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Direct and indirect influences of socio-economic position on the wellbeing of older adults: a Structural Equation Model using data from the first wave of the Irish Longitudinal Study on Ageing

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ABSTRACT

The authors use Structural Equation Modelling techniques to analyse the determinants of wellbeing amongst older adults using data from the first wave of the Irish Longitudinal Study on Ageing (TILDA), a rich source of data on people aged over 50 and living in private households. The analysis uses a two-group linear statistical model to explore the influence of socio-economic position on the wellbeing of men and women, with Full Information Maximum Likelihood estimation to handle missing data. The fit indices for the final model are highly satisfactory and the measurement structure is invariant by gender and age. The results indicate that socio-economic position has a significant direct influence on wellbeing and a strong indirect influence which is mediated by health status and lifestyle. The total standardised effect of Socio-economic Position on Socio-emotional Wellbeing is statistically significant ($p \leqslant 0.05$) and equal to 0.32 (men) and 0.43 (women), a very strong influence which risks being underestimated in standard multivariate models. The authors conclude that health, cognitive functioning and wellbeing reflect not just the ageing process, but also the impact of social inequalities across the lifecourse and how they are transmitted across different life spheres. These results can help to orient future research on factors which mediate between socio-economic position and wellbeing, an important policy-related issue.

KEY WORDS – wellbeing, health, older adults, socio-economic position, Ireland.

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Introduction

The concept of wellbeing has come to be viewed as a key criterion in relation to public policies, embracing a 'positive' perspective that shifts attention from 'adaptation' to 'flourishing', focusing on wellness rather than pathology (Shen and Lai 1998). This paradigm shift has influenced the study of ageing as well as the formulation of public policy in this area, particularly in light of the effects of population ageing. Most Western governments now embrace the goal of enabling older people to make an active social contribution and are seeking to understand the wider social determinants of health and wellbeing in order to reduce social differentials and promote social participation.

Just as the reduction of social gradients in health relies on the identification of risk and protective factors, promoting 'successful' ageing and active social participation amongst older adults arguably requires a similar strategy in relation to wellbeing. Read, Grundy and Foverskov conclude their recent review article by underlining the need for further research on the nature of the relationship between socio-economic position and wellbeing amongst older adults, arguing that this is a key nexus for improving outcomes:

> The results of the present review demonstrate the importance of social influences on later life subjective health and well-being and suggest a need for further investigation of possible mediating factors so that the pathways from SEP [socio-economic position] to subjective well-being are clarified. (2015: 10)

In the research literature, a distinction is often made between subjective and objective wellbeing (Bowling 2005). The former includes concepts that relate to emotional states or cognitive assessments, measured either globally or across different domains (Waddell and Jacobs-Lawson 2010). The combined analysis of such concepts has shown that they are typically closely inter-related, pointing to the existence of a higher-order factor (Slocum-Gori *et al.* 2009). We will take this as our point of departure, and use a measure of wellbeing that is broad enough to relate to a wide range of theories, hypotheses and applications. Drawing on research by Ryff and others, we define socio-emotional wellbeing as a second-order factor embracing life satisfaction, (absence of) depression, high quality of life and (absence of) loneliness (*cf.* Abbott *et al.* 2006; Burns and Machin 2009; Ryff and Keyes 1995; Springer, Pudrovska and Hauser 2011). This is conceived not as a scale, but as a latent variable, controlling for measurement error and uniqueness of indicators.

Social scientists have sought to identify the determinants of wellbeing amongst older adults using a wide range of measures and models (Baker *et al.* 2005; Baltes and Mayer 1999; Beekman *et al.* 1997; Bowling 2005;

Cramm, van Dijk and Nieboer 2012; Garatachea *et al.* 2009; George 2010; Gilleard, Hyde and Higgs 2007; Kendig, Browning and Young 2000; Lampinen *et al.* 2006; Layte, Sexton and Savva 2013; Morrow-Howell *et al.* 2003; Okun and Stock 1987; Pinquart and Sorensen 2000; Schwingel *et al.* 2009; Silverstein and Parker 2002; Waddell and Jacobs-Lawson 2010). These studies have identified, at most, weak effects for income, education and other indicators of socio-economic position (taken individually, for the most part) using multivariate models. For example, Waddell and Jacobs-Lawson (2010) examined the influence of a range of factors on positive wellbeing in a sample of older adults (50 and over), finding that education and income did not have a significant effect after controlling for marital status, self-rated health and depression. Similarly, Bowling (2005) found that socio-economic indicators were not significant in a regression model for quality of life. Cramm, van Dijk and Nieboer (2012) report that income is not significantly associated with wellbeing after controlling for such factors as neighbourhood services, security, social capital and social cohesion. Okun and Stock (1987: 105) conclude that 'social status and the objective conditions of life have little influence on SWB [subjective wellbeing] among the elderly', whilst Pinquart and Sorensen (2000: 197) observe that 'the relationship between income and SWB in old age still appears relatively small'. Read, Grundy and Foverskov (2015: 4–8) note that socio-economic disparities in subjective wellbeing amongst older adults have received comparatively little attention from researchers, observing that statistically significant associations between indicators of socio-economic position and indicators of wellbeing such as quality of life or life satisfaction are only found in about half of studies which address this issue, depending on the covariates included.

This finding is rather surprising, as relatively strong social gradients have been identified for health (House, Lantz and Herd 2005) and given that other factors have consistently been found to have significant effects on wellbeing, including social networks (Cramm, van Dijk and Nieboer 2012), social participation (Giles *et al.* 2005), physical activity (Lampinen *et al.* 2006), marital status (Baltes and Mayer 1999), living alone (Dean *et al.* 1992) and health status (Okun and Stock 1987). Some authors hypothesise that older adults may simply adjust their expectations to their current financial situation (Pinquart and Sorensen 2000), reducing the relevance of socio-economic factors to their wellbeing. By contrast, we argue that this pattern of results may be due to the ways in which the effects of socio-economic variables are mediated by other influences. After controlling for relevant mediators, direct effects may consequently be small or non-significant. On this basis, we argue that health and wellbeing among older adults may reflect the impact of social inequalities across the

lifecourse, suggesting that policies for successful ageing should target social inequalities within the general population and seek to identify and influence the factors that mediate their impact on health and wellbeing among older adults.

In this study, we explore the nature of the relationship between the socio-economic position of older adults in Ireland and their health and wellbeing by assessing the role of a number of potential mediating variables. To do so, we use Structural Equation Modelling techniques, which have great potential in the context of research on ageing due to their ability to accommodate latent variables, mediation effects and longitudinal data (*cf.* Gutiérrez *et al.* 2013; Kunzmann, Little and Smith 2000; Tomás *et al.* 2015), although they have not yet been widely used in this field (Lampinen *et al.* 2006).

The analysis has four main aims: (a) to develop a well-specified model that includes appropriate covariates for health and wellbeing; (b) to improve the measurement of wellbeing, health and socio-economic position by using latent variables; (c) to overcome the limitations of classical regression models by estimating a model that incorporates direct and indirect effects; (d) to apply advanced techniques for handling missing data within the Structural Equation Model context. Achieving these aims requires the use of state-of-the art modelling techniques, the strengths and limitations of which will be discussed in the course of the article.

Method

Data

The Irish Longitudinal Study on Ageing (TILDA) is the most important contemporary data collection initiative targeting older adults in Ireland (Kenny *et al.* 2010). TILDA is a large representative study based on face-to-face interviews with older adults (aged 50 years and over) and their partners/spouses (of any age), living in private households in Ireland. The study comprises survey questionnaires and a range of physical and biological measurements. It is based on a two-stage sampling design, and households were selected from within a stratified sample of clusters with probability of selection proportional to the estimated number of persons aged 50 or over. All persons aged 50 or over in the selected households (and their spouses or partners) were invited to participate. All participants in the first wave were interviewed in 2009–2011, and the survey design includes a second and third wave of data collection and one follow-up health assessment. The present analysis adopts a cross-sectional design that aims to identify pathways and mediators that deserve specific attention during the phase of longitudinal data analysis using subsequent waves of data from TILDA.

The adjusted response rate for the first wave was 62 per cent (Kearney *et al.* 2011: 4). The response to the self-completion questionnaire was approximately 84 per cent, whilst just over 80 per cent of respondents agreed to participate in the physical assessment. Comparisons with the Irish population using data from the Quarterly National Household Survey show that individuals with lower levels of educational attainment are under-represented and that there are small differences in response rates among particular age and gender groups (Kearney *et al.* 2011: 4). The TILDA survey questionnaires are broadly in line with those used in longitudinal studies in other countries, enhancing the relevance of this study.

Ireland, like most other advanced industrialised countries, faces the prospect of marked population ageing in coming years. It is estimated that the proportion of the population aged at least 65 years will rise from its current level (11%) to 14 per cent by 2021 and 19 per cent by 2031 (Kearney *et al.* 2011). Until the mid-1990s, low levels of economic growth were associated with the persistence of marginal farming activities, agricultural under-employment and large-scale out-migration. Traditionally viewed as a morally conservative and religious society, Ireland has experienced rapid secularisation since the late 1980s, accompanied by a decade of rapid economic growth and high immigration starting in the mid- to late 1990s.

Given the rapid expansion of educational participation over recent decades, there are marked differentials between young and old in terms of attainments. Other relatively recent changes, such as the liberalisation of the contraception laws (during the 1980s and early 1990s) and the introduction of divorce (1996) have had an impact on fertility, family life and women's social roles. State pensions are the main source of income for older adults in Ireland, accounting for roughly two-thirds of gross income for those aged 65 and older (Barrett *et al.* 2011). The percentage of pensioners who are at risk of poverty (*i.e.* below 60% of median equivalised income) following social transfers is lower than the European Union average (roughly 10%, compared to 14% in the 28 European Union member states and almost 17% in the United Kingdom), according to Eurostat data for 2013 (Ayres and Cracknell 2015).

The data-set comprises a male sample (with 3,740 cases) and a female sample (with 4,423 cases) drawn from the first wave of TILDA. The mean age is 63.5 years (standard deviation (SD) = 9.16) and 22.3 per cent live alone. More than one-quarter (29.4%) have a third-level (university/college) education and 36.1 per cent are in the professional, managerial and technical classes. Mean weekly household disposable equivalent income is €781.40 (SD = 1,537) and just 4.8 per cent define themselves as unemployed. The mean number of impairments is 2.28 (out of a total of 14; SD = 2.76).

The full sample for the first wave of TILDA comprises 8,504 individuals, but this includes partners aged under 50, who were excluded from the analysis (leaving a sample of 8,163). There are several important missing data patterns, due to (a) failure to return the self-completion questionnaire by roughly 15 per cent of the sample; (b) failure to participate in the clinical health assessment by about 20 per cent of the sample; (c) failure to provide complete data on incomes, which relates to 4,521 respondents out of 8,163 (yielding a response rate of just 44.6%). The listwise or pairwise exclusion of the aforementioned cases would yield a reduced sample and a considerable risk of bias due to selective non-response. To reduce (and hopefully eliminate) this risk, we used Full Information Maximum Likelihood (FIML), as – by contrast with many other techniques – this relies on the assumption that data are 'missing at random' (MAR) rather than 'missing completely at random'. Under the MAR assumption, missingness depends on variables that are observed, which holds when measured characteristics of the respondent predict response/non-response (Bentler 2006). This is a reasonable assumption in our case, as several different indicators of health status and socio-economic position were available and are used in the model, thus helping to control for failure to participate in the physical assessment or refusal to specify one's income. FIML calculates the likelihood function at the individual level and makes maximal use of the available data, whilst adjusting statistical tests and fit indices to account for the reduced sample size (Enders 2001). The first- and second-order moments are expressed as functions of a parameter vector, which implies that a means structure is required for estimation.

In the male sample, 3,064 cases out of 3,740 had at least one missing observation, and there were 157 distinct patterns of missing data. Sample sizes for pairs of variables ranged from 1,196 (for Income and Movement) to 3,740 (for 104 pairs out of 378), with a mean of 3,046. In the female sample, 3,646 cases out of 4,423 had at least one missing observation, and there were 198 distinct patterns of missing data. Sample sizes for pairs of variables ranged from 1,368 (for Income and High Occupation) to 4,423 (for 104 pairs out of 378), with a mean of 3,576.

Another issue relates to the structure of auto-correlation generated by the nesting of respondents within families and by the cluster sampling design. The nesting of respondents within families is not expected to influence the estimated coefficients, as we analysed the male and female samples separately (and only 49 households, or 0.6% of the total, contained two or more survey participants of the same sex). Other forms of auto-correlation that may be attributed to the sampling design were controlled for by using robust standard errors and fit indices.

The scale scores (for Depression, Quality of Life, *etc.*) were treated as manifest indicators of the latent variables in our model, which meant that an *ad hoc* approach was required in order to deal with small amounts of missing data on individual items within these scales. Where a small number of items on a sub-scale of a multi-item instrument (such as the 19-item CASP scale, for example) were missing, we used the EM algorithm to estimate these observations in SPSS Statistics Version 20 before calculating the scale scores in the normal manner. This approach once again makes maximal use of the available information and minimises the risk of bias. Two limitations of the study should be mentioned, namely the exclusion of older people with dementia and those living in nursing homes or other institutional settings. These design issues imply that the results of this study relate to dementia-free older adults in Ireland living in private households.

Measures

The model comprises four latent variables which capture individual attributes (denominated Socio-emotional Wellbeing, Cognitive Functioning, Overall Health Status and Socio-economic Position). There are also 12 explanatory variables which reflect the following characteristics of respondents: health-related behaviours (Smoker, Problem Drinker, Regular Drinker, Physical Exercise), background characteristics (Age, Lives Alone, Unemployed, Childhood Abuse, Religiosity) and social relationships (Intimate Relationships, Social Network, Social Participation). We focus on living alone rather than marital status, as the former captures what is arguably the most salient aspect of family structure in this context (Dean *et al.* 1992: 14–15). All measures used in the model are listed in Table 1 (together with summary data on the sample); a detailed description of the latent variables follows.

Socio-emotional Wellbeing is conceptualised as a latent variable with four indicators, three of which are scale scores from multi-item instruments and the fourth a single item: Depression (the 20-item CESD score; Radloff 1977), Loneliness (the five-item UCLA Loneliness Scale; Russell 1996), the 19-item CASP scale, which measures Quality of Life (Hyde *et al.* 2003) and Life Satisfaction (a single item with a seven-point response scale). The standardised factor loadings for Socio-emotional Wellbeing range from 0.50 (Quality of Life score for women) to 0.85 (Life Satisfaction for men) and the Composite Reliability (Raykov 1997) is 0.77 for both men and women. An error covariance was specified between Depression and Life Satisfaction due to the strong negative association between these two concepts, which was anticipated. Coefficients relating to the measurement of this latent variable are reported in Table 2.

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TABLE 1. *Measures included in Structural Equation Model*

Variable	Description	Scale	Summary data: Range, mean (SD)	Summary data: %
Socio-emotional Wellbeing:				
Depression	Twenty-item CES Depression Scale (Radloff 1977)	Rescaled to 0–1 metric, $N = 8,157$	0.00–0.88, 0.10 (0.12)	
Loneliness	Five-item UCLA Loneliness Scale (Russell 1996)	Rescaled to 0–1 metric, $N = 6,797$	0.00–1.00, 0.20 (0.22)	
Life Satisfaction	Single question item with seven-point response scale	Rescaled to 0–1 metric, $N = 8,163$	0.0–1.00, 0.85 (0.20)	
Quality of Life	Nineteen-item CASP Scale (Hyde *et al.* 2003)	Rescaled to 0–1 metric, $N = 6,620$	0.07–1.00, 0.77 (0.14)	
Cognitive Functioning:				
MMSE	Thirty-item Mini-Mental State Examination (Folstein, Folstein and McHugh 1975)	Rescaled to 0–1 metric, $N = 5,874$	0.30–1.00, 0.94 (0.07)	
MoCA	Thirty-item Montreal Cognitive Assessment (Nasreddine *et al.* 2005)	Rescaled to 0–1 metric, $N = 5,849$	0.07–1.00, 0.82 (0.13)	
Memory	Mean score for three ten-item memory tests (Roth *et al.* 1986)	Rescaled to 0–1 metric, $N = 8,163$	0.00–1.00, 0.63 (0.18)	
Executive Function	Single question item: 'Now I would like you to name as many different animals as you can think of'	Rescaled (/10) $N = 8,163$	0.00–5.00, 2.02 (0.72)	
Overall Health Status:				
Impairments	Number of functional impairments, including instrumental activities of daily living/activities of daily living (Lawton and Brody 1969)	Rescaled (/10) $N = 8,163$	0.0–1.40, 0.23 (0.28)	
Movement	'Timed up-and-go' test (Podsiadlo and Richardson 1991)	Natural log of (time) $N = 5,820$	1.46–4.65, 2.18 (0.26)	
Sensory Functioning	Mean self-rated vision, hearing, smell and taste (Kearney *et al.* 2010)	Rescaled to 0–1 metric, $N = 8,163$	0.00–1.00, 0.70 (0.18)	

TABLE 1. (*Cont.*)

Variable	Description	Scale	Summary data: Range, mean (SD)	Summary data: %
Cognitive Functioning	Latent variable defined above			
Socio-economic Position				
Third-level Education	Respondent has a third-level qualification (university/college)	0 = No 1 = Yes, *N* = 8,163		70.6 29.4
Assets	Total household assets (positive balance of deposit/savings account plus net value of any investments, cars, real estate, land or businesses)	Add 500 and take natural log, *N* = 7,797	6.21–16.15, 10.94 (2.34)	
Income	Net weekly equivalised household disposable income	Add 500 and take natural log, *N* = 3,642	6.22–10.65, 6.99 (0.47)	
High Occupation	Professional, technical-managerial employee or large farmer	0 = No 1 = Yes, *N* = 5,718		63.9 36.1
Socio-demographic:				
Age	Age	Years, rescaled (/10), *N* = 8,163	5.00–8.00, 6.35 (0.92)	
Gender	Gender	0 = Female 1 = Male, *N* = 8,163		54.2 45.8
Lives Alone	Respondent currently lives alone	0 = No 1 = Yes, *N* = 8,163		77.7 22.3
Childhood Abuse	Single item: 'Before you were 18 years old, were you ever physically/sexually abused by either of your parents/anyone other than your parents'	0 = No 1 = Yes, *N* = 8,163		91.0 9.0

Socio-economic:				
Unemployed	Respondent is currently unemployed	0 = No 1 = Yes, *N* = 8,163		95.2 4.8
Social Sphere:				
Intimate Relationships	Mean rating of intimacy of relationship with partner, children, other relatives, friends using six items from the English Longitudinal Study of Ageing	Rescaled to 0–1 metric, higher scores reflect closer relationships, *N* = 6,856	0.07–1.00 0.79 (0.13)	
Relatives and Friends	Number of close relatives and friends	Rescaled (/10), *N* = 8,163	0.00–2.50 1.06 (0.58)	
Social Participation	Frequency of: films, plays, concerts; classes/lectures; travel; work in home or garden; hobby; play cards/games; eat out; sport; visit or receive family/friends, eight categories (House, Lantz and Herd 1982)	Rescaled to 0–1 metric, *N* = 6,010	0.00–1.00 0.50 (0.14)	
Religiosity	Respondent attends a weekly religious service and religion is 'very important' and 'a source of strength'	0 = No 1 = Yes, *N* = 8,163		61.1 38.9
Health Behaviours:				
Smoker	Current or recent smoker (*i.e.* quit less than one year ago)	0 = No 1 = Yes, *N* = 8,163		80.1 19.9
Problem Drinker	Four-item CAGE scale (Ewing 1984)	0 = No 1 = Yes, *N* = 6,748		87.9 12.1
Regular Drinker	Respondent drinks regularly (at least seven standard drinks per week)	0 = No 1 = Yes, *N* = 6,424		75.7 24.3
Physical Activity	IPAQ Scale (Craig *et al.* 2003)	Add 100 to IPAQ metminutes and take natural log, *N* = 8,163	4.61–9.87 7.31 (1.36)	

Note: SD: standard deviation.

TABLE 2. *Unstandardised and standardised factor loadings for latent variables, robust standard errors*

Latent variable	Indicator	Unstandardised coefficient (SE)	Standardised coefficient	
			Male sample	Female sample
Socio-emotional Wellbeing	Depression	−0.63 (0.02)	−0.64	−0.59
	Loneliness	−1.37 (0.02)	−0.71	−0.73
	Life Satisfaction	0.87 (0.02)	0.50	0.52
	Quality of Life	1.00	0.83	0.85
Cognitive Functioning	MMSE	0.35 (0.01)	0.66	0.68
	MoCA	0.70 (0.01)	0.76	0.77
	Memory	1.00	0.77	0.79
	Executive Function	3.00 (0.05)	0.58	0.59
Overall Health Status	Impairments	−1.00	−0.62	−0.66
	Movement	−1.02 (0.03)	−0.64	−0.67
	Sensory Functioning	0.44 (0.01)	0.40	0.44
	Cognitive Functioning	0.37 (0.003)	0.45	0.47
Socio-economic Position	Third-level Education	0.22 (0.004)	0.52	0.53
	Assets	1.00	0.46	0.47
	Income	0.30 (0.01)	0.70	0.70
	Occupation	0.25 (0.01)	0.55	0.57

Notes: SE: robust standard errors. MMSE: Mini-Mental State Examination. MoCA: Montreal Cognitive Assessment.
Significance level: All loadings are statistically significant, $p \leqslant 0.05$.

Overall Health Status is a latent variable with four indicators: Movement ('Timed up-and-go' test), Cognitive Functioning (described below), Sensory Functioning (based on mean self-rated vision, hearing, smell and taste; *see* Kearney *et al.* 2010) and number of functional Impairments. Cognitive Functioning is a first-order latent variable with four indicators: the 30-item Mini-Mental State Examination (MMSE) (Folstein, Folstein and McHugh 1975), the 30-item Montreal Cognitive Assessment (MoCA) of cognitive functioning (Nasreddine *et al.* 2005), the respondent's mean score on three ten-item Memory tests (Roth *et al.* 1986) and a measure of Executive Function. The factor loadings vary between 0.58 (Executive Function – Men) and 0.79 (Memory – Women) and Composite Reliability is 0.79 for men and 0.80 for women.

These indicators of physical, mental and sensory function were chosen with a view to obtaining a summary measure of the respondent's overall health status. An error covariance was specified between MMSE and MoCA, which was expected given the similarities between these two

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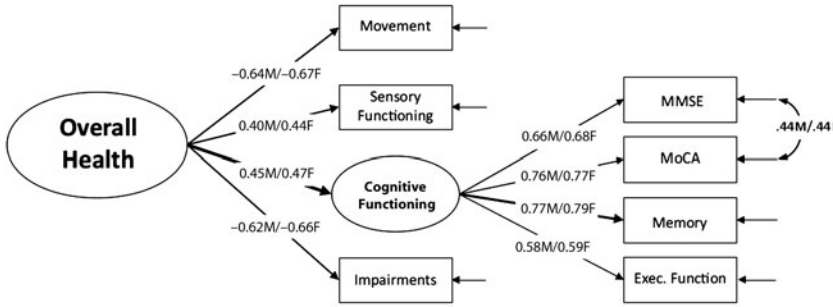

Figure 1. Measurement model for Overall Health Status with standardised Maximum Likelihood parameter estimates for men (M) and women (F) from the multiple-group model. *Notes*: MMSE: Mini-Mental State Examination. MoCA: Montreal Cognitive Assessment. Exec. Function: Executive Function.

assessments of cognitive functioning. A covariance was specified between Cognitive Functioning and Third-level Education, on the basis of the results of Lagrange Multiplier Tests, which suggests that higher levels of education are associated with improved cognitive functioning in later life (*cf.* Baltes and Mayer 1999). The measurement model for Overall Health Status (which incorporates Cognitive Functioning) is shown in Figure 1, extrapolating from the broader Structural Equation Model. The standardised factor loadings vary between −0.67 (Impairments – Women) and 0.47 (Cognitive Functioning – Women) and the Composite Reliability is 0.61 for men and 0.65 for women. The negative sign for the loadings of Movement and Impairments is due to the scale of these indicators (taking longer to complete the movement test; having more impairments).

Socio-economic Position is a latent variable with four indicators: Third-level Qualification, Total Household Assets, (equivalised) Income and (high) Occupation. An error covariance was added between Third-level Qualification and Occupation, which is explained by the way in which access to technical, professional and managerial roles is mediated by educational attainments. Income is defined as weekly household disposable income, including all sources and subtracting tax and social charges. A value of 1 was assigned to the head of household, 0.66 to all subsequent adults and 0.33 to children, and income was divided by the sum of these weights to obtain the equivalised value. The standardised factor loadings range from 0.46 (Assets – Men) to 0.70 (Income – Men/Women) and are shown in Table 2; the Composite Reliability is 0.65 for men and 0.66 for women.

A full set of covariances between the explanatory variables was specified and a number of covariances between the error terms of explanatory variables and indicators were also included, based on Lagrange Multiplier

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Test results and inspection of residuals. These involve covariances between: (a) the disturbances of Cognitive Functioning and Socio-economic Position; (b) the error terms associated with Loneliness and Lives Alone; (c) the error terms associated with Quality of Life and Lives Alone; (d) the error terms associated with Third-level Qualification and Lives Alone; (e) the error terms associated with Occupation and Age; (f) the error terms associated with Occupation and Lives Alone; (g) the error terms associated with MMSE and Life Satisfaction; (h) the error terms associated with MoCA and Life Satisfaction; (i) the error terms associated with Impairments and Depression; (j) the error terms associated with Impairments and Quality of Life; (k) the error terms associated with Movement and Physical Exercise; (l) the error terms associated with Impairments and Physical Exercise; (m) the error terms associated with Social Participation and Life Satisfaction; (n) the error terms associated with Social Participation and Income; (o) the error terms associated with Social Participation and Movement. All of these covariances are intuitively plausible and reflect the specificities of the indicators after conditioning on the underlying factors.

This process of model refinement was pursued, using the male data-set, until all plausible covariances had been included, and a Comparative Fit Index (CFI) of at least 0.95 and a Standardised Root Mean Square Residual (SRMR) below 0.07 had been obtained (Hu and Bentler 1999). In order to ensure that the resulting model does not capitalise on chance, we tested it using independent data from the female sample, which yielded a CFI which was greater than 0.95 and an SRMR which was below 0.07. The final multi-group model was estimated using data from the male and female samples simultaneously, imposing equality constraints on the unstandardised factor loadings, the variances and covariances of the indicator errors, and the variances and covariances of the factor disturbances.

Research design

As noted above, we use Structural Equation Modelling techniques to explore the ways in which Socio-emotional Wellbeing is influenced by the attributes and behaviours of individuals and their social environment. Structural Equation Models permit the simultaneous estimation of parameters and fit indices for complex configurations of latent and manifest variables (Loehlin 1992; Raykov and Marcoulides 2006). Models such as classical regression, path analysis, confirmatory factor analysis and latent growth curves may all be viewed as distinct types of Structural Equation Model.

As all data used in the analysis come from the first wave of TILDA, we cannot rely on the chronological order of data collection when specifying paths of potential influence. Nevertheless, each variable in the model has a 'temporal horizon' which, together with the results of previous research, can guide model construction. For example, Socio-emotional Wellbeing has a 'short temporal horizon', as it refers to the period immediately prior to the interview (including how respondents felt during the previous week, for example). The same applies to Overall Health Status, current levels of physical activity and forms of social participation.

Overall Health Status is assumed to influence Socio-emotional Wellbeing, rather than *vice versa*, in line with the assumptions that are most commonly made by other researchers (*cf.* Verbrugge and Jette 1994). In future papers, we will explore this relationship in greater detail by including cross-lagged effects. Health-related behaviours such as smoking and drinking alcohol are assumed to have a 'medium time horizon'. Living arrangements, social networks/relationships, socio-economic position and religiosity are associated with a 'long time horizon', as they are shaped by social roles assumed over a longer time period. Although it is possible that health, physical impairments and wellbeing might influence social networks and relationships, this does not appear to be common (Mor-Barak and Miller 1991). Childhood events (*e.g.* experience of physical or sexual abuse) are also considered to have a 'long time horizon', in common with age and other characteristics which are typically fixed at birth.

Physical Activity and Social Participation are viewed as mediating between Overall Health Status and Socio-emotional Wellbeing (as both are likely to depend heavily on health), and the latter two variables are regressed on Socio-economic Position and the other explanatory variables. In order to control for potential confounding, the explanatory variables (with the exception of Childhood Abuse) are regressed on Age and Socio-economic Position, and Socio-economic Position is regressed on Age, Living Alone and Childhood Abuse. This is to control for cohort effects and household composition, as income is expected to vary by household composition. This provides an additional defence against the risk of confounding of the relationship between Socio-economic Position and Socio-emotional Wellbeing.

All of the above assumptions will be subject to further analysis – to the extent that this is possible – using subsequent waves of data from TILDA. Even in the absence of longitudinal data, we believe that these pathways are plausible and useful. Whilst they cannot be tested directly using cross-sectional data, the analysis can nevertheless contribute to the study of health and wellbeing among older adults by identifying potentially important pathways of influence and thus helping to orient future research.

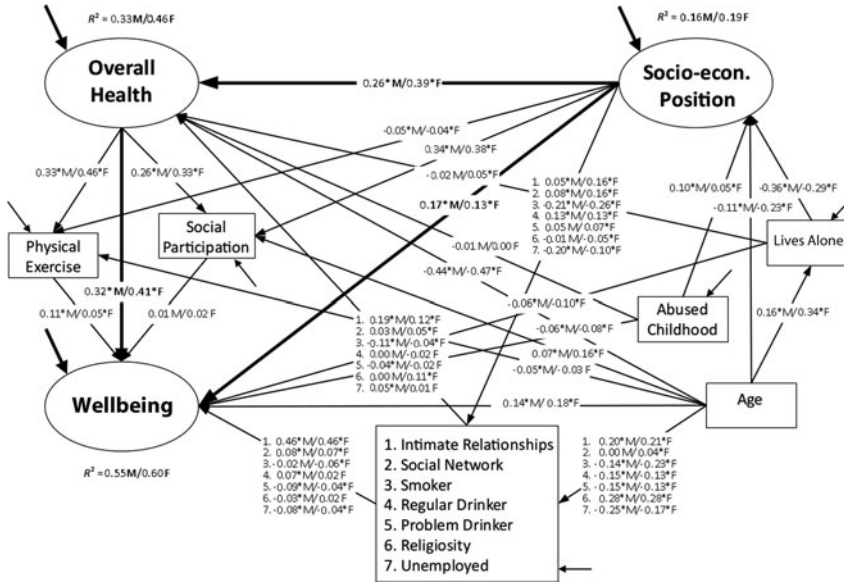

Figure 2. Structural Equation Model of influences on Socio-emotional Wellbeing (omitting indicators of latent variables and all correlations), showing standardised Maximum Likelihood parameter estimates for men (M) and women (F) from the multiple-group model.
Notes: MMSE: Mini-Mental State Examination. MoCA: Montreal Cognitive Assessment. Socio-econ. Position: Socio-economic Position.
Significance level: * $p \leqslant 0.05$.

The overall structure of the model is shown in Figure 2, following the standard conventions of path diagrams, but omitting (for simplicity) all correlations and indicators of the latent variables. Figure 2 also shows the standardised coefficients obtained from the final model, which will be discussed below. The model shows the different ways in which socio-economic and demographic characteristics, health-related behaviours and social relationships are considered to influence Overall Health Status and Socio-emotional Wellbeing. For example, Socio-economic Position can influence Socio-emotional Wellbeing: (a) directly, (b) indirectly through its influence on Overall Health Status, (c) indirectly via other explanatory variables such as smoking, taking exercise, unemployment, participating in social activities, and/or (d) even more indirectly via combinations of (b) and (c), *e.g.* by influencing smoking, which influences health status, which in turn influences wellbeing.

The model to be estimated is a multiple-group Structural Equation Model of the determinants of wellbeing amongst older adults, relying on FIML estimation to handle missing data. It was estimated using EQS 6.1 software (Bentler 2006), with robust standard errors based on the Fisher

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Information Matrix and robust fit indices. When assessing the precursors of wellbeing, a wide range of factors are considered, including health, socioeconomic position, gender, living arrangements, lifestyles, employment situation, health-related behaviours, physical impairments, traumatic childhood experiences, religiosity and social relationships. Of particular interest is the availability, in TILDA, of standardised clinical measures of health status as well as self-report scales and indicators.

Some of the predictors used in the model are dichotomous (Smoker, Problem Drinker, Regular Drinker, Lives Alone, Religiosity, Childhood Abuse, Unemployed), and there are two dichotomous indicators of Socioeconomic Position (Third-level Education and Occupation). We therefore use the Yuan-Bentler scaled chi-square statistic to assess model fit and robust standard errors to test individual coefficients. The inclusion of dichotomous explanatory variables does not give rise to difficulties, whilst a linear probability specification for dichotomous indicators is known to yield reliable results if the distribution of responses is not highly unbalanced (Hellevik 2007); it is not possible to combine FIML estimation with more sophisticated techniques for modelling categorical dependent variables.

Results

The Structural Equation Model is based on 27 observed variables in both the male and female samples and requires the estimation of 360 parameters (yielding 396 degrees of freedom in the final model, following the application of between-group equality constraints). As mentioned earlier, a mean and covariance structure model is fit to the data to permit the use of FIML by including intercepts for all manifest dependent variables. The fit indices for the final model (*see* Model 1.4 in Table 3) confirm that it is parsimonious and well-fitting; the chi-square statistic is influenced by the large sample size, but the alternative fit indexes are highly satisfactory (Fan, Thompson and Wang 1999) and all standardised residuals are under 0.10.

A series of tests were carried out to assess the invariance of the model across the male and female samples. An unconstrained model was compared with models incorporating the following incremental equality constraints: (a) constrained factor loadings; (b) plus constraints on the variances and covariances of indicator error terms; (c) plus constraints on the variances and covariances of factor disturbances; (d) plus constraints on the intercepts of all indicators. All coefficients relating to the explanatory variables and their effects on the key outcome variables were left unconstrained, as these were expected to vary between the male and female samples and are of substantive interest. The results of these tests are

TABLE 3. *Tests of invariance across sub-samples defined by gender and age*

Model	Yuan-Bentler chi-square (df)	Robust CFI	SRMR	Robust RMSEA	Confidence interval
1. Male and female samples:					
1.0a. Separate estimation, male sample	810*** (198)	0.954	0.024	0.033	0.031–0.035
1.0b. Separate estimation, female sample	959*** (198)	0.956	0.026	0.034	0.033–0.036
1.1. Unconstrained multiple-group model	1,769*** (396)	0.955	0.025	0.034	0.033–0.035
1.2. + equal factor loadings	1,813*** (408)	0.954	0.026	0.034	0.033–0.035
1.3a. + equal error variances/covariances	1,963*** (426)	0.950	0.028	0.034	0.033–0.036
1.3b. + equal error variances/covariances, excluding Depression score	1,864*** (425)	0.953	0.027	0.034	0.032–0.035
1.4. + equal disturbance variances/covariances	1,890*** (430)	0.952	0.027	0.034	0.032–0.035
1.5. + equal intercepts	2,771*** (457)	0.948	0.032	0.036	0.034–0.037
2. Age <65 and 65+ samples:					
2.0a. Separate estimation, younger sample	942*** (198)	0.946	0.025	0.033	0.031–0.034
2.0b. Separate estimation, older sample	820*** (198)	0.949	0.026	0.035	0.033–0.037
2.1. Unconstrained multiple-group model	1,762*** (396)	0.947	0.025	0.034	0.032–0.035
2.2. + equal factor loadings	1,874*** (408)	0.944	0.029	0.035	0.033–0.036
2.3. + equal error variances/covariances	2,629*** (426)	0.917	0.038	0.042	0.040–0.043

Notes: All fit statistics and indices refer to the covariance matrix only. Model 1.4 is the final model discussed in the text and shown in tables and figures. df: degrees of freedom. CFI: Comparative Fit Index. SRMR: Standardised Root Mean Square Residual. RMSEA: Root Mean Square Error of Approximation.

Significance level: *** $p < 0.001$.

summarised in Part 1 of Table 3, and suggest that the latent variables have invariant measurement properties across the male and female samples (although the means differ). One constraint on the factor loadings was dropped, as it led to large residuals and a significant deterioration in fit, namely the equality constraint on the variance of the error associated with Depression. When this constraint is dropped, the estimated variance

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is 0.007 for men and 0.011 for women, which suggests a greater dispersion of scores in the female sample. The final estimation incorporates equality constraints on all factor loadings, all error variances except for Depression, all error covariances, and all variances and covariances of factor disturbances.

We will begin by reporting the direct effects of a number of explanatory variables on Socio-emotional Wellbeing, using standardised coefficients for the male (M) and female (F) samples (*see* Part 1 of Table 4, as well as Figure 2; 'direct' effects are those which are not mediated by any other variables included in the model). The strongest influences on Socio-emotional Wellbeing are associated with close Intimate Relationships (0.46*M/0.46*F; * indicates $p \leqslant 0.05$) and Overall Health (0.32*M/0.41*F), followed by high Socio-economic Position (0.17*M/0.13*F) and Age (0.14*M/0.18*F). All four variables have strong and significant effects on Socio-emotional Wellbeing among older men and women. The overwhelming importance of intimate relationships (and thus the private sphere) emerges very clearly, and other relational variables also contribute, such as Social Network (0.08*M/0.07*F) and Lives Alone (−0.06*M/−0.10*F).

After controlling for potential confounding, it is evident that Overall Health has a particularly strong direct effect on Socio-emotional Wellbeing. This suggests that physical health is closely related to other forms of wellbeing, representing a powerful risk/protective factor. The moderate effect associated with Socio-economic Position – after controlling for potential confounders – reflects the existence of social differentials in Socio-emotional Wellbeing. Further tests (not reported here) show that the use of latent variable modelling techniques and FIML are essential in order to obtain an accurate estimate of these disparities in wellbeing.

Physical Exercise (0.13*M/0.06*F) has a significant positive influence on Socio-emotional Wellbeing, which is stronger for men than for women. Surprisingly, Social Participation does not have a significant effect, net of the influence of the other variables in the model. Physical activity, exercise and sport among older adults thus appear to offer benefits which go beyond the social opportunities that they offer. Having a drinking problem has a statistically significant negative impact on Socio-emotional Wellbeing (−0.09*M/−0.04*F), as does Unemployment (−0.08*M/−0.04*F), in both cases with stronger effects for men than women.

Being a Regular Drinker (0.07*M/0.02 F) contributes to wellbeing, whilst both Living Alone (−0.06*M/−0.10*F) and Childhood Abuse (−0.06*M/−0.08*F) have significant negative effects, all else being equal. Childhood experiences of physical or sexual abuse (which involve roughly 9% of men and of women in the TILDA sample) appear to have significant

TABLE 4. *Standardised direct, indirect and total effects on key outcomes from the Structural Equation Model*

Covariate	Standardised coefficient	
	Male sample	Female sample
1. Direct effects on Socio-emotional Wellbeing (R^2 = 0.55M/0.60 F)		
Intimate Relationships	0.46*	0.46*
Overall Health Status	0.32*	0.41*
Socio-economic Position	0.17*	0.13*
Age	0.14*	0.18*
Physical Exercise	0.11*	0.05*
Problem Drinker	−0.09*	−0.04*
Social Network	0.08*	0.07*
Unemployed	−0.08*	−0.04*
Regular Drinker	0.07*	0.02
Childhood Abuse	−0.06*	−0.08*
Lives Alone	−0.06*	−0.10*
Religiosity	−0.03*	0.02
Smoker	−0.02	−0.06*
Social Participation	0.01	0.02
2. Direct effects on Overall Health Status (R^2 = 0.33M/0.46 F)		
Age	−0.44*	−0.47*
Socio-economic Position	0.26*	0.39*
Intimate Relationships	0.19*	0.12*
Smoker	−0.11*	−0.04*
Unemployed	0.05*	0.01
Lives Alone	−0.02	0.05*
Problem Drinker	−0.04*	−0.02
Childhood Abuse	−0.01	0.00
Religiosity	0.00	0.11*
Regular Drinker	0.00	0.02
Social Network	0.03	0.05*
3. Effect of Socio-economic Position on Socio-emotional Wellbeing		
Total effect	0.32*	0.43*
Direct effect	0.17*	0.13*
Indirect effect	0.15*	0.30*

Notes: M: male. F: female.
Significance level: * $p \leqslant 0.05$.

consequences for Socio-emotional Wellbeing, particularly for women. Religiosity, Smoking and Social Participation do not have significant effects. The model explains 55 per cent of the variance of Socio-emotional Wellbeing for men and 60 per cent for women, and the results suggest that the main determinants do not vary greatly by gender.

It is interesting to compare these results with those for Overall Health Status (*see* Part 2 of Table 4), as the determinants of these two outcomes are different. The most important influence on Overall Health is Age, which has a strong negative effect (−0.43*M/−0.40*F). Socio-economic Position has a relatively strong direct effect on Overall Health Status (0.20*M/0.26*F), which reflects the well-known 'social gradient' in health (Wilkinson 1996). This is only slightly higher than the direct effect of Socio-economic Position on Socio-emotional Wellbeing (0.17*M/0.14*M), confirming the importance of this explanatory variable. Intimate Relationships (0.17*M/0.10*F) are also related to Overall Health, albeit not to the extent observed in the case of Socio-emotional Wellbeing. Where intimate relationships are, on average, stronger and closer, overall health also tends to be better. Significant negative effects are observed for Smoking (−0.10*M/−0.03 F), Problem Drinker (−0.04*M/−0.02 F) and Living Alone (−0.04*M/0.00 F), but only for men. Religiosity is more strongly associated with Overall Health among women than among men, a finding that may require further research.

Turning now to mediated influences, the results show that Socio-economic Position has a significant indirect effect on Socio-emotional Wellbeing, which operates via several distinct paths (*see* Part 3 of Table 4). This finding qualifies and extends existing analyses by showing that relatively weak and inconsistent results in relation to the effect of Socio-economic Position do not mean that this is a weak explanatory variable, and do not rule out the existence of a strong social gradient in wellbeing, as well as in health. The pattern of influences involving these variables is quite complex, transmitting social differentials across a number of spheres, from intimate relationships to health-related behaviours and lifestyles.

Figure 2 shows the mediated effects that influence Socio-emotional Wellbeing. The first, and arguably most important, path links Socio-economic Position to Overall Health Status (0.26*M/0.39*F), and the latter to Socio-emotional Wellbeing (0.32*M/0.41*F). The effect of Overall Health on Socio-emotional Wellbeing is itself partially mediated by Physical Exercise (0.33*M/46*F for the effect of Health on Exercise, and 0.11*M/0.05*F for the effect of Exercise on Wellbeing). The strength of these effects confirms that the main way in which Socio-economic Position influences Socio-emotional Wellbeing is via Overall Health Status.

Another path runs from Socio-economic Position to Intimate Relationships (0.05*M/0.16*F) and from the latter to Socio-emotional Wellbeing (0.46*M/0.46*F). Thus, more affluent individuals (particularly women) tend to have closer intimate relationships and consequently derive a benefit in terms of wellbeing; a similar effect is observed for Social Networks. Health-related behaviours, like smoking and drinking,

similarly mediate between Socio-economic Position and Socio-emotional Wellbeing. Smoking is much less common among older adults of higher Socio-economic Position (−0.21*M/−0.26*F), and has negative effects on both Health (−0.11*M/−0.04*F) and Wellbeing (−0.02 M/−0.06*F). Regular consumption of alcohol – which is positively associated with Socio-economic Position – tends to boost Wellbeing (particularly among men). Unemployment also mediates between Socio-economic Position and Wellbeing, particularly for men, and the higher their Socio-economic Position, the lower the likelihood of being unemployed (−0.20*M). Unemployment, in turn, has a negative effect on Socio-emotional Wellbeing among men (−0.08*M).

We have so far assumed that the factor structure of Socio-emotional Wellbeing and other latent variables remains stable throughout adult life, across all TILDA respondents, regardless of age. In order to assess whether the results reported above are sensitive to age and/or cohort effects, we estimated a second multiple-group model, with individuals aged 50–64 as group 1 and those aged 65 years and over as group 2. Part 2 of Table 3 summarises the overall fit for this sequence of nested models, and shows that the factor loadings may be considered invariant across the two groups (the robust CFI drops slightly, from 0.947 to 0.944, the Yuan-Bentler chi-square increases by 112 units (in the context of a large sample size), whilst the degrees of freedom increase by 12). The latent variables thus show approximate metric invariance across the two sub-samples and arguably provide appropriate measurements of the key variables. When the error variances and covariances are constrained to be equal, model fit deteriorates significantly. There are large residuals for the variances of all indicators of health status (MMSE, MoCA, Movement, Executive Function) and for Income, Depression and other variables.

If we compare key coefficients between the younger and older sub-samples, we find that Socio-economic Position has a stronger effect on Socio-emotional Wellbeing in the younger sample (0.16, compared to 0.10 in the older sample), whilst Overall Health has a stronger effect on Wellbeing amongst the older respondents (0.30 and 0.44, respectively). Intimate Relationships have comparable effects on Wellbeing in the two groups (0.46 in the younger sample and 0.42 in the older) and most other effects are similar. Interestingly, the effect of Age on Wellbeing is similar in the younger and older samples (0.09 and 0.08), whilst its effect on Health is greater among those aged 65 years and over (−0.34, compared to −0.22 in the younger sample). In other words, multiple-group analysis by age (in addition to gender) confirms the usefulness of the model, the stability of its measurement structure, and yields some interesting insights into the determinants of Health and Wellbeing at different ages.

Discussion

The most important finding of this analysis is that social differentials in wellbeing among older adults are the result of strong direct and indirect effects, mediated by overall health, in particular. The total standardised effect of Socio-economic Position on Socio-emotional Wellbeing amongst older adults in Ireland is equal to 0.32 for men and 0.43 for women, indicating a strong gradient which is likely to be underestimated in multivariate models which control for a standard set of proximal influences. Indeed, without using latent variable modelling to overcome measurement error and FIML to handle missing data patterns, estimates of the direct effect of Socio-economic Position (0.17 for men and 0.13 for women) would have been considerably smaller and may not have reached statistical significance, even with a relatively large sample. This helps to explain why relatively small and often non-significant direct effects have been reported for Socio-economic Position and Wellbeing. The present analysis thus goes beyond existing research by showing that Socio-economic Position has a strong and pervasive – albeit partially mediated – influence on Wellbeing.

The model confirms three findings that have been reported in the research literature on wellbeing amongst older adults, extending these to the Irish context and contributing some new insights. The first of these findings relates to the fundamental importance of social connections in sustaining wellbeing. Lee and Ishii-Kuntz (1987) showed that the size of friend networks had a significant effect on emotional wellbeing and loneliness amongst older adults and this has been replicated in numerous studies (Giles *et al.* 2005; Silverstein and Parker 2002). In our analysis, the quality of support provided by partners, relatives, friends and other acquaintances is a powerful predictor of Socio-emotional Wellbeing. Secondly, our results confirm the explanatory power of health status in relation to wellbeing (*cf.* Litwin and Shiovitz-Ezra 2010). We show that Overall Health is the main factor that mediates between Age and Socio-economic Position, on the one hand, and Socio-emotional Wellbeing, on the other. Thirdly, we present evidence for a significant positive effect of age on wellbeing, after controlling for other variables, which has already been reported (Bowling 2005). This suggests that the capacity for wellbeing continues to develop through later life and does not decline with age. To the extent that a decline in wellbeing occurs among older adults, therefore, this should not be viewed as an inevitable outcome, although advancing age generates powerful risk factors for health.

This study raises the important substantive question of why the influence of Socio-economic Position on Socio-emotional Wellbeing should be

mediated by health and (to a lesser extent) lifestyle factors. Socio-emotional Wellbeing is a second-order factor which reflects life satisfaction, assessments of quality of life, and symptoms of depression and loneliness. Conceptualised in this way, this outcome variable reflects an intrinsic capacity of the individual: regardless of their income, living conditions, educational attainments and occupational group, older adults have the capacity to achieve a state of wellbeing. This process is influenced by various factors, including lifestyles, social networks, social participation and health. The influence of social and contextual factors appears to be channelled from the wider social sphere towards the more intimate personal sphere via mediating variables such as these. Mediation, in this context, appears to be due to the specific ways in which distinct spheres of life are linked together by attributes such as health, behaviours such as smoking and taking physical exercise, and social networks.

The strengths of the present analysis include the number and range of covariates considered (Aim 1), the use of latent variable modelling techniques to control for measurement error (Aim 2), the inclusion of clinical measures of health status and cognitive functioning (Aim 2), the estimation of a statistical model which includes direct and indirect influences (Aim 3) and the use of FIML estimation (Aim 4). The use of multiple-group Structural Equation Models to explore gender differences, to control for clustering and to assess model invariance across distinct age ranges is a further strength. As we stressed at the beginning of the paper, the results are necessarily conditional upon theoretical assumptions regarding pathways of influence that cannot be tested directly. The relationships specified are plausible and in line with current approaches to the determinants of health, lifestyles and wellbeing. The strength and coherence of the results suggest, at the very least, that indirect socio-economic influences on wellbeing deserve sustained research attention.

Future research using additional waves of data from TILDA will focus on testing different models of these direct and indirect pathways, including cross-lagged effects. The results reported here should be interpreted as providing *tentative*, rather than conclusive, evidence of direct and indirect pathways of influence, and as preparing the ground for more targeted analyses.

Conclusion

The statistical analysis of mediation effects in relation to outcomes such as Socio-emotional Wellbeing is situated at the frontier of interdisciplinary social science research and is essential in order to guide public policy.

Research on mediation demands sophisticated methods which draw on theoretical knowledge, empirical data and advanced statistical techniques. Although it may be difficult – or even impossible – to counteract the health consequences of social inequalities across the lifecourse, the results of our analysis suggest that the reduction and/or appropriate management of health problems has the potential to reduce socio-economic differentials in wellbeing amongst older adults. This implies that policies to improve the health status of the older adult population can have considerable multiplier effects, and contribute indirectly to enhancing social participation. The identification of indirect socio-economic effects which are mediated by health behaviours reinforces the importance of health prevention and the promotion of healthy leisure activities which are attractive to older people. The importance of social relationships and overcoming loneliness highlights the need to adopt a broad approach and to understand how policies and social processes impact on the personal sphere of intimacy and relationships.

The 'intimate' character of Socio-emotional Wellbeing and of its proximal determinants can make public policy appear a rather blunt instrument, and one that is most likely incapable of bringing about change. The present analysis helps to orient policy makers by contextualising different kinds of determinants and showing how intimate, intermediate and more general factors are closely inter-related. This leads to a number of new insights regarding the role of policy in relation to the wellbeing of older adults, as we have seen.

The value of the present analysis rests above all with the insights that it provides into the systematic relationships between socio-economic factors, health, lifestyles and wellbeing. The findings reinforce the importance of studying indirect pathways of influence in relation to health and wellbeing amongst older adults. They shed light not only on how enduring inequalities tend to shape life chances within the population as a whole, but also suggest that targeted interventions could reduce the effects of inequalities on wellbeing by intervening along these pathways.

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