Impact of deprivation on occurrence, outcomes and health care costs of people with multiple morbidity

Judith Charlton[1], Caroline Rudisill[2], Nawaraj Bhattarai[3] and Martin Gulliford[4]

Abstract

Objective: This study aimed to estimate the impact of deprivation on the occurrence, health outcomes and health care costs of people with multiple morbidity in England.

Methods: Cohort study in the UK Clinical Practice Research Datalink, using deprivation quintile (IMD2010) at individual postcode level. Incidence and mortality from diabetes mellitus, coronary heart disease, stroke and colorectal cancer, and prevalence of depression, were used to define multidisease states. Costs of health care use were estimated for each state from a two-part model.

Results: Data were analysed for 141,535 men and 141,352 women aged $\geq$30 years, with 33,862 disease incidence events, and 13,933 deaths. Among incidences of single conditions, 22% were in the most deprived quintile and 19% in the least deprived; dual conditions, most deprived 26%, least deprived 16% and triple conditions, most deprived 29%, least deprived 14%. Deaths in participants without disease were distributed most deprived 22%, least deprived 19%; in participants with single conditions, most deprived 24%, least deprived 18%; dual conditions, most deprived 27%, least deprived 15%, and triple conditions, most deprived 33%, least deprived 17%. The relative rate of depression in most deprived participants with triple conditions, compared with least deprived and no disease, was 2.48 (1.74 to 3.54). Costs of health care use were associated with increasing deprivation and level of morbidity.

Conclusions: The higher incidence of disease, associated with deprivation, channels deprived populations into categories of multiple morbidity with a greater prevalence of depression, higher mortality and higher costs. This has implications for the way that resources are allocated in England's National Health Service.

Keywords

comorbidity, coronary heart disease, depression, deprivation, diabetes, equity, health care costs, health care utilization, primary care, socioeconomic inequalities, stroke

Introduction

Socioeconomic inequalities in health status are observed in all countries.[1] In Europe, lower socioeconomic position and measures of social and material deprivation are associated with greater morbidity and mortality.[2] This includes the more frequent occurrence[3] and higher mortality[4,5] from chronic conditions, as well as a higher frequency of mental health problems including depression.[6–8] Deprived areas also show greater use of primary care and hospital services.[9] This has been recognized in the methods used to allocate financial resources for health care in the UK.[10] In England, these currently include a weighting for disability-free life expectancy (DFLE), which is generally worse in more deprived areas, as well as age, sex and historical patterns of health care use.[11]

[1]Research Associate, Department of Primary Care and Public Health Sciences, King's College London, London, UK
[2]Lecturer, Department of Social Policy, London School of Economics and Political Science, London, UK
[3]Research Associate, Department of Primary Care and Public Health Sciences, King's College London, London, UK
[4]Professor of Public Health, Department of Primary Care and Public Health Sciences, King's College London, London, UK

Corresponding author:
Martin Gulliford, Division of Health and Social Care Research, King's College London, 7th Floor Capital House, 42 Weston Street, London, SE1 3QD, UK.
Email: martin.gulliford@kcl.ac.uk

There is a growing recognition that people with multiple long-term conditions are some of the heaviest users of health services and account for the highest health care costs.[12] Multiple morbidity is more frequent in deprived populations.[13] However, little is known about the extent of socioeconomic inequalities among patient populations with multiple morbidity. Is deprivation associated with worse outcomes and higher costs in patients with multiple morbidity? Alternatively, are outcomes and costs determined by the extent of physical morbidity, with deprivation becoming less relevant after the onset of clinical disease? These questions are important in allocating resources, and commissioning services for the important group of people with multiple long-term conditions.

This paper aims to determine how social and material deprivation are associated with health outcomes and health care use in patients with multiple morbidity. The research is part of a larger project to evaluate the cost-effectiveness of lifestyle disease prevention interventions in primary care. Results for the association of depression with multiple morbidity have been reported elsewhere.[14]

Methods

Sample selection

The Clinical Practice Research Datalink (CPRD) contains records for about three million patients from approximately 600 family practices in the UK. The recording of clinical diagnoses in CPRD has high predictive value.[15] For this research, the sample was restricted to the 491 CPRD general practices in England that participate in the data linkage scheme that facilitates provision of data for deprivation quintile (Indices of Multiple Deprivation 2010[16]) by participant postcode of residence. A sample of 300,006 participants over the age of 30 was sampled from participants registered with eligible practices contributing to the CPRD from 1 January 2005 to 30 April 2012. Deprivation scores were not available for 17,067 participants in the sample, who were excluded from the study. Participant records were analysed from later of the date of their registration at the practice or the date on which the practice began to provide research standard data into CPRD. Followup ended when participants ended their registration at the practice, reached the age of 100, died or the date of last data collection for the practice was reached. There were 52 participants who provided less than one day's record who were excluded, leaving 282,887 participants for analysis. Participants were allocated to deprivation categories using the quintiles of the index of multiple deprivation for 2010 (IMD2010) linked at participant postcode level.

Disease states

The research included four conditions known to be associated with lifestyle risks: diabetes mellitus, coronary heart disease (CHD), stroke and colorectal cancer. The conditions were selected because of their negative association with physical activity for a wider study of the effect of lifestyle interventions on disease prevention in primary care.[17] Participants with none of the conditions remained at risk. When participants developed one or more of these conditions, their person-time was allocated to one of nine disease states including those with single morbidity (diabetes only, CHD only, stroke only, colorectal cancer only), dual morbidity (diabetes and CHD, diabetes and stroke, CHD and stroke) and triple morbidity (diabetes, CHD and stroke). As the number of colorectal cancer cases was too small to subdivide into multidisease states, data were analysed for all colorectal cancer cases together as a single morbidity state. Case definitions were based on sets of Read codes that have been reported previously.[18,19] Participants' person time in each state was further subdivided into depressed and not depressed as reported previously.[14] Prevalent depression was recorded if the participant had a diagnosis of depression in the year of interest or diagnosis of depression ever recorded and a prescription for antidepressant drugs in the year of interest. There were 40,685 participants recorded as depressed during the period 2007–2011. Data for deaths were analysed from the later of 1 January 2007 or start of each participant's record to the earlier of 31 December 2011 or the end of each participant's record.

Health care use was evaluated from participants' electronic records in CPRD for the period 2007 to 2011. Primary care sue covered consultations at the practice, emergency consultations, home visits, out-of-hours visits and telephone consultations; hospital utilization included inpatient admissions, outpatient episodes, day cases and emergency episodes. Numbers of events per person-year were calculated for each patient. Costs of health care use were estimated using unit costs values from standard reference sources.[20] Drug prescriptions were enumerated and prescription costs were calculated by linking the Multilex drug code for each prescription to the drug cost obtained from the First DataBank Europe (FDBE) database.[21] This provided the cost of each prescribed drug for each participant.

Statistical analysis

Person years, incident events and deaths were tabulated by deprivation quintile and number of conditions. Relative rates were estimated from a Poisson regression model adjusting for age group and sex. Predictors were

deprivation quintile and number of conditions. The interaction term between deprivation and number of conditions was found to be significant both for incidence ($P = 0.0098$) and mortality ($P = 0.0009$). Relative rates were therefore estimated for each quintile of deprivation and category of number of conditions, using the least deprived quintile and lowest category of morbidity for reference.

A two-part model was used to estimate costs in each state for each quintile of deprivation. At the first stage, a probit model was fitted in order to estimate the probability of costs being nonzero. At the second stage a general linear model (GLM), with a log link and gamma errors, was fitted adjusting for age group, sex, number of comorbidities, depression status and deprivation quintile. The model was used to predict mean costs for each category. Weighted mean values for predicted costs for each deprivation category were obtained by averaging across age groups weighted according to the age distribution of the European Standard Population.

Results

Data were analysed for 141,535 men and 141,352 women; 43% of men and 48% of women were 55 years and older; the more deprived quintiles tending to have a slightly younger age distribution. There were 266,981 participants aged 100 or younger who had no disease of interest at the start of their observation period. There were 33,862 incident events, with new diagnoses of one of the four conditions of interest including diabetes mellitus, CHD, stroke or colorectal cancer. Incident events resulted in a single condition state in 82% of instances, dual condition states in 16% and triple condition states in 2%. There were 13,933 deaths, including 53% in participants at risk with no study conditions, 35% in participants with a single study condition, 11% associated with dual conditions and 2% associated with triple conditions.

Table 1 shows the incidence of new onset of single, dual or triple condition states by deprivation quintile. Relative rates indicate the excess risk associated with the given level of deprivation and morbidity compared with healthy participants in the least deprived quintile, adjusted for age group and gender. In participants with none of the study conditions, the incidence of single conditions was associated with deprivation. The rate ratio for the most deprived quintile, compared with the least deprived, was 1.57 (95% confidence interval 1.51 to 1.63). The most deprived quintile accounted for 18% of person years at risk but 22% of incident events with single conditions. The incidence of dual conditions was also associated with deprivation. The most deprived quintile accounted for 26%, but the least deprived quintile 16%, of incidences of dual conditions. Compared with participants who had no disease and were in the least deprived quintile, the relative risk of

Table 1. Incidence of single, dual and triple morbidity by deprivation quintile. Figures are frequencies except where indicated. Data analysed from start of each participants' record.

Incidence of	Deprivation quintile	Person years at risk (%)[a]	Incidences (%)[a]	Relative rate (95% CI)[b]
Single conditions	Least deprived	2,127,313 (24)	5,310 (19)	Reference
	2	1,802,380 (20)	5,153 (19)	1.14 (1.10 to 1.19)
	3	1,904,770 (21)	5,875 (21)	1.24 (1.19 to 1.28)
	4	1,542,895 (17)	5,231 (19)	1.36 (1.31 to 1.41)
	Most deprived	1,580,294 (18)	6,189 (22)	1.57 (1.51 to 1.63)
Dual conditions	Least deprived	94,508 (19)	911 (16)	3.58 (3.33 to 3.84)
	2	94,813 (19)	993 (18)	3.91 (3.65 to 4.18)
	3	105,952 (21)	1,123 (20)	3.94 (3.70 to 4.22)
	4	94,805 (19)	1,095 (20)	4.37 (4.10 to 4.67)
	Most deprived	116,483 (23)	1,444 (26)	4.73 (4.46 to 5.02)
Triple conditions	Least deprived	5,862 (15)	78 (14)	4.76 (3.81 to 5.96)
	2	6,448 (17)	80 (15)	4.48 (3.59 to 5.58)
	3	7,842 (21)	110 (20)	5.05 (4.18 to 6.10)
	4	7,525 (20)	114 (21)	5.49 (4.56 to 6.61)
	Most deprived	10,431 (27)	156 (29)	5.51 (4.70 to 6.47)

[a]Figures are percent of total incident events across deprivation quintiles at that level of morbidity.
[b]Relative rates indicate the excess risk associated with deprivation and existing morbidity level, compared with healthy participants in the least deprived quintile for reference, adjusted for age group and gender.

disease incidence in participants with single conditions was 3.58 (3.33 to 3.84) for the least deprived quintile and 4.73 (4.46 to 5.02) for the most deprived quintile. The incidence of disease in participants with dual conditions was also associated with deprivation, with the most deprived quintile accounting for 29% of incidences and the least deprived quintile accounting for 14% of incidences. Compared with the reference category, the relative risk of triple conditions was 4.76 (3.81 to 5.96) for the least deprived quintile and 5.51 (4.70 to 6.47) for the most deprived quintile. The differential incidence of study conditions according to deprivation category contributed to a greater accumulation of person years in categories with greater morbidity and deprivation. However, relative inequalities between deprivation quintiles were smaller at higher morbidity levels, consistent with the observed interaction of incidence and deprivation.

Table 2 shows the association between deprivation and mortality at different levels of morbidity. The most deprived quintile accounted for 22% of deaths in participants with no study conditions, 24% in single conditions, 27% in dual conditions and 33% of deaths in

participants with triple conditions. As expected, mortality increased as the number of conditions increased. However, relative socioeconomic inequalities in mortality were smaller at higher levels of morbidity because person-time at risk was also unequally distributed between deprivation categories.

Table 3 shows the prevalence of depression by number of conditions and deprivation quintile. In participants with no morbidities, the prevalence of depression was strongly associated with deprivation, the prevalence being 6.4% in the least deprived quintile and 11.1% in the most deprived quintile. Depression was more frequent in participants with single, dual or triple comorbidities, as reported previously.[14] However, depression was associated with deprivation, being most prevalent in the most deprived quintile, for all single, dual and triple disease states.

Table 4 presents the results of the two-part model used to estimate participant health care costs. The probit model was used to estimate the probability of health care costs being greater than zero, while the GLM was used to estimate associations of log health care costs when these were greater than zero.

Table 2. Mortality from all causes by deprivation quintile at different levels of morbidity. Figures are frequencies except where indicated. Data analysed from the later of 1 January 2007 or start of each participant's record to the earlier of 31 December 2011 or the end of each participant's record.

Number of conditions	Deprivation quintile	Person years (%)[a]	Deaths (%)[a]	Relative rate (95% CI)[b]
None	Least deprived	582,775 (24)	1,369 (19)	Reference
	2	493,756 (20)	1,382 (19)	1.14 (1.05 to 1.22)
	3	522,321 (21)	1,580 (21)	1.22 (1.13 to 1.31)
	4	424,354 (17)	1,433 (19)	1.35 (1.25 to 1.45)
	Most deprived	436,389 (18)	1,634 (22)	1.51 (1.41 to 1.63)
Single conditions	Least deprived	56,961 (19)	867 (18)	3.34 (3.06 to 3.64)
	2	56,870 (19)	878 (18)	3.33 (3.06 to 3.63)
	3	63,550 (21)	1005 (21)	3.43 (3.16 to 3.73)
	4	56,739 (19)	927 (19)	3.69 (3.39 to 4.01)
	Most deprived	69,342 (23)	1149 (24)	3.95 (3.65 to 4.28)
Dual conditions	Least deprived	7090 (16)	232 (15)	5.98 (5.19 to 6.87)
	2	7764 (17)	231 (15)	5.52 (4.80 to 6.36)
	3	9395 (21)	328 (22)	6.58 (5.83 to 7.43)
	4	9028 (20)	310 (21)	6.62 (5.85 to 7.50)
	Most deprived	12,460 (27)	398 (27)	6.93 (6.20 to 7.76)
Triple conditions	Least deprived	441 (12)	35 (17)	13.50 (9.65 to 18.90)
	2	653 (18)	32 (15)	9.22 (6.49 to 13.09)
	3	688 (19)	41 (20)	8.86 (6.49 to 12.09)
	4	647 (18)	32 (15)	9.13 (6.43 to 12.97)
	Most deprived	1102 (31)	70 (33)	12.21 (9.60 to 15.53)

[a]Figures are percent of total deaths across deprivation quintiles at that level of morbidity.
[b]Relative rates indicate the excess risk associated with deprivation and existing morbidity level, compared with healthy participants in the least deprived quintile for reference, adjusted for age group and gender.

Table 3. Depression prevalence by deprivation quintile at different levels of morbidity. Figures are frequencies except where indicated. Data for 2007 to 2011.

Number of conditions	Deprivation quintile	Person years	Depressed (%)[a]	Relative rate (95% CI)[b]
None	Least deprived	59,268	3803 (6.4)	Reference
	2	50,644	3683 (7.3)	1.14 (1.09 to 1.19)
	3	54,857	4225 (7.7)	1.21 (1.15 to 1.26)
	4	47,065	4202 (8.9)	1.41 (1.35 to 1.47)
	Most deprived	51,566	5741 (11.1)	1.76 (1.69 to 1.83)
Single Conditions	Least deprived	8531	639 (7.5)	1.34 (1.23 to 1.46)
	2	8365	754 (9.0)	1.62 (1.49 to 1.75)
	3	9588	910 (9.5)	1.70 (1.58 to 1.82)
	4	8660	922 (10.6)	1.86 (1.73 to 2.00)
	Most deprived	10,643	1459 (13.7)	2.33 (2.19 to 2.48)
Dual conditions	Least deprived	1324	88 (6.7)	1.34 (1.08 to 1.65)
	2	1411	152 (10.8)	2.09 (1.78 to 1.46)
	3	1660	183 (11.0)	2.15 (1.85 to 2.49)
	4	1607	195 (12.1)	2.30 (1.99 to 2.66)
	Most deprived	2190	310 (14.2)	2.56 (2.28 to 2.88)
Triple conditions	Least deprived	106	9 (8.3)	1.86 (0.96 to 3.60)
	2	126	13 (10.4)	1.94 (1.13 to 3.34)
	3	153	12 (8.1)	1.61 (0.92 to 2.82)
	4	138	24 (17.4)	3.29 (2.20 to 4.92)
	Most deprived	230	31 (13.5)	2.48 (1.74 to 3.54)

[a]Bracketed percent represents the prevalence of depression in each category.
[b]Relative rates indicate the excess risk associated with deprivation and existing morbidity level, compared with healthy participants in the least deprived quintile for reference, adjusted for age group and gender.

The figures presented are regression coefficients and 95% confidence intervals. The interaction between depression and IMD quintile was significant both in the probit model ($P = 0.0025$) and the GLM model ($P = 0.0008$). However, the interaction between number of conditions and IMD quintile was not significant in the probit model ($P = 0.844$) and was of borderline significance in the GLM model ($P = 0.0487$). Thus, there was strong evidence that the association of depression with health care costs varied with IMD quintile, but this was not so for number of conditions. A model without interactions is presented as the quantitative impact of interactions was modest.

Table 5 presents the mean health care costs by deprivation, for different levels of morbidity and depression status. Figures represent the weighted mean across age groups, using the European Standard Population for weighting. Health care costs increased, as expected, as morbidity increased, and were always considerably higher when depression was present. In participants with none of the study conditions, health care costs were associated with deprivation, being 24% higher in men and 25% higher in women in the most deprived quintile than in the least deprived. When depression was present, health care costs were 29% higher in men and 28% higher in women in the most deprived quintile compared with the least deprived. A similar pattern of association of deprivation with health care costs was observed in participants with single and dual comorbidities. In participants with three comorbidities, there was no consistent evidence that health care costs were associated with deprivation. Associations with deprivation tended to be more consistent in women than in men.

Discussion

What this paper shows

This epidemiological study evaluated the impact of deprivation on incidence, mortality, prevalence of depression and health care costs associated with multiple morbidity in a large population. The results show that deprivation is overall strongly associated with the incidence of the study conditions. Participants in higher categories of deprivation are differentially filtered into higher categories of multiple morbidity. Therefore, people living in deprived circumstances represent a much higher proportion of the population with multiple morbidity than of those with single or no morbidity.

Table 4. Two-part regression model for patient health care costs. Figures are coefficients (95% confidence intervals). Data for 2007 to 2011.

	Probit model			GLM Model		
	Coefficient	95% confidence interval	*P* value	Coefficient	95% confidence interval	*P* value
Age-group (years)						
30–44	Reference			Reference		
45–54	0.12	(0.11 to 0.14)	0.000	0.14	(0.12 to 0.16)	0.000
55–64	0.35	(0.33 to 0.37)	0.000	0.36	(0.34 to 0.38)	0.000
65–74	0.73	(0.71 to 0.76)	0.000	0.60	(0.58 to 0.62)	0.000
75–84	0.83	(0.80 to 0.86)	0.000	0.81	(0.79 to 0.83)	0.000
≥85	0.64	(0.60 to 0.68)	0.000	1.04	(1.02 to 1.07)	0.000
Gender (Female)	0.51	(0.49 to 0.52)	0.000	0.08	(0.07 to 0.10)	0.000
Depression (Depressed)	1.41	(1.35 to 1.46)	0.000	0.64	(0.63 to 0.66)	0.000
Number of comorbidities						
None	Reference					
One morbidity	1.15	(1.12 to 1.19)	0.000	0.69	(0.67 to 0.71)	0.000
Two morbidities	1.18	(1.09 to 1.27)	0.000	0.93	(0.90 to 0.95)	0.000
Three morbidities	1.29	(0.94 to 1.63)	0.000	1.05	(1.00 to 1.11)	0.000
Deprivation quintile						
Least deprived	Reference					
Quintile 2	0.01	(−0.01 to 0.03)	0.506	0.05	(0.03 to 0.08)	0.000
Quintile 3	−0.01	(−0.03 to 0.01)	0.370	0.07	(0.05 to 0.09)	0.000
Quintile 4	−0.03	(−0.05 to −0.01)	0.008	0.11	(0.09 to 0.13)	0.000
Most deprived	−0.03	(−0.05 to −0.01)	0.004	0.21	(0.20 to 0.23)	0.000
Constant	0.33	(0.32 to 0.35)	0.000	5.68	(5.67 to 5.70)	0.000

GLM: general linear model.

Table 5. Predicted mean costs of health care utilization by deprivation quintile, comorbidity and depression for men and women. Figures are UK£ per year, weighted mean of age-specific means. Data for 2007 to 2011.

	No morbidity		One comorbidity		Two comorbidities		Three comorbidities	
	Not depressed	Depressed	Not depressed	Depressed	Not depressed	Depressed	Not depressed	Depressed
Men								
Least deprived	286	723	744	1475	947	1875	1247	2707
2	302	763	785	1556	1000	2258	1316	2561
3	305	775	797	1581	1014	2009	1336	2602
4	316	808	830	1650	1057	2096	1209	2714
Most deprived	349	893	917	1824	1168	2318	1539	2629
P value[a]	0.017	0.013	0.013	0.012	0.013	0.251	0.295	0.991
Women								
Least deprived	367	800	833	1605	1059	2040	1865	2944
2	388	844	879	1693	1117	2152	1676	2785
3	393	858	892	1720	1134	2186	1477	3254
4	408	894	930	1795	1183	2281	1540	2952
Most deprived	451	989	1028	1985	1308	2522	1488	2860
P value[a]	0.015	0.013	0.013	0.012	0.013	0.012	0.061	0.999

[a]Test for trend across index of multiple deprivation (IMD) quintiles.

In the same way, deaths in people with multiple morbidity are more highly concentrated into the most deprived quintile. Paradoxically, relative inequalities in incidence and mortality tend to be smaller as the level of morbidity increases, because the denominator of people at risk, as well as the numerator of incident events or mortality, is influenced by deprivation category. However, depression is more frequent in the most deprived quintile at each level of multiple morbidity. Per capita health care costs are determined by the extent of physical morbidity and, while multiple morbidity is more frequent in deprived populations, per capita costs tend not to be associated with deprivation in patients with multiple morbidity.

Strengths and limitations of this paper

The paper was based on analysis of a very large sample of nearly 300,000 participants drawn from primary care registers in the UK. The CPRD population has been shown to be representative of the UK population in terms of age, sex and deprivation. Clinical diagnoses recorded in CPRD have been shown to have very high predictive values.[15] However, we acknowledge that coding in CPRD is often imprecise[18,19] and each of the conditions identified may encompass a range of presentations and degrees of severity. Problems of misclassification might be greater in deprived areas. We also know that the gap between estimated and reported prevalence for conditions such as coronary heart disease, stroke or hypertension is greater for general practices in areas of higher deprivation.[22] Results are thus likely to underestimate the impact of deprivation on the incidence of single morbidities and related health care costs.

The study only included four types of physical morbidity and one mental health condition, depression. We acknowledge that there are other forms of morbidity including musculoskeletal, respiratory and gastrointestinal disease, as well as other mental disorders, which were not included in these analyses. Future studies should include a wider range of morbidities. There were necessarily smaller numbers of participants with multiple comorbidities and there was more limited power to detect associations with deprivation in participants with three comorbidities. Socioeconomic status was evaluated in terms of social and material deprivation at the small area level. The use of individual-level socioeconomic measures would be preferable. We also recognize that different socioeconomic indicators, such as educational attainment, income and wealth, may show varying patterns of association with health measures, especially in older adults in whom multiple morbidity is frequent.[23] We analysed deprivation in quintiles, as the number of participants with higher levels of multiple morbidity was low, but greater effects might have been observed at more extreme categories of deprivation.

Depression has been defined in different ways even in the context of CPRD research studies. The present definition was the same as used in our previous paper,[14] but the prevalence of depression was somewhat lower here, in data for a later period, in England, and in a more highly selected group of family practices. We caution that it may be difficult to obtain precise estimates for mental disorders from clinical diagnoses and prescriptions in electronic health records.

What other research shows

The association of deprivation with greater morbidity and mortality and higher health care costs is well recognized. Our previous analyses reported on the association of depression with multiple morbidity but did not evaluate associations with deprivation.[14] Brilleman et al.[24] reported on comorbidity and primary care costs and found that while most comorbidities, especially depression, were associated with increased costs, some comorbidities might be associated with more limited costs if items of care were overlapping or if the condition was associated with less intensive intervention. Fewer studies have evaluated the importance of deprivation for people with established morbidity, and little attention has been paid to the impact of deprivation on multiple morbidity, especially in relation to health care costs. Wong et al.[25] reported a cross-sectional analysis of an elderly sample in Hong Kong. Their results confirmed an association between depression and both number of comorbidities and socioeconomic status. Droomers et al.[26] found an association between lower socioeconomic status, use of health care services and comorbidities over 9 years in a Dutch sample of respondents 25 years and older. Barnett et al.[13] investigated incidence of one or more morbidities in a crosssectional study of people registered at 314 general practices in Scotland to find that those of lower socioeconomic status were more likely to have multiple morbidities than those who were not and that socioeconomic status was particularly related to mental health disorders. Payne et al.[27] observed an association of unplanned hospital utilization with multiple morbidity, depression and depression, consistent with the findings of the present study.

Policy implications

The findings of this study have implications both for resource allocation and for intervention strategies to attenuate morbidity differences related to socioeconomic status. In England, a weighted capitation

formula is used to allocate health care resources to authorities in local areas. In addition to weighting for age and gender and utilization-based estimates of need, the formula currently includes an additional weighting for DFLE.[11] DFLE is strongly associated with deprivation[28] and is included in the formula as a potential measure of unmet need for health care. The present results provide empirical support for this approach, but also provide evidence of greater costs for health service users in deprived areas, through generally greater levels of multiple morbidity, as well as more frequent depression as an important driver of costs.[24] Recent changes in the English NHS may require a reexamination of resource allocation formulae.[29] While these results do not point to specific lessons for how need should be calculated, they highlight the importance of considering the cost implications of deprivation and multiple morbidity and the importance of funding interventions that might prevent these costs. Predictive risk modelling would be likely to pick up these drivers of resource use to inform better allocation decisions.[30] Reducing the impact of deprivation-associated multiple morbidity on health and health care costs requires action related to treatment decisions, as well as resource allocation.

In considering the tasks of the new local commissioners of services, a number of studies have demonstrated that employing effective treatments not only helps patients across the socioeconomic spectrum but can also reduce socioeconomic inequalities in outcomes. For example, increased uptake of specific medical technologies to prevent heart failure was found to reduce absolute differences in heart failure rates by socioeconomic status among patients in the English General Practice Research Database (GPRD) from 1999 to 2007.[31]

Conclusions

This study provides new evidence of the impact of deprivation on the occurrence of multiple morbidity. People living in social and material deprivation are channelled, through the higher incidence of disease, into higher categories of multiple morbidity. People living in deprived circumstances live longer with multiple morbidity, and more of those who die have multiple morbidity. Depression is associated with morbidity, but deprivation is associated with a higher prevalence of depression at any level of morbidity. In multiple morbidity, the costs of health care use tend to be more strongly determined by the level of morbidity than the deprivation level. The data emphasize the importance of disease prevention and health promotion to reduce inequalities in health. The findings demonstrate the impact of deprivation on needs for services for patients with multiple morbidity. These needs include not only disease management pathways but also needs for mental health care, social care for attendant disabilities and end-of-life care.

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