The Global Activity Limitation Indicator (GALI) measured function and disability similarly across European countries

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Abstract

Objective
This work aims to validate and increase understanding of the Global Activity Limitation Index (GALI), an activity limitation measure from which the new structural indicator Healthy Life Years (HLY) is generated.

Study design and setting
Data from the Survey of Health and Retirement in Europe (SHARE), covering 11 European countries and 27,340 individuals of over 50 years of age, was used to investigate how the GALI was associated with other existing measures of function and disability, and whether the GALI was consistent or reflected different levels of health in different countries.

Results
The GALI was significantly associated with the two subjective measures of activities of daily living score and instrumental activities of daily living score, and the two objective measures of maximum grip strength and walking speed (p<0.001 in all cases). The GALI did not differ significantly between countries in terms of how it reflected three of the health measures, with the exception being instrumental activities in daily living (IADL).

Conclusions
The GALI appears to satisfactorily reflect levels of function and disability as assessed by longer-standing objective and subjective measures, both across Europe and in a similar way between countries.
**Keywords**

Global Activity Limitation Index, Healthy life years, disability-free life expectancy, functional limitation, disability, ageing.

**Running title**

Evaluation of the Global Activity Limitation Index (GALI) in Europe
Introduction

Health expectancies, combining information on mortality and morbidity, have become essential indicators of the health of our ageing populations, where the quality of remaining life is seen as at least as important as the quantity. Europe is no exception and indeed has now introduced a disability-free life expectancy, called the Healthy Life Year (HLY) as the first European structural indicator on health.(1) These indicators are to be monitored annually by the Spring Council meeting (European Commission 2003 and 2004).

A major purpose of monitoring health expectancies is to determine whether the year on year increases in life expectancy, still evident in the majority of countries, are accompanied by decreases in unhealthy life years (known as the compression of morbidity hypothesis) (2-5), or by increases in unhealthy life years (expansion of morbidity).(2, 4-6) Despite the commonly held view that the endpoint of the epidemiological transition is the compression of morbidity, Robine & Michel(5) have suggested that further life expectancy increases and the emergence of greater numbers of the oldest old might result in further expansion of disability. Analysing three chronological series, they have demonstrated that the proportion of years lived in good health have decreased in Australia, remained constant in Great Britain and increased in Austria and that this was related to the initial level of life expectancy. They suggest that expansion of disability goes with the highest life expectancy and compression with the lowest.(5)

Although health expectancies are available for over 50 countries worldwide, including many European countries, Robine and Michel’s hypothesis is difficult to confirm because differences in the underlying health measure and in the methods of calculation hamper harmonization. To date cross-national comparisons of health expectancies across Europe have been few and have relied on post rather than pre collection harmonisation. The Cross National Determinants of Quality of Life and Health Services for the Elderly project (CLESA) is the first attempt to make a cross-national comparison of disability-free life expectancy (DFLE) using data from five European countries (Finland, Italy, The Netherlands, Spain and Sweden) and Israel.(7) Even when longitudinal analysis was possible CLESA has major disadvantages since the activities of daily living (ADL) measures were collected in different periods from 1987 to 1993 (baseline) and from 1990 to 2000 (follow-up), with various response categories, and with data being harmonised post-collection.(8) Although Italy showed the lowest total life expectancy without disability among both men (72%) and women (61%) and Sweden the highest (89% among men
and 71% among women), it is difficult to determine whether or not these differences in DFLE are real. A few countries (France, UK, Belgium, Ireland, Netherlands, United States, Switzerland and Australia) have attempted to estimate Dementia Free Life Expectancy but again cross-national comparisons are difficult due to differing diagnostic instruments, a lack of harmonisation of case-definitions and, in some countries, omission of those in institutions. (9, 10)

According to the recent RAND Europe report, HLY will be distinguished from other indicators of health expectancy by harmonisation at the point of collection which allows comparability across countries. (11) HLY is based on a Global Activity Limitation question (GALI) from the Statistics on Income and Living Conditions (SILC) survey. The GALI, which has been designed particularly for health expectancy comparisons across Europe (12, 13), has only been validated to date against other measures of health and function in one country, Belgium. (12, 14) Other than the GALI, there are only a very limited number of questions on health and functioning in the SILC, which restricts further validation of the GALI in other languages and cultures. However the GALI was included in the Survey of Health and Retirement in Europe (SHARE) alongside a wide range of other disability measures. SHARE was based on the US Health and Retirement Survey (HRS) and was conducted in 2004 on individuals aged 50 years and over in 11 European countries: Germany, Austria, Belgium, Denmark, Spain, France, Greece, Italy, Netherlands, Sweden and Switzerland.

As the GALI will be used to monitor levels of health within and between countries through the HLY indicator, it is important to understand what the GALI is actually measuring and to check its robustness. Using data from SHARE this paper aims to validate the GALI for the first time in multiple European countries and to investigate whether the GALI reflects similar levels of disability and functioning in different countries.
Methods

The sample size for SHARE ranged from 947 (Switzerland) to 3671 (Belgium) persons per participating country (table 1), representing the non-institutionalized population aged 50 and older.(15) The SHARE main questionnaire consists of 20 modules (supplemented by a self-completion questionnaire). The GALI is self-reported whereby an individual is asked “For the past six months at least, to what extent have you been limited because of a health problem in activities people usually do?” There are three possible responses: not limited, moderately limited or severely limited. Due to the low numbers reporting themselves as severely limited in the SHARE study, the severely and moderately limited individuals were merged into one category classed (limited), as is also done when calculating the HLY indicator.(1) To investigate the validity of the GALI we compared it to a number of other common measures of function and disability which were simultaneously collected, including maximum grip strength, walking speed (only measured in those aged over 75 years and those under 75 years with self-reported walking limitation), an activities of daily living score (ADL) and an instrumental activities of daily living score (IADL). Further details of these measures are given in Appendix 1. Both ADLs and IADLs were self-reported, and therefore essentially subjective, whereas both maximum grip strength and walking speed can be considered objective measure, being measured using consistent techniques across countries. Further details of the SHARE data and methodology can be found in previous publications.(16)

Statistical methods

To assess the relationship between the GALI and the other functioning and disability measures, logistic regression models were fitted, adjusting for age, gender and the clustering effect of country. The probability of being classed as limited or not limited for the GALI for each value or category of the measure of function or disability of interest could then be estimated from the logistic regression models, and the relationships assessed. Additional models were also fitted to assess if the relationship between the GALI and other measures differed by country. This was done by firstly fitting logistic regression models for each country individually, to estimate the odds of being limited or not limited by different measures, adjusted for age. For this analysis the continuous measures were dichotomised, using cut-offs provided by SHARE. These were, for walking speed <=0.4 metres/second versus >0.4 metres/second and for both ADLs and IADLs a score of one or more versus none. For maximum grip strength a binary version of the variable was not included in the SHARE dataset, therefore the variable
was dichotomised using gender-specific tertiles across all countries, with the lower third (poor grip strength) forming one category, compared to all others. The odds ratios from the logistic regression models were then compared by assessing heterogeneity between countries by fitting random effects meta-analysis models for each health measure of interest.

**Results**

The characteristics of the SHARE study sample are described by country in Table 1. The country cohorts were fairly similar in terms of age and gender composition, with a mean age of between 63.9 years (Netherlands) to 66.9 years (Spain), and percentage of males varying from 42.1% (Spain) to 47.4% (Sweden). The percentage describing themselves as limited varied considerably by country and was highest in Germany (49.5%) and lowest in Greece (30.4%). Other measures of disability and functioning, both objective and subjective, also showed variations across Europe. The percentages who reported difficulty with at least one ADL or one IADL were lowest in Switzerland (6.8% and 8.5% respectively) and highest in Spain (14.1% and 25.4%).

(Table 1 here)

We first explored whether the GALI reflected disability and function on other measures overall using logistic regression models and these results are reported in Figure 1 and Table 2. In all cases the GALI significantly reflected poorer function as assessed by the other measures (p<0.001 in all cases). For example Figure 1 shows that as maximum grip strength increased, the probability of reporting limitation with the GALI decreased, and as the number of ADL and IADL restrictions increased so did the probability of being limited. On the other hand the probability of reporting no limitation with the GALI if limited on the other measures was non-zero, though small and a minimum with the most severe measure (ADL). The SHARE study did however appear to provide strong evidence that overall the GALI effectively captured limitation as measured by other subjective and objective disability and functioning items.

(Figure 1 and Table 2 here)
Next we undertook analyses to determine if the GALI measured the same level of functioning and disability across countries, that is, were the individuals identified as limited in one country similar to those identified in another. For each country the limited group had poorer function however this measured, as can be seen in Table 3, where crude unadjusted values are reported for each GALI classification. However the prevalence of each of the other disability and function measures between the groups who were limited and not limited by the GALI appeared to vary by country, indicating that the GALI could be identifying different groups of individuals in different countries. This was further investigated by fitting logistic regression models for each country to obtain an odds ratio of being limited dependent on different function and disability measures, and then investigating the odds ratios for heterogeneity across countries. Figure 2 shows that there was no significant country variation in the odds of being limited dependent on each measure: ADL (p=0.106), maximum grip strength (p=0.077) and walking speed (p= 0.524). There was however significant heterogeneity for IADL score (p<0.001). From Figure 2(b) it can be seen that the odds ratios of being assessed as limited by the GALI if an individual had difficulties with one or more IADLs compared to none, varied from an odds ratio of 3.85 (95% CI: 2.94, 4.76) for Greece to 9.42 (95% CI: 6.66, 12.18) for Sweden. Therefore although all countries showed increased odds of being limited if an individual had difficulty with at least one IADL, the relationship was more pronounced in some countries compared to others. In general from Figure 2, it can be seen that within each country there was mostly a significant association between the GALI score and other measures and furthermore this was always in the direction that would be expected, i.e. individuals with poorer functioning and disability measures were more likely to be classed as limited by the GALI.

(Table 3 and Figure 2 here)

In terms of gender and age comparisons for those with missing compared to recorded data, the only significant difference was for grip strength where participants with missing data were on average older (missing grip strength: mean age=70.1 years; recorded grip strength mean age = 64.6 years; p<0.0001).
**Discussion**

The Global Activity Limitation Index (GALI) is a new single item disability measure developed to allow consistent monitoring of the health of the European population.\(^{(1)}\) The GALI and two other single item questionnaires on self-rated health and chronic morbidity form the Minimum European Health Module, which is included in the European Union Statistics of Income and Living Conditions Survey (EU-SILC), now running in all 27 countries in the European Union. The importance of the GALI makes it imperative that its properties are fully evaluated and understood. To date the GALI has only undergone validation in one European country.\(^{(12, 14)}\) In contrast the analysis presented here is based on a large data set of over 27,000 individuals from 11 European countries, and is therefore the first cross-national validation of the GALI. As in the single country validation, we found that generally the GALI appeared to be a good indicator of poor function and disability, as reflected by other subjective and objective measures.

Previous cross-European studies such as the European Community Household Panel (ECHP) included a similar question to the GALI from which disability-free life expectancy has been calculated.\(^{(17, 18)}\) However countries individually translated the question and response categories into their own language and no checks were made on whether there were any cultural issues that were likely to impair understanding or reporting. The GALI, on the other hand, was developed in a bottom-up approach, systematically reviewing all global disability questions and then forming the English version with a clear definition of the concepts that the item was measuring.\(^{(13)}\) This enabled translation guidelines to be developed so that the item could be translated to the underlying concept, thereby ensuring a higher degree of harmonisation and a reduction in the possible cultural differences that might occur.

Although attempts have been made to reduce differences in the cultural understanding and reporting of the GALI, it remains a self-reported measure of disability and it is still possible that the cross-national variation in the GALI may be due to some cultures being more or less reticent about reporting the severity of their problems. This is particularly acute when response categories are ordinal such as ‘none, mild, moderate, severe, extreme’ or in the case of self-rated health ‘excellent, very good, good, bad and very bad.’ Older people especially may rate their difficulties as less severe than younger people because they subconsciously compare themselves with others of the same age. One strategy for overcoming this is the use of anchoring vignettes \(^{(19)}\) which are a set of hypothetical individuals with
health problems rated by each respondent on the same scale as the original health question, allowing the researcher to recalibrate the original response. Although the GALI responses are ordered categorical ‘not limited, limited but not severely, severely limited’ HLY are defined as no limitation which would appear to be less prone to interpretation than the 3-point Likert items. Despite this there were a few individuals who were restricted in the other disability and function measures (according to the cutpoints we used) who reported no limitation in the GALI and this requires further research.

A strength of our study is the large number of countries covered in the SHARE survey, the wide range of measures of functioning and disability including objective measurements and the data quality in terms of completeness. Out of 27,340 individuals in the SHARE data set who were over 50 years of age, 27178 (99%) were analysed for ADL and IADL, 25080 (92%) for maximum grip strength, and 27,170 (99%) had data available for the GALI, though only 2525 (49% of those over 75 years of age) had walking speed recorded. Those missing on grip strength were significantly older than those with recorded data but the level of missing data for this variable was low overall (8%).

Measures of disability were introduced into Health Interview Surveys as self-rated health was felt to be too subjective (despite it correlating well with mortality and health service use (20)) and reported morbidity is sensitive to change over time, level of education, and medical advances. Disability was thought to be more objective, easier to identify by individuals, easier to report (though still subjective as self-reported) and important in determining need not only for health services but also for long-term care.(21) Disability is usually measured through basic personal care Activities of Daily Living (22) and/or Instrumental Activities of Daily Living (23) and these often take the form of a minimum of 5 separate questions although there is a wider range of potential items for any particular survey. A single item on disability such as the GALI is particularly useful therefore for inclusion in non-health surveys such as the Labour Force Surveys. We have shown that the GALI satisfactorily reflects poor functioning and disability on a range of subjective and objective items and in a similar manner across different European countries. The GALI therefore appears to be a useful addition to European surveys where time constraints make a longer set of ADLs or IADLs impossible as well as a firm basis for the HLY indicator.
Conflict of Interest Statements

There are no conflicts of interests.

Acknowledgements

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References


### Table 1: Characteristics of the SHARE population aged 50 years and over, by country

<table>
<thead>
<tr>
<th></th>
<th>Austria</th>
<th>Belgium</th>
<th>Denmark</th>
<th>France</th>
<th>Germany</th>
<th>Greece</th>
<th>Italy</th>
<th>Netherlands</th>
<th>Spain</th>
<th>Sweden</th>
<th>Switzerland</th>
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</thead>
<tbody>
<tr>
<td>Sample size</td>
<td>1839</td>
<td>3671</td>
<td>1597</td>
<td>3032</td>
<td>2931</td>
<td>2655</td>
<td>2493</td>
<td>2848</td>
<td>2343</td>
<td>2984</td>
<td>947</td>
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<tr>
<td>Mean age (SD)</td>
<td>65.6(9.7)</td>
<td>65.0(10.1)</td>
<td>64.9(10.6)</td>
<td>65.2(10.7)</td>
<td>64.6(9.4)</td>
<td>64.6(10.5)</td>
<td>64.9(9.1)</td>
<td>63.9(9.7)</td>
<td>66.9(10.6)</td>
<td>65.5(10.2)</td>
<td>65.5(10.5)</td>
</tr>
<tr>
<td>% Male</td>
<td>42.2</td>
<td>46.8</td>
<td>46.7</td>
<td>44.9</td>
<td>46.7</td>
<td>46.5</td>
<td>45.0</td>
<td>46.9</td>
<td>42.1</td>
<td>47.4</td>
<td>46.0</td>
</tr>
<tr>
<td>GALI % limited</td>
<td>47.2</td>
<td>38.8</td>
<td>46.6</td>
<td>39.4</td>
<td>49.5</td>
<td>30.4</td>
<td>40.2</td>
<td>45.0</td>
<td>46.9</td>
<td>44.5</td>
<td>34.3</td>
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<tr>
<td>ADL % with 1 or more</td>
<td>9.2</td>
<td>11.6</td>
<td>10.4</td>
<td>12.0</td>
<td>8.8</td>
<td>8.7</td>
<td>10.6</td>
<td>7.4</td>
<td>14.1</td>
<td>8.8</td>
<td>6.8</td>
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<tr>
<td>IADL % with 1 or more</td>
<td>17.5</td>
<td>17.6</td>
<td>17.5</td>
<td>16.6</td>
<td>13.3</td>
<td>18.1</td>
<td>14.1</td>
<td>14.7</td>
<td>25.4</td>
<td>14.8</td>
<td>8.5</td>
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<tr>
<td>Maximum grip strength % in lower tertile</td>
<td>27.4</td>
<td>35.8</td>
<td>32.7</td>
<td>41.2</td>
<td>26.7</td>
<td>45.5</td>
<td>50.7</td>
<td>29.4</td>
<td>62.6</td>
<td>33.5</td>
<td>34.9</td>
</tr>
<tr>
<td>Walking speed % &lt;=0.4 m/s (sample size)</td>
<td>14.1 (128)</td>
<td>13.5 (453)</td>
<td>13.5 (237)</td>
<td>18.8 (398)</td>
<td>18.4 (218)</td>
<td>28.7 (258)</td>
<td>27.3 (209)</td>
<td>8.4 (308)</td>
<td>32.6 (383)</td>
<td>7.8 (319)</td>
<td>7.1 (126)</td>
</tr>
</tbody>
</table>
Table 2: Logistic regression analyses of association between the odds of being classed as limited by the GALI and other subjective and objective measures of disability and function

<table>
<thead>
<tr>
<th>Subjective measures</th>
<th>Odds ratio (95% confidence interval)</th>
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<tr>
<td>ADL (1+ ADL v no ADL limitation)</td>
<td>8.63 (7.13, 10.46) ***</td>
</tr>
<tr>
<td>IADL (1+ IADL v no IADL limitation)</td>
<td>6.01 (5.02, 7.21) ***</td>
</tr>
<tr>
<td><strong>Objective measures</strong></td>
<td></td>
</tr>
<tr>
<td>Maximum grip strength (lower tertile vs middle/upper tertiles)</td>
<td>0.57 (CI: 0.50, 0.66)***</td>
</tr>
<tr>
<td>Walking speed (&lt;=0.4 m/sec vs &gt;=0.4 m/sec)</td>
<td>0.46 (0.34, 0.61) ***</td>
</tr>
</tbody>
</table>

All analyses were adjusted for both age and gender and the clustering effect of country.

*** = p<0.001
Table 3: Comparison of the Global Activity Limitation Indicator (GALI) and other measures of disability and function in those 50 years of age and over, by country

<table>
<thead>
<tr>
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<tr>
<td>Limited</td>
<td>18.2</td>
<td>24.5</td>
<td>19.7</td>
<td>24.8</td>
<td>16.2</td>
<td>23.2</td>
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<td>27.9</td>
<td>18.1</td>
<td>16.7</td>
<td></td>
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<tr>
<td>Not limited</td>
<td>1.2</td>
<td>3.4</td>
<td>2.2</td>
<td>3.7</td>
<td>1.4</td>
<td>2.4</td>
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<td>2.0</td>
<td>1.4</td>
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<tr>
<td>Difference**</td>
<td>16.9</td>
<td>21.1</td>
<td>17.4</td>
<td>21.1</td>
<td>14.8</td>
<td>20.8</td>
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<td>25.0</td>
<td>23.7</td>
<td>19.5</td>
<td>21.4</td>
<td>26.2</td>
<td>14.0</td>
<td>24.3</td>
<td>17.5</td>
<td>21.0</td>
<td>(14.6, 27.5)</td>
</tr>
<tr>
<td>18.9)</td>
<td>26.2)</td>
<td>27.4)</td>
<td>27.4)</td>
<td>22.8)</td>
<td>25.8)</td>
<td>30.4)</td>
<td>28.2)</td>
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<td>(28.2)</td>
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<tr>
<td><strong>Walking speed % &lt;=0.4 m/s</strong></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Limited</td>
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<td>17.9</td>
<td>15.7</td>
<td>26.1</td>
<td>20.5</td>
<td>33.3</td>
<td>29.1</td>
<td>10.1</td>
<td>36.6</td>
<td>10.3</td>
<td>13.8</td>
<td></td>
</tr>
<tr>
<td>Not limited</td>
<td>13.3</td>
<td>7.3</td>
<td>8.3</td>
<td>7.6</td>
<td>12.3</td>
<td>22.8</td>
<td>24.0</td>
<td>6.2</td>
<td>24.0</td>
<td>4.4</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td>Difference**</td>
<td>1.1</td>
<td>10.6</td>
<td>7.4</td>
<td>18.5</td>
<td>8.2</td>
<td>10.5</td>
<td>5.1</td>
<td>4.0</td>
<td>12.7</td>
<td>5.9</td>
<td>12.3</td>
<td>(3.4, 21.2)</td>
</tr>
<tr>
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<td>(4.3,</td>
<td>(-1.7,</td>
<td>(10.8,</td>
<td>(-3.5,</td>
<td>(-4.6,</td>
<td>(-7.6,</td>
<td>(-2.4,</td>
<td>(2.6,</td>
<td>(0.0,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14.0)</td>
<td>16.4)</td>
<td>26.2)</td>
<td>20.0)</td>
<td>21.7)</td>
<td>17.8)</td>
<td>22.8)</td>
<td>(11.9)</td>
<td></td>
<td></td>
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</tbody>
</table>

**Difference = limited – not limited**
Figure 1: Probability of being classed as limited or not limited by the GALI against other measures of disability and function

a) ADL score

b) IADL score

c) Maximum grip strength

d) Walking speed (age 75+ only)
Figure 2: Comparison of the odds of being limited by the GALI and other measures of disability and function, by country
(p-values reflect a test for heterogeneity between countries)

a) One or more ADLs compared to none

b) One or more IADLs compared to none
c) Maximum grip strength, lower tertile compared to upper two tertiles

Differences in odds ratio of being limited, by maximum grip strength:

- Greece
- Austria
- Sweden
- Germany
- Netherlands
- France
- Switzerland
- Spain
- Belgium
- Italy
- Denmark
- Combined

\[ p = 0.077 \]

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d) Walking speed of \( \leq 0.4 \text{m/sec} \) compared to \( >0.4 \text{m/sec} \) (age 75+ only)

Differences in odds ratio of being limited, by walking speed:

- Italy
- Austria
- Denmark
- Greece
- Spain
- Sweden
- Netherlands
- Belgium
- Germany
- France
- Switzerland
- Combined

\[ p = 0.524 \]
Appendix 1: Functioning and disability measures

<table>
<thead>
<tr>
<th>Measure</th>
<th>SHARE</th>
<th>Categories</th>
<th>Process</th>
</tr>
</thead>
</table>
| Global Activity Limitation Index (GALI)      | For the past six months at least, to what extent have you been limited because of a health problem in activities people usually do? | SHARE: 1. Severely limited  
2. Limited, but not severely  
3. Not limited | This variable was aggregated resulting in two categories: (0) not limited & (1) limited. |
| Activities of Daily Living (ADL)             | Please tell me if you have any difficulty with these because of a physical, mental, emotional or memory problem. | 1. Dressing, including putting on shoes and socks  
2. Walking across a room  
3. Bathing or showering  
4. Eating, such as cutting up your food  
5. Getting in or out of bed  
6. Using the toilet, including getting up or down | If they had problems with at least one of the activities, then they were classified as having restrictions. |
| Instrumental activities of daily living (IADL) | Please tell me if you have any difficulty with these because of a physical, mental, emotional or memory problem. | 7. Using a map to get around in a strange place  
8. Preparing a hot meal  
9. Shopping for groceries  
10. Making telephone calls  
11. Taking medications  
12. Doing work around the house or garden  
13. Managing money, e.g. paying bills & keeping track of expenses | If they had problems with at least one of the activities, then they were classified as having restrictions. |