Clinical multimorbidity and physical function in older adults: a record and health status linkage study in general practice

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Background. Multiple chronic conditions occurring in the same individual are associated with adverse health outcomes. In family practice, individuals are seen who, over time, may experience many different symptoms, illnesses and chronic diseases. Measures for defining multimorbidity, which incorporate the diverse range of health problems seen in population-based family practice, remain to be developed. We have investigated whether routinely collected consultation data could be used as the basis for a simple classification of multimorbidity that reflects an individual’s overall health status.

Methods. Morbidity consultation data for 9439 English patients aged 50 years and over in an 18-month time period were linked to their self-reported physical health status measured by Short-Form 12 at the end point. Associations between physical function and all-cause multimorbidity counts were estimated relative to single morbidity only, and between physical function and morbidity severity (185 morbidities categorized on four ordinal scales of severity) relative to persons who had not consulted about any of the 185.

Results. In the 18-month period, 19% had consulted for a single morbidity and 23% for six or more (a high multimorbidity count). An estimated 24% of poor physical function in the family practice consulting population may be attributable to high multimorbidity. There was an increasing strength of association between poor physical function and increasing severity of multimorbidity on all four severity scales. Estimated associations (adjusted odds ratios) of the most severe morbidity categories with poor physical function were, for each of the four scales, respectively, 5.6 for chronicity [95% confidence interval (CI) 4.4–7.1], 7.0 for time course (4.5–10.6) and 3.6 for health care use (2.0–6.6) and for patient impact (6.7; 5.2–8.8).

Conclusions. Multimorbidity defined by using routinely collected family practice consultation data and classified by count and by severity was associated with poorer physical function. This approach offers the potential for systematic use of routine records to classify multimorbidity and to identify groups with high likelihood of poor physical status for needs assessment and targeted intervention.

Keywords. Ageing, comorbidity, consultation, general practice, health status indicators.

Introduction

The study of two or more morbidities which occur together in individuals is defined as multimorbidity.1 In an ageing European population,2 multimorbidity and its consequences3 are becoming an increasingly important issue for public health and policy makers,4 as well as for clinicians and their patients.5 Current approaches to defining multimorbidity have been varied and inconsistent.6 Some studies have proposed specific tools to measure multimorbidity based on a selected number of chronic conditions7–9 or counts of the number of different conditions,10,11 but problems exist with both approaches. First, they have often been designed for use in secondary care and ignore the variety and range of morbidities seen in general practice.
Second, while overall counts are a useful measure of multimorbidity, they do not take into account the nature of the individual morbidities contributing to the counts, such as their relative severity or their shared clinical characteristics. 12 Third, research definitions of multimorbidity may not be easily applicable to the clinical setting where health care is delivered.13,14

In primary care, where multimorbidity is the rule rather than the exception,6,10 GPs by definition may deal with many different morbidities presented by the same individual. As each encounter contributing to multimorbidity is routinely recorded during consultations, often on computerized systems, so a catalogue of health states emerges through which an individual passes over time. Such health events might be linked to each other,15 because they represent overlapping syndromes16 or are a result of shared causes or mechanisms, and their combinations might help to explain different patterns in health course or progression.

Studies of multimorbidity in primary care, based on a limited number of empirically selected chronic conditions, have shown that it is negatively associated with overall health, and a specific measure of morbidity ‘burden’ from the US has shown that it is associated with increased referral to secondary care and increased health care costs.17–19 Existing measures of multimorbidity do not cover the range of morbidity that is seen in population-based general practice, do not incorporate severity of the individual morbidities in relation to health status nor have they been developed to be acceptable or useful to clinicians providing actual care. We have developed a classification of morbidity severity20 for application to a large proportion of morbidity as seen and routinely coded in everyday family practice in the UK. In this paper, our objective was to apply two scales of multimorbidity, one based on simple morbidity counts and the other on the severity classification, to a database of consultations in order to (i) describe the distribution of multimorbidity in family practice; and (ii) to investigate whether identifying multimorbidity in this way has the potential for practical application in practice as a marker of general health status.

Methods

Design and setting

The design was a cross-sectional study, which links general practice consultation data for an 18-month period to health survey data. The study was carried out with GPs and practices drawn from six of the 12 North Staffordshire General Practice Research Network (NSGPRN) practices and all phases had Local Research Ethics Committee approval.

Population surveys

The registered populations of six general practices aged 50 years and over from the NSGPRN formed the sampling frame for the study as they had also participated in health surveys of their registered practice populations. GPs (n = 34) within these practices actively participate in training and feedback on the quality of their recording of all patient consultations.21 The older adults sampled for the current study had previously participated in postal general health surveys related to two different studies of pain and function (KNEST22 and NorSTOP23) described elsewhere. Responders to the surveys had been asked for consent to review their medical records and patients who consented formed the sampling frame for the study described here. The target population for the surveys had been 19 742 and there were 14 670 (73%) responders, of whom 11 232 (56%) gave consent to review of their general practice records. Morbidity data for these 11 232 patients for an 18-month period were then linked to survey data obtained at the end of this period, which included self-reported physical function status based on the Short-Form (SF) questionnaire. All consultation data, stripped of personal identifiers, were downloaded for the study time period and postal codes based on patients’ residential addresses were used to allocate a small area deprivation code to each individual (Townsend score) based on data derived from the 2001 National Census. This score uses data on housing quality, car ownership and number of people in the household to produce a composite score of relative deprivation.24 Different versions of the SF questionnaires had been used to measure physical function (SF-36 in KNEST and SF-12 in NorStop), but all items in the SF-12 are found in the SF-36, and so these 12 items were summarized into an overall physical function score (PCS—Physical Component Score). These questionnaires are widely used and well validated generic instruments for measuring health status.25,26 The SF Health Outcomes Scoring Software was also used to impute any missing data to obtain the most complete set of summary scores, and 96.5% of the study sample had a PCS.27

Consulting morbidity data

GPs in the study practices used the Read system28 to code all morbidity encounters in actual consultations. Morbidity data (i.e. symptoms and diseases) in this system are grouped under 19 main Read chapters, each with four numbered hierarchical levels providing progressively finer diagnostic detail. We used morbidity data collated at the third hierarchical level or above for the purposes of this study, and here relate to at least one consultation for a given morbidity category in the 18-month study period (repeat consultations for the same morbidity were not included).

Measures of multimorbidity

The first measure of multimorbidity was based on simple counts. All-cause morbidity counts were categorized...
into consultation during the study period for a single morbidity only, two or three consultations (low count), four or five (medium) and six or more morbidities (high). Consulters for a single morbidity only formed the reference group. The simple count approach incorporates the whole consulting population and anyone who had not consulted at all in the study period was excluded from this analysis.

The second measure of multimorbidity was based on combinations of 185 selected morbidities classified by severity. These morbidities had previously been classified by GPs on four separate ordinal scales of severity (chronicity, time course, health care use and patient impact on activities of daily living), using a system developed by consensus and validation studies.20,29 The severity categories for each scale are ordered as follows: (i) chronicity—acute, acute-on-chronic, chronic and life-threatening; (ii) time course—one-off, recurrent, permanent and progressive; (iii) health care use—low, medium and high; and (iv) patient impact—low, medium and high.

From these categories, we constructed a scale of multimorbidity ranked by the severity of the contributing morbidities. Since different individuals might consult in an 18-month period about morbidities from any or all of the severity categories on the four different scales, each scale was used separately to classify multimorbidity in individuals in the study population into (i) not classifiable by severity i.e. did not consult for a morbidity classified on this scale; (ii) a single severity category; or (iii) combinations of severity categories (Figure 1). Because of small numbers, the life-threatening category was excluded and the high health care use category was treated as a single group. Patients included in this classification had consulted for at least one of the 185 classified morbidities and could be classified on at least one of the scales. Consulters for all other morbidity formed the reference group for this multimorbidity analysis (‘undefined’ by severity) and the same reference group was used for all comparisons involving the four severity scales. The strengths of this more stringent approach in contrast to the

<table>
<thead>
<tr>
<th>Severity scales</th>
<th>Categorisation</th>
<th>Ordinal categorisation of severity</th>
<th>Hypotheses</th>
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<tbody>
<tr>
<td>Chronicity</td>
<td>Single</td>
<td>Acute (A)</td>
<td>Poorer physical function</td>
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<tr>
<td></td>
<td>Single</td>
<td>Acute-on-chronic (AC)</td>
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<td></td>
<td>Single</td>
<td>Chronic (CH)</td>
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<td>Dual multimorbidity</td>
<td>A + AC</td>
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<td>Dual multimorbidity</td>
<td>A + CH</td>
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<td>Dual multimorbidity</td>
<td>AC + CH</td>
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<td>Triple multimorbidity</td>
<td>A + AC + CH</td>
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<tr>
<td>Time course</td>
<td>Single</td>
<td>One-off (OF)</td>
<td>Poorer physical function</td>
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<td>Single</td>
<td>Recurrent (RC)</td>
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<td>Single</td>
<td>Permanent (PM)</td>
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<td>Single</td>
<td>Progressive (PR)</td>
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<td>Dual multimorbidity</td>
<td>OF + RC</td>
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<td>OF + PM</td>
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<td>Dual multimorbidity</td>
<td>OF + PR</td>
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<tr>
<td>Triple multimorbidity</td>
<td>OF+ RC + PM</td>
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<tr>
<td>Triple multimorbidity</td>
<td>OF + PM + PR</td>
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<td>Quadruple multimorbidity</td>
<td>OF + RC + PM+ PR</td>
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<tr>
<th>Health care use*</th>
<th>Single</th>
<th>Low (L)</th>
<th>Poorer physical function</th>
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<tr>
<td></td>
<td>Single</td>
<td>Medium (M)</td>
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<tr>
<td></td>
<td>Single</td>
<td>High (H)</td>
<td></td>
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<tr>
<td>Dual multimorbidity</td>
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<td>Any High</td>
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<th>Patient impact</th>
<th>Single</th>
<th>Low (L)</th>
<th>Poorer physical function</th>
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<tr>
<td></td>
<td>Single</td>
<td>Medium (M)</td>
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<tr>
<td></td>
<td>Single</td>
<td>High (H)</td>
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<tr>
<td>Dual multimorbidity</td>
<td>L + M</td>
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<td>Dual multimorbidity</td>
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<td>Dual multimorbidity</td>
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<tr>
<td>Triple multimorbidity</td>
<td>L + M + H</td>
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*indicates the high health care use category treated as a single group because of small consulting numbers.
conventional approach of choosing non-consulters were as follows: (i) both cases and reference group were consulters who had the same possibility of morbidity being recorded at least once; (ii) cases and reference group were drawn from the same population; and (iii) the different morbidity scales had a common reference group. Previous socio-demographic analyses had shown that this reference group was comparable to non-consulters (relatively better physical function, younger, men and affluent) and were comparable between different general practice populations. Repeat consultations for the same morbidity or for other morbidities in the same severity category were not included.

Statistical analysis
The SF-12 physical function scores were dichotomized using the sample mean (PCS 40.7) for the survey population into ‘poor’ and ‘good’ physical function. The associations between multimorbidity and poor physical function were measured, using unconditional logistic regression to estimate odds ratios (ORs) with 95% confidence intervals (CIs), by comparing multimorbidity groups to the reference group, and adjusting for age, gender and deprivation.

Two multimorbidity analyses were performed. First, for the whole study population, the associations between multimorbidity count and physical function were assessed. Population Attributable Fractions (PAFs) were derived from the adjusted ORs. With the ‘exposure’ status based on multiple levels of multimorbidity, the formula used to calculate PAF was: \( PAFk = pk(0k - 1)/0k \), where level \( k \) is one of the multimorbid count groups, \( pk \) is fraction of the total ‘cases’ i.e. poor function attributable to exposure at level \( k \) and \( 0k \) is level-specific adjusted OR.

Second, associations between combinations of severity categories and poor physical function were estimated for each of the four morbidity severity scales separately. The trend in estimates within each scale was assessed on the basis of the null hypothesis in linear trend of association. OR estimates for the single and multimorbidity subgroups (dual, triple and quadruple multimorbidity) within each scale were then assessed for their consistency (i.e. if they varied by chance) and heterogeneity was examined both within the crude and adjusted estimates. Cochran’s \( Q \) was used to assess heterogeneity in the adjusted ORs that was statistically significant at the 5% level and \( I^2 \) statistics used to estimate the level of heterogeneity expressed as a percentage figure (0% no heterogeneity and 100% complete heterogeneity). All analyses were performed using SPSS version 11.0 for Windows.

Results
Out of the 11 232 eligible patients, 9439 (84%) had consulted their GP in the 18-month period prior to the surveys. The mean age of the consulting population was 66 years (SD 10.1), 5229 (55.4%) were female and the mean Townsend deprivation score was 0.44 (SD 0.50).

Morbidity counts
In the 18-month period, 877 morbidity categories had been used by GPs in consultations. Among consulters, 1779 (19%) had single-level morbidity and distribution of levels of multimorbidity was as follows: 3428 (36%) low, 2107 (22%) medium and 2125 (23%) high counts. Compared to those who had consulted for one morbidity only, the associations of multimorbidity count with poor physical function, adjusting for age, gender and deprivation, were as follows: low (OR 1.5; 95% CI 1.4–1.7), medium (2.7; 2.4–3.1) and high (4.4; 3.9–5.1). Of the total poor physical function in a consulting population of this age that might be attributable to multimorbidity, the estimates were 4% attributable to low counts, 20% to medium and 24% to high (Table 1).

Morbidity severity categories
Of the total consulting population, 875 (9%) had consulted for morbidities undefined by severity. The numbers who were classified on each scale were as follows: chronicity 7656 (81%), time course 7666 (81%), health care use 7323 (78%) and patient impact 7073 (75%). The distribution of single and multiple categories of severity within each scale is shown in Table 2. On all

Table 1 Associations between morbidity counts and physical function measured using SF-12

<table>
<thead>
<tr>
<th>Morbidity counts</th>
<th>n (%)</th>
<th>Physical function</th>
<th>Unadjusted OR (95% CI)</th>
<th>Adjusted OR* (95% CI)</th>
<th>PAF</th>
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<tr>
<td>n (%)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1 morbidity</td>
<td>1779 (19)</td>
<td>1174 (66.0)</td>
<td>605 (34.0)</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>2 or 3</td>
<td>3428 (36)</td>
<td>1884 (55.0)</td>
<td>1544 (45.0)</td>
<td>1.6 (1.4–1.8)</td>
<td>1.5 (1.4–1.7)</td>
</tr>
<tr>
<td>4 or 5</td>
<td>2107 (22)</td>
<td>852 (40.4)</td>
<td>1255 (59.6)</td>
<td>2.9 (2.5–3.3)</td>
<td>2.7 (2.4–3.1)</td>
</tr>
<tr>
<td>&gt;6</td>
<td>2125 (23)</td>
<td>597 (28.1)</td>
<td>1528 (71.9)</td>
<td>5.0 (4.3–5.7)</td>
<td>4.4 (3.9–5.1)</td>
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*Adjusted for age, gender and deprivation.
severity scales, there was an increasing trend of association (all scales $P < 0.001$) of severity category and poor physical function as severity increased, adjusting for age, gender and deprivation. Within the chronicity scale, these associations increased from dual acute and acute-on-chronic: adjusted OR 2.8; 95% CI 2.2–3.5) to triple multimorbidity (5.5; 4.3–7.0) ($I^2 = 84\%$, $P = 0.001$). Within the time-course scale, the adjusted estimates increased in the strength of association from dual (one-off and recurrent: 2.5; 1.7–2.8) to quadruple multimorbidity (7.0; 4.5–10.6). Within the patient impact scale, the adjusted estimates increased in the strength of association from dual (low and medium: 2.5; 2.0–3.0) to triple multimorbidity (6.7; 5.2–8.8) ($I^2 = 95\%$, $P < 0.001$). Within the health care use scale, full analysis of the different combinations was not possible, as there were few patients with high health care use morbidity. However, the association of dual low and medium multimorbidity with poor physical function (3.3; 2.8–3.9) was similar to that for high health care use morbidity (3.6; 2.0–6.6) (Table 2).

**Discussion**

We have applied two straightforward ways of classifying multimorbidity in family practice using routinely gathered consultation data—by simple counts or by scales based on the severity of contributing morbidities—and shown that multimorbidity is common and that both methods of classifying multimorbidity discriminate between individuals in terms of their health status. Multimorbidity and the severity of multimorbidity were associated with poor physical function, independent of age, gender and deprivation. The estimated proportion of poor physical function in the total consulting population of this age that might be attributed to the presence and severity of multimorbidity is substantial.
We undertook two separate approaches to defining multimorbidity: a morbidity count based on all consultation morbidities and a method based on the severity of contributing morbidities based on a more limited range of morbidities. In the first approach, counts related to all-cause morbidity. Few studies have used the range of morbidities (from non-specific symptoms to diseases) that is seen in British general practice. Previous studies, using selected counts of self-reported chronic conditions, have shown similar associations between high counts and poorer function. Our study shows the same associations of poor physical function with morbidity counts derived from the full range seen in general practice as routinely recorded on computers during consultation. In the second approach, based on measures of severity of individual morbidities, multimorbidity was classified by combinations of severity category of the individual morbidities placed in ascending order within each of four different scales. The advantage of this approach is that morbidities are allocated into ‘severity’ groupings according to a shared characteristic such as chronicity. This provides a measure of overall health status but at the same time maintains the link to individual clinical morbidities which may require specific management. The only comparable approach to our study has been developed in the US, where Starfield et al. used a global case-mix approach that incorporates morbidity burden (i.e. composite score based on the nature of different morbidities, age, gender and likely health care use). However, this measure has yet to be applied in the clinical decision-making arena, has not been linked to health status data and not been fully tested in British general practice.

Morbidities recorded in routine consultations depend on the accuracy of morbidity recording. Specific chronic disease recording is now routine in general practice, but the spectrum of morbidity seen by the practitioner not only reflects clinical and recording performance but also the different stages of illness, symptomatology and behaviours with which patients present to their GP. Other multimorbidity definitions might, for example, include repeat consultation for the same morbidity or the number of different morbidities consulted for in the same consultation, but the precision of such information might come at the cost of added complexity. Our 18-month snap-shot, however, provides a reasonable time over which the overall health status of the individual patient might be determined. Multimorbidity using clinician-classified severity categories might also differ from the clinician’s assessment of the actual morbidities presented by a patient and with patients’ own views of their illnesses. While multimorbidity scales based on severity showed positive associations with poor physical function, they might also differ from multimorbidity based on other aspects such as psychological status.

Potential practical applications
The Black report on inequalities in health previously highlighted the need for routine measures of functional status in everyday life, and one might conclude that only regular population surveys could do this. Such methods, however, are time consuming and fixed in time. We propose an alternative—namely measures based on the dynamic of routine consultations—data that can be made readily available from general practice populations. One implication for clinical practice is that, with the development of computer-assisted software, clinicians could review the patient records for a time-limited period and classify multimorbidity in the ways proposed to indicate physical health status. Clinicians could then use this as a basis for identifying health needs or monitoring health changes in the consulting population. Other indices for defining multimorbidity focusing on chronic diseases also show an association between multimorbidity and poor physical function. Our study, however, suggests that ‘non-chronic’ or limiting and lower impact morbidities may also be part of the multimorbid ‘effect’.

Current research has focused on either chronic disease and multiple chronic diseases or the notion of consultations as just a pejorative measure of frequent health-seeking behaviour. Our study offers a practical but systematic and standardized solution to defining multimorbidity incorporating the broader range (symptoms, illnesses and diseases) of health problems seen in general practice and their relative severity. Such a solution offers the potential to identify groups, especially of older people, who have higher likelihood of poor physical status, based on their individual morbidity pattern. Defining multimorbidity based on routinely collected consultation data provides opportunities for assessing need in subgroups of the registered population and supporting clinical decision making for the individual patient. Should general practice retain the entry for health care provision, then our methodology is likely to aid the practical challenges of how we deal with multimorbidity in general practice. Further work is to be undertaken at translating this research into practice.

In conclusion, our study suggests that routine morbidity consultations may provide a simple way of measuring multimorbidity in primary care population, which does not require additional information. Such measurement reflects physical health status at least and provides the potential to influence and monitor health care management of older patients. Collaborative health care approaches which tackle, for example, the complexity of severe chronic diseases may offer a model of health care for multimorbidity. GP will also manage wider and complex health states for their registered populations excluded by specific chronic disease models, and our approach offers a novel and practical way of dealing with this complexity.
Acknowledgements

We wish to thank all patients, GPs, staff at Primary Care Research Centre and the Network and survey teams. Contributors: Drs James Bashford, Gordon Carpeneter, Luan Coar, Vince Cooper, Dai Evans, Jimmy Lees and Alyson Rees of the North Staffordshire GP Consortium Group.

Declaration

Funding: Medical Research Council Training Fellowship in Health Services Research (G106/1035) to UTK; North Staffordshire Primary Care Research Consortium, MRC Programme grant (G9900220) and NHS R&D.

Ethical approval: In England, North Staffordshire Local Research Ethics Committees approval was given (Project 1101, 862, 02/75).

Conflicts of interest: None.

References


3 Starfield B. Local Research Ethics Committees approval was given NHS R&D. (Project 1101, 862, 02/75).


34 Wensing M, Vingerhoets E, Grol R. Functional status, health problems and comorbidity in primary care patients with multimorbidities, and their needs have to be addressed. J Clin Epidemiol 2001; 54: 78–86.


