual sports activities. Journal of Health Economics. 2009;28:839-54.

16. Sarma S, Devlin RA, Gilliland J, Campbell MK, Zaric GS. The Effect of Leisure-Time Physical Activity on Obesity, Diabetes, High BP and Heart Disease Among Canadians: Evidence from 2000/2001 to 2005/2006. Health Economics. 2015;24(12):1531-47.

17. Becchetti L, Giachin Ricca E, Pelloni A. The Relationship Between Social Leisure and Life Satisfaction: Causality and Policy Implications. Social Indicators Research. 2012;108(3):453-90.

18. Dolan P, Kavetsos G, Vlaev I. The Happiness Workout. Social Indicators Research. 2014;119(3):1363-77.

19. Downward P, Dawson P, Mills TC. Sports participation as an investment in (subjective) health: a time series analysis of the life course. Journal of Public Health. 2015.

20. Huang H, Humphreys BR. Sports participation and happiness: Evidence from US microdata. Journal of Economic Psychology. 2012;33(4):776-93.

21. Rasciute S, Downward P. Health or happiness? What is the impact of physical activity on the individual? Kyklos. 2010;63(2):256-70.

22. Bakken Ulseth A-L. Social integration in modern sport: Commercial fitness centres and voluntary sport clubs. European Sport Management Quarterly. 2004;2(4):95-115.

23. Delaney L, Kearney E. Sport and Social Capital in the United Kingdom: Statistical Evidence from National and International Survey Data. London: DCMS; 2005.

24. Downward P, Pawlowski T, Rasciute S. Does Associational Behavior Raise Social Capital? A Cross-Country Analysis of Trust. Eastern Economic Journal. 2014;40(2):150-65.

25. Awaworyi Churchill S, Mishra V. Trust, Social Networks and Subjective Wellbeing in China. Social Indicators Research. 2016:1-27.

26. Oishi S, Diener E, Lucas RE. The Optimum Level of Well-Being: Can People Be Too Happy? Perspectives on Psychological Science. 2007;2(4):346-60.

27. Bjørnskov C. The Happy Few: Cross–Country Evidence on Social Capital and Life Satisfaction. Kyklos. 2003;56(1):3-16.

28. Ram R. Social Capital and Happiness: Additional Cross-Country Evidence. Journal of Happiness Studies. 2010;11(4):409-18.

29. Yu G, Sessions JG, Fu Y, Wall M. A multilevel cross-lagged structural equation analysis for reciprocal relationship between social capital and health. Social Science & Medicine. 2015;142:1-8.

30. Yip W, Subramanian SV, Mitchell AD, Lee DTS, Wang J, Kawachi I. Does social capital enhance health and well-being? Evidence from rural China. Social Science & Medicine. 2007;64(1):35-49.

31. Borghesi S, Vercelli A. Happiness and health: Two paradoxes. Journal of Economic Surveys. 2012;26(2):203-33.

32. Wollebæk D, Strømsnes K. Voluntary Associations, Trust, and Civic Engagement: A Multilevel Approach. Nonprofit and Voluntary Sector Quarterly. 2008;37(2):249-63.

33. Huppert FA, So TTC. Flourishing Across Europe: Application of a New Conceptual Framework for Defining Well-Being. Social Indicators Research. 2013;110(3):837-61.

34. Sarracino F. Social capital and subjective well-being trends: Comparing 11 western European countries. The Journal of Socio-Economics. 2010;39(4):482-517.

35. Brown TA. Confirmatory Factor Analysis for Applied Research. New York, NY: The Guilford Press; 2006.

36. Browne MW, Cudeck R. Alternate ways of assessing model fit. In: Bollen KA, Long JS, editors. Testing structural equation models. Newbury Park, CA: Sage; 1993. p. 136-62.

37. Hu L-T, Bentler PM. Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Concentional Criteria Versus New Alternatives. Structural Equation Modeling. 1999;6(1):1-55.

38. Downward P, Rasciute S. Exploring the covariates of sport participation for health: an analysis of males and females in England. Journal of Sport Sciences. 2015;33(1):67-76.

39. Downward P, Riordan J. Social Interactions and the Demand for Sport: an Economic Analysis. Contemporary Economic Policy. 2007;25(4):518-37.

40. WHO. Global recommendation on physical activity for health: World Health Organisation; 2011 [Available from: http://www.who.int/dietphysicalactivity/leaflet-physical-activity-recommendations.pdf.

Table 1

Variables employed and their summary statistics based on mean values and for binary variables as sample proportions.

Variable	Description	Scale of variable	All (2008-09)	Males (2008-09)	Females (2008-09)	All (2010-11)	Males (2010-11)	Females (2010-11)
PA	Physical activity: Total minutes sports activity in four weeks	Metric	424.823 (975.373)	601.584 (1,162.864)	284.353 (767.036)	466.444 (1,037.372)	687.521 (1,345.623)	298.741 (673.818)
SHS	Subjective health status: How is your health in general?	Ordinal (1=very bad to 5= very good)	3.944 (.953)	3.949 (.959)	3.940 (.948)	3.949 (.964)	3.934 (.965)	3.961 (.964)
SC	Would you say that most people are trustworthy?	Ordinal (1=you can't be too careful, 2=depends, 3=can be	1.891 (.953)	1.939 (.955)	1.854 (.950)	1.943 (.957)	1.981 (.960)	1.915 (.955)

		trusted)						
SWB	Subjective well-being: Taking all things together, how happy would you say you are?	Ordinal (1=extremely unhappy to 10=extremely happy)	7.780 (1.744)	7.807 (1.720)	7.759 (1.764)	7.762 (1.796)	7.721 (1.792)	7.793 (1.798)

Note. Standard deviation in parentheses

Table 2

Comparison of different models for Waves 2008-09 and 2010-2011 (Overall sample)

	Wave 2008-09						Wave 2010-11					
	Model 1 DV SWB			Model 2 DV PA			Model 1 DV SWB			Model 2 DV PA		
	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE
PA -> SHS	.179*	.179*					.186*	.186*			.	
SHS -> PA				.170*	.170*					.184*	184*	
PA -> SC	.019 n.s	.019 n.s					.006 n.s.	.006 n.s.				
SC-> PA				.007 n.s	.007 n.s					-.008 n.s	-.008 n.s.	
PA -> SWB	.066*	.015 n.s	.051*				.054*	.004 n.s.	.050*			
SWB -> PA				.065*	.016 n.s	.050*				.055*	.004 n.s.	.047
SHS -> SWB	.279*	.279*					.265*	.265*				
SWB -> SHS				.289*	.289*					.276*	.276*	
SC -> SWB	.058*	.058*					.068*	.068*				
SWB -> SC				.079*	.079*					.089*	.089*	

χ^2 (df); p	58.278 (1); .000	31.615 (1); .000	37.920 (1); .000	18.632 (1); .000
CFI	.948	.972	.938	.970
RMSEA (90% CI); pclose	.068 (.054-.083); .020	.050 (.036-.065); .481	.074 (.055-.095); .020	.051 (.032-.072); .419

Note. Estimated with 1,000 bootstrap samples and bias-corrected estimates; DV=dependent variable; TE=total effect; DE: direct effect; IE=indirect effect; * $p \leq .05$; $^{n.s.}$ not significant

Table 3

Comparison of different models for Waves 2008-09 and 2010-2011 (Males only)

	Wave 2008-09						Wave 2010-11					
	Model 1 DV SWB			Model 2 DV PA			Model 1 DV SWB			Model 2 DV PA		
	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE
PA -> SHS	.209*	.209*					.208*	.208*				
SHS -> PA				.204*	.204*					.205*	.205*	
PA -> SC	.000 n.s	.000 n.s					-.005 n.s	-.005 n.s				
SC -> PA				-.013 n.s	-.013 n.s					-.018 n.s	-.018 n.s	
PA -> SWB	.070*	.011 n.s	.059*				.060*	.010 n.s	.050*			
SWB -> PA				.071*	.013 n.s	.058*				.060*	.010 n.s	.050*
SHS -> SWB	.282*	.282*					.241*	.241*				
SWB -> SHS				.291*	.291*					.251*	.251*	
SC -> SWB	.052*	.052*					.066*	.066*				
SWB -> SC				.069*	.069*					.081*	.081*	

χ^2 (df); p	19.635 (1); .000	8.814 (1); .003	12.239 (1); .000	5.580 (1); .018
CFI	.965	.985	.956	.982
RMSEA (90% CI); pclose	.058 (.038-.082); .236	.038 (.018-.062); .771	.062 (.034-.095); .213	.040 (.013-.074); .633

Note. Estimated with 1,000 bootstrap samples and bias-corrected estimates; DV=dependent variable; TE=total effect; DE: direct effect; IE=indirect effect; * $p \leq .05$; $^{n.s.}$ not significant

Table 4

Comparison of different models for Waves 2008-09 and 2010-2011 (Females only)

	Wave 2008-09						Wave 2010-11					
	Model 1 DV SWB			Model 2 DV PA			Model 1 DV SWB			Model 2 DV PA		
	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE
PA ->SHS	.635*	.635*					.196*	.196*				
SHS -> PA				.142*	.142*					.193*	.193*	
PA -> SC	.125*	.125*					.007 n.s	.007 n.s				
SC -> PA				.017 n.s	.017 n.s					-.011 n.s	-.011 n.s	
PA -> SWB	.243*	.096*	.147*				.066*	.010 n.s	.056*			
SWB -> PA				.060*	.018 n.s	.042*				.066*	.010 n.s	.056*
SHS-> SWB	.221 n.s	.221 n.s					.281*	.281*				
SWB -> SHS				.288*	.288*					.295*	.295*	
SC -> SWB	.054*	.054*					.071*	.071*				
SWB -> SC				.085*	.085*					.096*	.096*	

χ^2 (df); p	10.960 (1); .001	24.024 (1); .000	28.286 (1); 000	13.791 (1); .000
CFI	.984	.963	.928	.966
RMSEA (90% CI); pclose	.038 (.020-.060); .803	.058 (.039-.079); .230	.084 (.059-.112); .013	.058 (.033-.086); .270

Note. Estimated with 1,000 bootstrap samples and bias-corrected estimates; DV=dependent variable; TE=total effect; DE: direct effect; IE=indirect effect; * $p \leq .05$; $^{n.s.}$ not significant

APPENDIX Table 5

Variables employed and their summary statistics based on mean values and for binary variables as sample proportions for samples < 75 years.

Variable	Description	Scale of variable	<75 years (2008-09)	<75 years (2010-11)
PA	Physical activity: Total minutes sports activity in four weeks	Metric	463.521 (.968.546)	510.178 (1,080.506)
SHS	Subjective health status: How is your health in general?	Ordinal (1=very bad to 5= very good)	4.015 (.927)	4.022 (.938)
SC	Would you say that most people are trustworthy?	Ordinal (1=you can't be too careful, 2=depends, 3=can be trusted)	1.874 (.950)	1.929 (.956)
SWB	Subjective well-being: Taking all things together,	Ordinal (1=extremely unhappy to	7.760 (1.744)	7.739 (1.793)

how happy would you say 10=extremely happy)

you are?

APPENDIX: Table 6

Comparison of different models for Waves 2008-09 2010-2011 (<75 years only)

	Wave 2008-09						Wave 2010-11					
	Model 1 DV SWB			Model 2 DV PA			Model 1 DV SWB			Model 2 DV PA		
	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE
PA -> SHS	.171*	.171*					.173*	.173*				
SHS -> PA				.160*	.160*					.169*	.169*	
PA -> SC	.026*	.026*					.008 n.s	.008 n.s				
SC -> PA				.009 n.s	.009 n.s					-.007 n.s	-.007 n.s	
PA -> SWB	.075*	.023*	.052*				.058*	.009 n.s	.049*			
SWB -> PA				.075*	.025*	.050*				.059*	.010 n.s	.049*
SHS -> SWB	.295*	.295*					.279*	.279*				
SWB -> SHS				.310*	.310*					.292*	.292*	
SC -> SWB	.062*	.062*					.069*	.069*				
SWB -> SC				.089*	.089*					.094*	.094*	

χ^2 (df); p	76.054 (1); .000	42.394 (1); .000	44.496 (1); .000	22.866 (1); .000
CFI	.921	.957	.917	.958
RMSEA (90% CI); pclose	.083 (.068-.099); .000	.061 (.046-.078); .101	.085 (.065-.108); .003	.060 (.041-.083); .180

Note. Estimated with 1,000 bootstrap samples and bias-corrected estimates; DV=dependent variable; TE=total effect; DE: direct effect; IE=indirect effect; * $p \leq .05$; $^{n.s.}$ not significant