



Methodology of Age UK's Index of Wellbeing in Later Life

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Introduction

Five steps were required in constructing Age UK's Index of Wellbeing in Later Life "WILL". They can be broadly termed as (1) Conceptual model; (2) Data preparation; (3) Modelling wellbeing; (4) Choice of domains; and (5) Calculating the WILL Index.

Each of these steps methods involved research activities as well as consultations with the experts (see Table below for a summary).

Step	Research activity	Consultation
1. Conceptual model: Identifying components of wellbeing in later life	Review of past studies	Panel of experts consulted for the comprehensive list of components of wellbeing in later life
2. Data preparation: Finding the most suitable dataset and variables	Review of datasets Selection of items Compilation of indicators Initial analysis	Deliberative workshops with older men/women to sense check initial findings
3. Modelling wellbeing: Identifying significant components and calculating wellbeing score	Structural Equation Modelling	Panel of experts consulted to present the findings
4. Choice of domains: Selecting five domains of wellbeing in later life	Principal Component Analysis	Panel of experts consulted for the determination of domains and domain-specific results
5. Calculating the Index of Wellbeing in Later Life	Determine individual indicators and their relative weights Calculate domain-specific indices Calculate overall WILL Index	Extensive discussion with policy and services experts for research translation

The methods chosen were deemed most suitable in meeting the objectives set out for the WILL Index:

- Why wellbeing? What are important components of wellbeing in later life?
- How older people in the United Kingdom are doing?
- Where and why wellbeing is low?
- What effect various policy and practical levers might have in improving wellbeing in later life?

One of the novelties of the modelling work in the 2nd and 3rd step is that it is performed on individual level data. This enables us to determine wellbeing scores for each individual in the dataset. This in turn makes it possible to analyse unequal experiences of wellbeing among older people. This offers improvement over other similar work hitherto.

The WILL Index calculated in the final step allows us to account for multiple indicators of wellbeing in one single but easy to understand aggregated summary measure. It includes tiers such as domains and indicators, which are drawn from all the previous steps. The Index calculated is much more comprehensive – covering all aspects of older people's lives – than what a single indicator can capture. The Index summarises differences across subgroups of older population and will help us monitor changes in overall wellbeing over time and between subgroups of people.

Step 1: Conceptual model

The research team started its work by undertaking an extensive review of a large number of past studies on wellbeing and quality of life, particularly those with a focus on measurement. The review covered 55 wellbeing scales or models, including the ONS wellbeing model, the European Social Survey report on measuring wellbeing, the OECD's work 'How's Life' measuring wellbeing, WHO's European Health Report, and the 'Older people's health and wellbeing Atlas produced by Public Health England.

Very few of these focused on older people, with some notable exceptions though, such as the study using subjective wellbeing as a measure of healthy ageing in people aged 50+ (Jivraj et al. 2014). Some others provided a measure of quality of life in older people, such as the CASP19 scale which was developed to measure quality of life in early old age group of 65-75 (Hyde et al. 2003), the World Health Organization's (WHO) broader measure of quality of life - WHOQOL-OLD (Power et al. 2005), and the Older People's Quality of Life (OPQOL) Questionnaire (Bowling 2010).

The review provided insights on a number of questions, particularly whether wellbeing is an outcome of interest to measure progress in older people's lives? What specific factors are important for wellbeing in later life?

A key finding has been that wellbeing is an umbrella term that encapsulates how we are faring in various spheres of life. It is not limited to an understanding of financial means only, but also other areas of life such as health and social engagement. It also includes attributes of local communities where older people live, an important aspect emphasised in other similar studies (see, e.g. WHO 2015). No single indicator, or a single domain of life, can fully capture both the breadth of wellbeing as a concept and its diversity amongst the older population in the UK.

While academic debate will continue about how 'wellbeing' should be defined, for our purposes it is not essential to address all of its finer points. We have chosen to make use of a notion of wellbeing which points to a state in which an individual or group is financially comfortable, healthy and engaged in meaningful activities. It points to a stock of personal, familial, and community resources that help individuals cope well when things go wrong. Wellbeing therefore encapsulates how we are faring, in all domains of life, including financial resources, health, social, personal and the local environment.

The literature review was followed up by face-to-face consultations with a carefully selected group of British experts involved in research and policy advice on diverse issues of older people. These early discussions led to additional work in understanding how best to capture wellbeing in later life.

The expert group also appreciated the importance of this line of work in developing a valid and reliable instrument to assess different aspects of wellbeing in later life; one which will integrate all relevant dimensions of wellbeing into a single coherent scale.

The work in this first step led to the development of a conceptual model of wellbeing in later life, comprising a list of components of wellbeing important for older people in the UK.

The list included as many as 200+ factors relating to people's health status, physical and mental, and satisfaction with healthcare and social services; employment, pension and wealth (especially home ownership); care and helping responsibilities; social, creative and cultural participation and the attributes of local communities.

The list included both objective and subjective indicators. Some of them would operate at an individual level (e.g. age or health status) whereas others would influence wellbeing at the local area level (e.g., access to transport or health care services) or at the national level (e.g., the level of state pension and its indexation).

Moreover, we needed to make a distinction between those variables that could become part of our operational definition of wellbeing in later life and those, although relevant in influencing wellbeing, could not be considered as they will not form a component of our understanding of wellbeing. For example, despite that there is some evidence that inflation affects wellbeing, it is not expected to form a part of our operational definition of wellbeing – hence, we have not considered a measure of inflation as potential component of wellbeing.

Step 2: Data preparation

The next task involved searching for nationally representative surveys in the United Kingdom which could give us data on the chosen components of wellbeing in later life. The two most comprehensive household surveys recording data on indicators relevant to wellbeing are the Understanding Society (USoc) and the English Longitudinal Study of Ageing (ELSA) surveys.

Both USoc and ELSA are representative of the older population, but each one has strengths and limitations. For example, USoc is an annual survey which covers all the four UK constituent countries whereas ELSA is only applicable to England and is carried out every two years.

One limitation both surveys have in common is that not all the same questions are asked in each wave. This is the case in USoc for its modular format, which means that some modules (i.e. questions pertaining to a particular topic such as mental health) have only been recorded once or with a gap of one or two years.

We examined the questionnaires of both surveys for each available year (wave) and decided to use the USoc survey as the main data source. This decision is based on the coverage of the identified individual variables, for the number of people included in the sample, its representativeness and longitudinal nature.

Box 1: Understanding Society dataset

Understanding Society is an innovative study about 21st century UK life and how it is changing. It captures important information about people's social and economic circumstances, attitudes, behaviours and health. The study is longitudinal in its design.

The study consists of four distinct samples: (a) a new random sample representative of the whole UK population large enough for the investigation of sub-populations, of around 27,000 households; (b) an ethnic minority boost facilitating minority group research, around 4,000 households; (c) the incorporation of the existing British Household Panel Study (BHPS) sample of around 8,200 households, and (d) an Innovation Panel of around 1500 households, used primarily for testing purposes.

The target of 40,000 households across the study's samples gives a unique opportunity to explore issues for which other longitudinal surveys are too small to support effective research. It permits analysis of small subgroups, such as disabled older people, and analysis at regional and sub-regional levels, allowing examination of the effects of geographical variation in policy, for example differences between the countries of the UK.

The first wave of USoc data was collected between January 2009 and January 2011, the second wave between January 2010 and January 2012, and so forth. Majority of time sensitive indicators, such as health, are drawn from a single wave, 4th wave, whose data was collected between January 2012 and January 2014.

During the interview, information is collected using different types of questionnaires. Questionnaires used in the study:

- a household coversheet and questionnaire (one per household)
- an individual questionnaire (one per eligible adult, aged 16 and above)
- a proxy questionnaire for those individuals who are not present and give their permission for information to be collected on their behalf
- an adult self-completion questionnaire (one per eligible adult)
- a youth self-completion questionnaire (for youths aged 10-15 years)

The majority of data come from the individual questionnaire. In the sample there are approximately 14,000 older people of age 60 or over.

Next, using the 200+ possible wellbeing factors from Step 1, we located questions in USoc that provide relevant data. Because of its modular format, we could not derive all the data required from a single wave. Instead, we pooled together data from four waves with valid answers to key indicators of wellbeing in later life.

In extracting data from USoc, there are a number of different possibilities.

- Some survey questions provided the required data on wellbeing. These included measures of family status, living arrangement, employment status, housing tenure, etc.
- Some survey questions needed to be added together to provide data on wellbeing. For example, older people receive different monetary benefits as they are all entitled to a Winter Fuel Allowance, some also get tax credit or family-related benefits, and others get disability benefits. By summing all sources of monetary benefits, a measure of benefit income is obtained which served as an indicator of wellbeing.

Likewise, total income was calculated by adding together State and private pension incomes, disability and social assistance benefits, as well as earnings (if any).

- Some indicators were more complex and required a specialised statistical modelling method to condense the detailed information available into a single summary indicator. Let us consider the case of mental health. A widely used set of questions on mental health, available in the USoc survey, are drawn from the 12-Item General Health Questionnaire (GHQ-12). This questionnaire comprises questions on psychiatric disorders such as feelings of unhappiness or depression, loss of confidence, enjoyment of daily activities, loss of sleep, sense of usefulness, etc. In this sense, mental health itself is not a directly observed variable, instead it is derived from its constituent parts using a modelling method called factor analysis (see Annex A.1 for more details).

On the whole, this step prepared the dataset for further work by extracting all the relevant variables from the USoc dataset.

Next, within this step of data preparation, the insights obtained were further reinforced by focus group discussions with older men and women (12 each). The research team presented findings from the initial analysis of the data and asked them to comment, with reference to what they had told us earlier in the session.

In these discussions, older men and women provided their opinion on a number of factors: What constitutes wellbeing? What does not affect their wellbeing? How have the factors changed through their lifetime? What are the best ways to measure older people's wellbeing?

A key insight was that wellbeing is a holistic notion and there is very little that does not impact on wellbeing. Health and finances become ever so important in later life, and greater value is assigned to partners. The discussion pointed explicitly to a whole host of other factors such as the value of giving, learning to forgive, not obsessing by what others think, the loss of significant others and having good friends.

Step 3: Modelling wellbeing

Next, we applied a statistical method suitable for identifying the most significant components of wellbeing in later life. Structural equation modelling (SEM) is by far the most suitable statistical method for this purpose. SEM offers us a statistical model for defining, identifying, and estimating total, direct and indirect, causal influences and effects to obtain the predicted individual scores of wellbeing and the relative contribution of each indicator to wellbeing.

A key attribute of SEM is that it enables an unobserved variable (in this case wellbeing) to be estimated from the statistical relationships among the observed variables (Kline 2011). A detailed description of the way we used SEM can be found in Annex A2.

The results of SEM allowed us to calculate the relative importance of about 40 variables that are considered significant in determining wellbeing in later life. The SEM model results are then used to predict individual scores of wellbeing for all older people included in our dataset created at Step 2.

Some of the key findings of SEM are:

- Wellbeing in later life is strongly linked with activities in social and civic organisations, such as a tenants/Residents group, religious group or social clubs. Likewise, engagement in creative and cultural activities is also linked with higher wellbeing in later life.
- People who are married or living with other members of their family also enjoy higher wellbeing.
- A high level of care-giving or helping (20+ hours a week) has a negative effect on wellbeing, while caring or helping for less than 20 hours per week has a positive effect.
- Other indicators such as being in good health, personality, and having a large social network are also strong contributors.

In our analysis we also considered a number of individual characteristics which although not part of our operational definition of wellbeing and consequently not part of the Index were nonetheless of potential interest, such as age, gender, ethnicity and number of children (distinguishing between those living in and away from the household).

Step 4: Choice of domains

Next, we made use of another statistical method to see how the significant variables from SEM could be grouped together in different domains. For this purpose, we applied the method of principal component analysis (PCA) on the SEM list of significant variables. This helped us to categorise the variables under five different domains:

1. **Personal**, covering living arrangements, family status, care and helping, intergenerational connections, and thinking skills;
2. **Social**, covering social, civic, creative and cultural participation as well as neighbourliness and friendships, and personality attributes;
3. **Health**, covering physical and mental health, mental wellbeing, long-standing illness or disability, diagnosed health conditions, and physical activities;
4. **Resources**, covering employment status and earnings, pension income, financial and housing wealth, home ownership, and material resources;
5. **Local**, covering satisfaction with medical, leisure, public transport and shopping services.

When the indicators are grouped by domain, we can also see how important each domain is to overall wellbeing. The domain contributing most to overall wellbeing is Social, which accounts for a third of the total wellbeing score. Personal and Health domains each contribute over a fifth (22 per cent each) with Resources contributing 19 per cent and Local the remaining four per cent. Local is quite a bit lower than the others; this is likely due to having fewer indicators, plus indirect effects are already captured in the various person-level indicators.

Step 5: Calculating the Wellbeing in Later Life Index

Age UK's Index of Wellbeing in Later Life followed the tradition observed in calculating other similar indices, most notably the Human Development Index (UNDP 1990) and the Active Ageing Index (Zaidi et al. 2016).

Firstly, to 'normalise' each indicator, say x , into a unit-free variable ranging between 0 and 100, the following formula is used:

$$x \text{ index} = \frac{x - \min(x)}{\max(x) - \min(x)}$$

The transformed variable therefore uses a 0-100 scale based on the indicator score observed for an individual and comparing it to the lowest and highest scores of the same indicator observed amongst all individuals in the dataset.

This transformation allows different indicators to be added together, referred to as 'aggregation'. The aggregation of individual-level indicators to calculate the Index is performed at two levels.

- Firstly, all normalised indicators selected for each domain are aggregated. For instance, we aggregated all indicators in the first domain 'Personal' into a domain-specific index, referred to as the Index for the 1st domain Personal. This method is adopted to calculate five domain-specific indices.
- Secondly, all domain-specific indices are further aggregated into one overall index. The relative importance of indicators included in each domain determines the relative importance of that domain. These relative weights assigned to each domain are important parameters in calculating the overall index.

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Annex A1: Factor Analysis

Older people receive different monetary benefits – they are all entitled to Winter Fuel Allowance, for example, and some get tax credit or family-related benefits. By summing all sources of monetary benefits we obtained a measure of benefit income.

That is straightforward, but in other cases it is much less so. Let us consider the case of mental health. A widely used composite indicator of mental health, available in the Understanding Society survey, is known as the GHQ-12 index. GHQ-12 stands for the 12-Item General Health Questionnaire and, of course, it is composed of twelve different questions on psychiatric disorders within community-based individuals.

The list includes such items as feeling of unhappiness or depression, loss of confidence, enjoyment of daily activities, loss of sleep, sense of usefulness, etc. In the survey we have the individual responses to each of the 12 questions, with options ranging between ‘much less than usual’ and ‘better than usual’.

However we cannot obtain the GHQ-12 index by merely adding these responses.

- Firstly, we would not know *a priori* whether, say, enjoying daily activities more than usual has the same importance to a person’s mental health as feeling depressed more than usual. In this sense, mental health is not an “observed” variable.
- Secondly, the survey does not directly ask about mental health; the questions are in fact about unhappiness, usefulness, sleep, etc.

Plenty of research has agreed that the 12 items in this battery of questions capture mental health, but ‘mental health’ is not directly “observed” or recorded – it has to be estimated out of the 12 “observed” items.

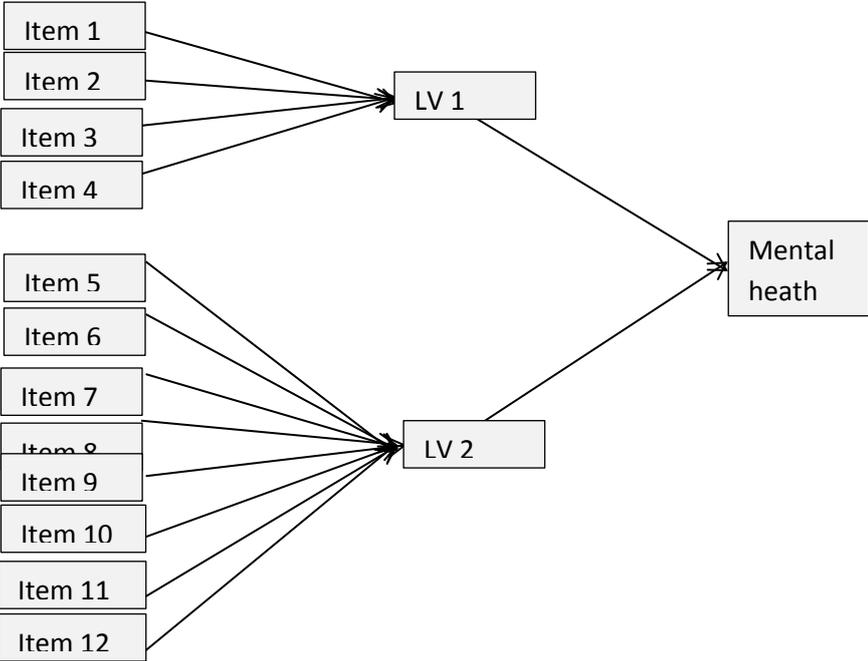
A variable that is not directly observed in the data but can be created out of other variables which have been recorded in a dataset is known as a “latent” variable. Therefore, mental health is a latent variable that we can estimate by means of the 12 observed items that compose the GHQ-12 battery of questions.

How can we go about and estimate this latent variable? For starters, we need to estimate the relative importance of each item (in some cases we also need to ‘standardise’ the variables to compare ‘like with like’) and only then could we obtain meaningful figures for the indicator of mental health. This is precisely what Factor Analysis is meant to do.¹

We mentioned that we would need to estimate the ‘relative importance’ of each item. However, this would be the easiest of structural possibilities. It could become more complicated than this as with 12 items, there are several alternative structures possible regarding their interrelations. For example a group of, say, 4 items could distinctly

¹ Exploratory factor analysis, to be more precise. Factor analysis is usually divided into exploratory and confirmatory. The former seeks a general latent structure from the covariance matrix (i.e. the interrelations between items). In turn, confirmatory factor analysis attempts at testing whether a particular structure fits a dataset in the sense that it provides a satisfactory account of the existing interrelations or not.

correspond to one latent variable whilst the other 8 could separately constitute another latent variable, and both latent variables in turn could come together to conform the latent variable 'mental health'. Diagrammatically,

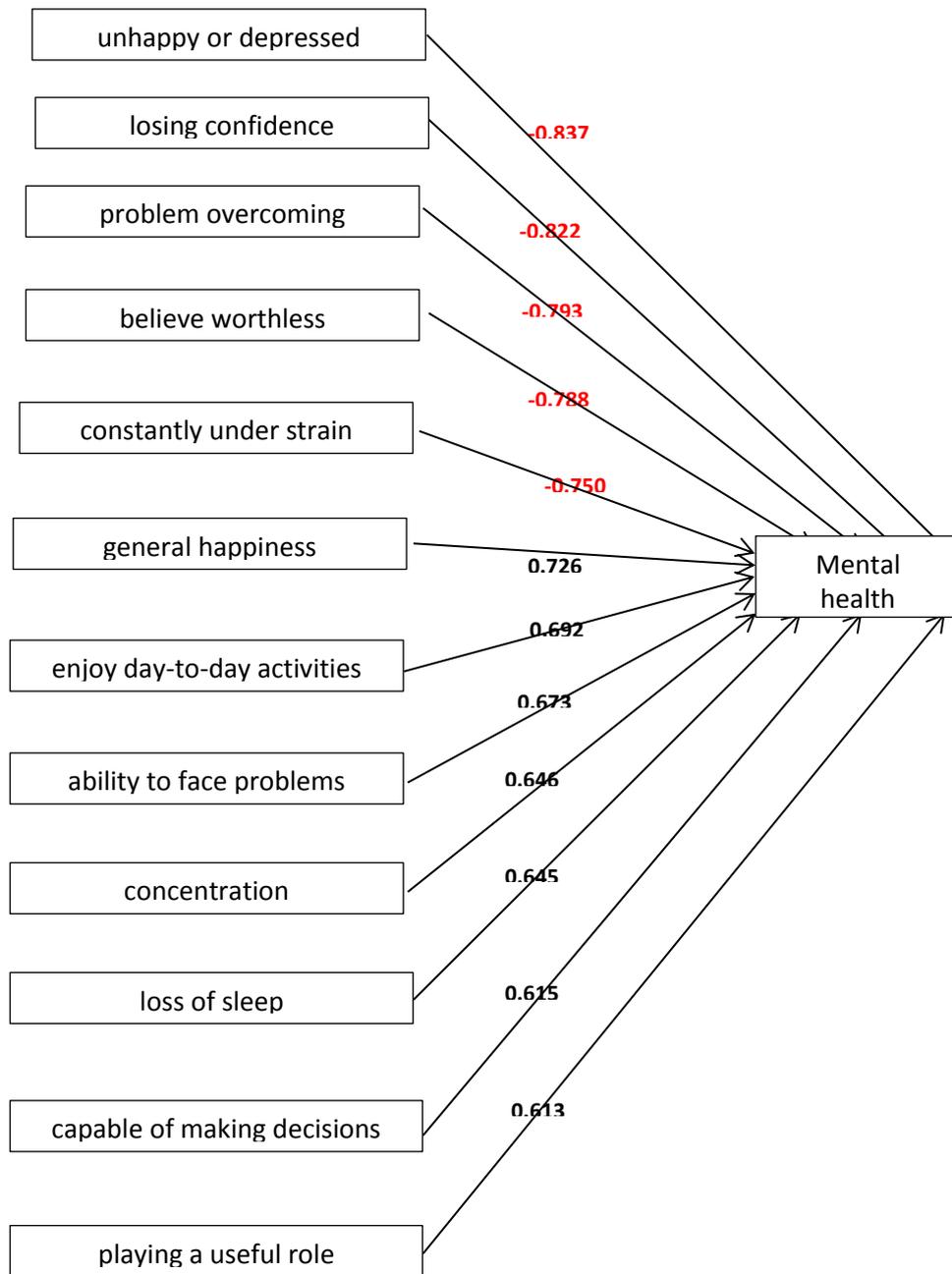


Needless to say, in principle there would be many other ways to connect the 12 items to create the latent variable 'mental health'. Modern statistical software evaluates all the different options and renders the best fitting structure. In this particular case of the GHQ-12, the final result was only one factor – i.e. each item explained part of one latent variable, our mental health indicator.

We can see that the responding 'more than usual' to any of the first five items (e.g. feeling unhappy more than usual) indicates a reduced mental health status, whilst 'more than usual' in any of the other seven (e.g. feeling able to face problems more than usual) denotes a better mental health status. We can also see the relative importance of each item, as indicated by the figures next to each arrow below. These are known as the 'standardised coefficients'. These coefficients tell us that, for example, feeling unhappy or depressed more than usual is not only deleterious to mental health but it is relatively more important to mental health than feeling that one plays a useful role more than usual – and by how much (around 36 per cent²).

We applied factor analysis to obtain the indicators for mental health, neighbourliness, thinking skills (where we found two intermediate latent variables – one for memory and one for intelligence), and health status.

² $[(0.837/0.613)-1]*100=36.5\%$



Annex A2: Structural Equation Modelling

Once we finished preparing indicators that we would use to construct the Index and estimate individual wellbeing scores, we needed to draw up a statistical model that would estimate the relative importance to wellbeing of each indicator as well as articulate and take into account their interrelationships.

Wellbeing is another of the 'latent', unobserved variables, which according to our theoretical framework should encompass the influences of all the indicators.

- Structural equation modelling (SEM) is a statistical tool that combines factor analysis and path analysis. As in factor analysis, SEM can be used to estimate a latent variable, obtain the relative importance of each of its constituent factors, and gauge the appropriateness of the construct in terms of goodness of fit.
- The path analysis element allows us to consider the intermediate effects of one indicator onto another indicator (for example, the relationship between age and employment) or indicators (e.g. marital status, caring and helping responsibilities and creative and cultural participation).

The final list of standardised coefficients that shows the relative importance of each indicator reflect the direct effects of each indicator onto wellbeing once any interactions or indirect effects have been accounted for.

Unfortunately (or not), the 'everything is related to everything else' approach to a statistical model is doomed to failure. In technical terms, such a model would not be 'identifiable' – in plain English, the computer would say 'no'. And it would say 'no' irrespective of the sample size; it is not a question of getting more respondents but of the model itself, of the number of relationships (i.e. coefficients) that we ask the computer to estimate.

An example from school algebra may help at this stage. Remember that it is possible to obtain the value for variable X in the following equation $5X - 8 = 0$, but it is not possible to obtain unique values for X and Y here $5X - Y = 0$, because in the former we have one equation and one unknown value, whereas in the latter example there are two unknowns and only one equation. Adding all the possible interrelationships between the indicators in a SEM model comes against a similar problem.

Therefore, we started from a structure without any interrelationships and then followed two premises to add the links between intervening indicators: the link should reflect findings in existing literature, and it should contribute significantly to improving the overall statistical fit of the model.

Based on our own expertise and the literature review, we identified a number of interrelationships with little disagreement among scholars – for example, that between chronological age and long-standing illness or disability. In this case, we could assume a direction of causality from age to long-standing illness or disability.

However, in many other instances, it is less clear what comes 'before' and what 'after'. However, in SEM the links between indicators can be introduced as paths from one variable

onto another – i.e. denoting a causal relation – or as covariances – i.e. denoting that both indicators are interrelated but without setting the direction of causality.

We opted for the second approach, in the cases in which the association could go one way or the other – or both. An example of an association or link between indicators that is not so clear-cut is that between health status and retirement. Lower health status may precipitate the retirement decision, but retirement may also have deleterious consequences to an individual's health.

Regarding the contribution to the overall model fit, we relied on 'modification indices' – an output of the statistical software we used to run the SEM models that estimates the changes in a measure of fit for each possible link between any two indicators. Even though adding some associations between variables would make 'statistical sense' in that the model fit would increase, if it did not make 'gerontological' sense, we decided not to include them.

The final model specification incorporates a number of these associations or relationships between indicators. The final result is a list of standardised coefficients that indicate the relative importance of each variable to wellbeing and the sign of the relationship – i.e. whether an increase in the value of the indicator or its presence (vis-à-vis its absence) improves or reduces wellbeing. Therefore, the standardised coefficients indicate whether changes in or values of an indicator (e.g. more retirement income, less social participation, or being single as opposed to, say, married) is 'good' or 'bad' for wellbeing and by how much.

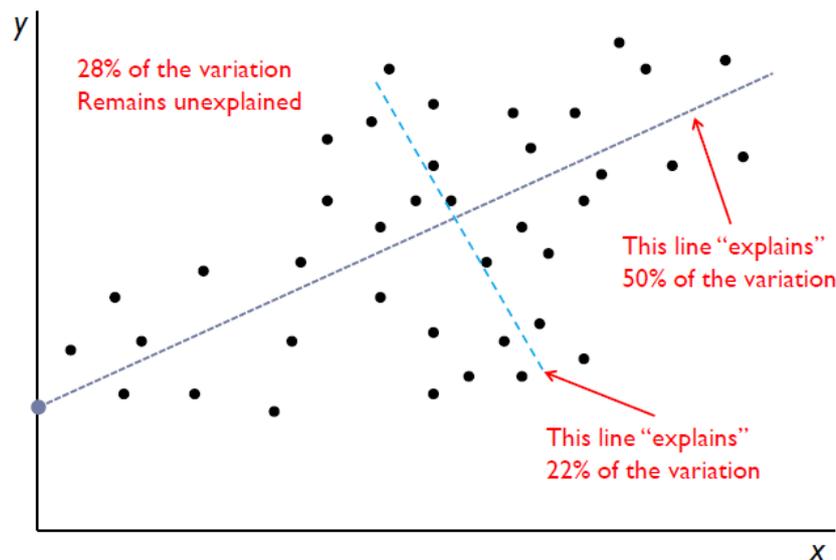
Annex A3: Principal Component Analysis

The SEM results provided us with a measure of the relative importance of each indicator for wellbeing. However, with so many indicators the results are hard for a reader to absorb. The results are also needed to be presented in a concise manner as a guide for influencing policy. Therefore, we needed to reduce the complexity and multiple dimensionality of these results to more manageable levels. This is what the statistical technique Principal Component Analysis (PCA) has helped us to achieve.

Though the mathematics behind this transformation is complicated, an example using the familiar regression line may help to interpret the idea.

- Imagine there are two variables, X and Y, and a number of observation points that link levels of X and levels of Y.
- Now, think of a regression line, which is a straight line that cuts across the observations at the best possible level and slope – ‘best’ here means that the line explains more of the variation between the observations than any other possible straight line.
- Let us now imagine that this best-fitting line explains 50 per cent of the variation. Of course we could explore other lines that, though explaining less than that, may shed additional information or insight into the relationship between both variables.
- To continue with the example, let us then assume that the second best-fitting line explains another 22 per cent of the variation. Each regression line denotes a ‘component’ – hence the name of this statistical technique.
- Now, with both components together we can explain 72 per cent of what relationship there is between X and Y. This leaves 28 per cent of the variation unexplained, a better result than the original 50 per cent that was not accounted for.

The chart below describes the situation used in the example mentioned above.



PCA is the technique that estimates the best-fitting 'lines' and the optimal number of components (we write 'lines' in inverted commas because in our case we did not study the relationship between two variables, but between 40 indicators!).

We ran a PCA on the dataset containing all significant variables and obtained that thirteen components were enough, which we then subsumed into five. Interpreting what each component is telling about the relationships between the indicators is more an art than a science, but some patterns emerged which eventually led us to label the five components as: Personal, Social, Health, Resources, and Local. To avoid statistical jargon we refer to these components as 'domains' of wellbeing. The table below presents the composition of each

Five domains containing multiple indicators of wellbeing in later life				
1 PERSONAL	2 SOCIAL	3 HEALTH	4 RESOURCES	5 LOCAL
1.1 Live with people	2.1 Social participation	3.1 Limiting longstanding illness	4.1 Employed	5.1 Medical services
1.2 Married	2.2 Civic participation	3.2 Diagnosed health conditions	4.2 Earnings	5.2 Leisure services
1.3 Widowed	2.3 Cultural participation	3.3 Mental health	4.3 Income-related benefits	5.3 Public transport
1.4 Divorced	2.4 Neighbourliness	3.4 Mental wellbeing	4.4 Pension income	5.4 Shopping facilities
1.5 Have children	2.5 Have friends	3.5 Physical activities	4.5 Housing wealth	
1.6 Education	2.6 Personality/ Openness		4.6 Financial wealth	
1.7 Being a carer	2.7 Personality/ Conscientiousness		4.7 Financial debt	
1.8 Carer, <20 hours	2.8 Personality: Extraversion		4.8 Home owned outright	
1.9 Carer, >20 hours	2.9 Personality/ Agreeableness		4.9 Home owner - mortgaged	
1.10 IG connections	2.10 Personality/ Emotional instability		4.10 Material resources	
1.11 Cognition				

domain – that is to which domain each indicator belongs to.

PCA not only renders the optimal number of the components but also the relative contribution of each component. The placement of individual indicators into the domains also determines the relative weight of each of the five domains.

The domain contributing most to overall wellbeing is Social, which accounts for a third of the total wellbeing score. Personal and Health domains each contribute over a fifth (22 per cent each) with Resources contributing 19 per cent and Local the remaining four per cent.

Local is quite a bit lower than the others; this is likely due to having fewer indicators, plus indirect effects are already captured in the various person-level indicators.