Depression and socio-economic risk factors:
7-year longitudinal population study

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Background Low socio-economic status is associated with a higher prevalence of depression, but it is not yet known whether change in socio-economic status leads to a change in rates of depression.

Aims To assess whether longitudinal change in socio-economic factors affects change of depression level.

Method In a prospective cohort study using the annual Belgian Household Panel Survey (1992–1999), depression was assessed using the Global Depression Scale. Socio-economic factors were assessed with regard to material standard of living, education, employment status and social relationships.

Results A lowering in material standard of living between annual waves was associated with increases in depressive symptoms and caseness of major depression. Life circumstances also influenced depression. Ceasing to cohabit with a partner increased depressive symptoms and caseness, and improvement in circumstances reduced them; the negative effects were stronger than the positive ones.

Conclusions The study showed a clear relationship between worsening socio-economic circumstances and depression.

Declaration of interest None.

Low socio-economic status, particularly when assessed by indices of material standard of living, is consistently associated with a higher prevalence of depression in cross-sectional studies (Lorant *et al*, 2003). However, such studies cannot distinguish between associations due to selection (reverse causality) or confounding (Goldberg, 2001) and those that are truly causal. A decade of research has suggested that causation has the edge over selection (Dohrenwend *et al*, 1992; Ritsher *et al*, 2001). A recent meta-analysis found that the effect of low socio-economic status on depression is greater for episode maintenance than for onset (Lorant *et al*, 2003). Since most longitudinal studies have been of short duration and have characterised socio-economic status using relatively time-invariant variables such as education or occupational social class (Lynch *et al*, 1997; Weich & Lewis, 1998*a*), it is not yet known how changes in socio-economic status affect changes in the risk of depression over time. If socio-economic status influences depression through time-invariant mechanisms (such as personality traits), then short-term improvement of socio-economic status would not have any influence on socio-economic inequalities in depression. We thus set out to assess how changes in socio-economic status affect changes in the symptoms and caseness of depression in the general population over a 7-year period.

METHOD

Participants

The study used data from the Belgian Households Panel Survey (Jacobs & Marynissen, 1993), an annual face-to-face survey of a cohort of individuals aged 16 years and over living in private households. Participants were recruited in 1992 using stratified multistage area probability sampling representative of Belgium's three administrative regions (Flanders, Wallonia and Brussels). Details of the cohort design are set out elsewhere (Bracke, 1998). Although the participation rate at baseline was 49.7%, an external validation has shown that the cohort was representative of the Belgian population (Jacobs & Marynissen, 1993). Since the third wave, the Belgian panel has been included in the European Household Community Panel. Cross-national comparison of income, poverty and social exclusion variables showed that Belgian results are in line with the average of the European Union (Eurostat, 2001).

The first eight waves of the survey (1992–1999) were used. In the first wave 8741 individuals were interviewed. Because loss to follow-up (at an annual rate of 13%) reduced the sample size over time, an average of 453 new participants were added each year. New participants came from two sources: individuals joining an already participating household, and new households being selected using the same sampling framework. The final sample comprised 11 909 individuals who each participated in an average of 4.6 waves, providing 54 941 observations.

Measures

Depression

Depression was assessed using a modified version of the global depression scale of the Health and Daily Living Form (HDL; Moos *et al*, 1990). This self-administered symptom checklist was developed to evaluate the presence and severity of symptoms of major depression, according to Research Diagnostic Criteria (Spitzer *et al*, 1978). The psychometric properties and scoring method of the HDL scale have been described elsewhere (Moos *et al*, 1990). The HDL global depression scale comprises 18 items, has a good internal reliability (Cronbach's $\alpha=0.94$) and was highly correlated ($r=0.88$) with the Beck Depression Inventory in a validation study (Swindle *et al*, 1998). Following Bracke (2000), caseness of major depression was defined as the presence of depressed mood plus five additional symptoms.

Socio-economic status

Following James S. Coleman's rational choice social theory, Oakes & Rossi (2003) defined socio-economic status in relation to three types of resources: material

standard of living, skills and social relationships. Material standard of living was measured by income, deprivation, poverty, and subjective financial strain. We computed the monthly net equivalent household income using the Organisation for Economic Cooperation and Development (1982) equivalence scale. The index of deprivation elaborated by Weich & Lewis (1998a) was calculated; this index allocates one point for each of the following:

(a) annual household income in the first quintile;

(b) no access to a car;

(c) no saving from income;

(d) fewer than four domestic household appliances from a list of ten;

(e) living in rented accommodation;

(f) living in a home with two or more major structural problems (such as damp, infestation or dry rot).

Poverty was defined as living in a household with an income less than half of the population median income. Subjective financial strain was assessed by a question asking, 'How well are you managing these days with your current income?' Scores ranged from 0 (very well) to 5 (with great difficulty).

Skills were assessed by educational status and unemployment: education was quantified using the number of years of education and unemployment was coded as 1 if the individual was unemployed (and available for work) for more than 6 months in the past year and as 0 otherwise.

Social relationships were assessed by civic participation and living arrangements. Civic participation was defined as participation in voluntary associations (Harpham et al, 2002), scored as 1 for those who were currently members of at least one social organisation (such as a local community, cultural or sports organisation) or who were volunteer workers and as 0 otherwise. Living arrangements were coded as 1 for individuals living with a partner, including a spouse, and as 0 otherwise.

Questions concerning socio-economic status referred to the preceding year, whereas depression items referred to the 3 months prior to interview.

Statistical analyses

In order to assess the extent of changes in both socio-economic status and depression, we computed a longitudinal variance ratio (the longitudinal variance divided by the total variance). These ratios range in principle from 0 to 1, and reflect the relative magnitude of longitudinal (within-individual) variance to cross-sectional (between-individual) variance. A ratio of 1 would indicate no between-individual variance and that all variance in a given variable over the course of the study was due to longitudinal (within-individual) change. A ratio of 0 would imply that there was no change over time and that all variance was cross-sectional (between individuals).

To account for clustering at the individual level, a standard fixed-effect model was used and is estimated by taking the difference between each observation at time t and its average 7-year value for both socio-economic and depression variables (Hsiao, 1986). As a consequence the analysis focused on longitudinal changes in socio-economic factors and in depression. The choice of a fixed-effect model, as against a random-effects model, is supported by the Hausman test ($m=366.1$, $P<0.0001$) (Hsiao, 1986). For analysis concerning caseness of major depression, we used a conditional logistic regression, which is the equivalent of a fixed-effect model for a binary response. Because women are more vulnerable to low socio-economic status than men (Lorant et al, 2003), we compared results according to gender by a t-test.

In a longitudinal model, loss to follow-up could result in bias if poor people and those with depression are more likely to be lost to follow-up than those who are well off and not depressed. To allow for a correction of this selection bias, an inverse Mill's ratio was estimated by a probit regression and then included in the model as an additional explanatory variable. We used the Heckman selection model adapted by Wooldridge for panel-data fixed-effect models (Wooldridge, 1995).

Because the effect of income on depression has been shown to be greater among those on the lowest incomes, we stratified the analysis by income groups and tested for statistically significant interactions (Weich et al, 2001). Moreover, to distinguish between the effects of improving and worsening socio-economic status on rates of depression, we compared each of these groups against a reference group defined as individuals with no change on any given socio-economic measure. We used an F-test in order to test whether improvement had a different effect from deterioration in absolute value. All estimations were carried out with SAS version 9 for UNIX.

RESULTS

Between 1992 and 1999, at least one episode of depression had been experienced by 17.3% ($n=2064$) of the sample: 1208 participants had only one episode, 397 had two episodes, 212 had three episodes

Table I Depression, socio-economic and demographic status of the eight waves of the Belgian Households Panel (1992–1999)

Variable	Sample size (n)[1]	Score or % affected[2]		Longitudinal variance ratio[3]
HDL depression (score 0–72): mean (s.d.)	54 190	5.2	(8.3)	0.49
Major depression caseness, % (s.d.)	54 190	7.2	(25.8)	0.69
Subjective financial strain (score 0–5): mean (s.d.)	54 839	2.1	(1.2)	0.43
Poverty, % (s.d.)	54 429	12.5	(33.1)	0.58
Deprivation index (score 0–6): mean (s.d.)	54 874	1.2	(1.2)	0.30
Household income equivalent, log ε: mean (s.d.)	54 435	6.9	(0.5)	0.47
Education, years: mean (s.d.)	54 221	10.7	(3.0)	0.12
Unemployment, % (s.d.)	54 078	6.7	(25.1)	0.46
Civic participation, % (s.d.)	54 941	38.7	(48.7)	0.46
Living with a partner or spouse, % (s.d.)	54 331	77.8	(41.6)	0.21
Female, % (s.d.)	53 787	52.6	(49.9)	0.00
Age, years: mean (s.d.)	53 773	46.2	(17.8)	0.09

HDL, Health and Daily Living.
1. Number of repeated observations on 11 909 participants.
2. Means and standard deviations are computed on the whole period.
3. Ratio of within-individuals variance to total variance (within-individuals plus between-individuals).

and 247 had four episodes or more. Table 1 shows characteristics of the study sample and the longitudinal variance ratios for each of the study exposures and outcomes. A substantial proportion of the variance in HDL depression scores (49%) and depression caseness (69%) was due to within-individual change over time. Several socio-economic variables also displayed a high level of (within-individual) longitudinal variance, particularly poverty status (58%), income (47%), unemployment (46%), civic participation (46%), financial strain (43%), deprivation (30%) and living with a partner (21%). The level of longitudinal variance was much more limited for educational status (12%).

The estimates of the fixed-effect models are shown in Table 2. The left-hand part of the table is related to depression scores and the right-hand side addresses the case of major depression. All coefficients are bivariate and controlled only for the inverse Mill's ratio. An increase of subjective financial strain (e.g. from 'with difficulty' to 'with great difficulty') or in deprivation was associated with statistically significant changes in both depression score and the likelihood of being a case of major depression. Becoming poor resulted in a statistically significant increase in depression score (but not in cases of major depression). Increase in income or becoming unemployed were associated neither with a change in depression score nor with a change in cases of major depression. Changing civic participation was associated with lower depression score only, to a statistically significant degree. Change in living arrangements was associated with change

in both depression score and change in cases of major depression.

There were statistically significant gender differences. Change in subjective financial strain increased the depression score to a greater extent for women than for men (women $\beta=0.48$ v. men $\beta=0.23$; $t=4.2$, $P<0.001$). Change in poverty had a greater effect among women compared with men (women $\beta=0.47$ v. men $\beta=0.19$; $t=2.2$, $P=0.01$). Embarking on a cohabiting relationship reduced depression more among women than among men (women $\beta=-1.23$ v. men $\beta=-0.43$; $t=-3.45$, $P<0.01$). These results were similar when running a multiplicative model with gender as an interaction term. On stratifying by income, subjective financial strain had a greater effect for individuals living in households with below-median income compared with those in households with above-median incomes ($\beta=0.42$ v. $\beta=0.32$, $P<0.05$, $t=1.7$). Similarly, the association between depressive symptoms and change in deprivation reached statistical significance for individuals in low-income households but not for those in higher-income households ($\beta=0.21$ v. $\beta=0.02$, $P<0.01$, $t=2.5$). Change in partnership had a greater effect for individuals in low-income households than for those with higher incomes ($\beta=-1.14$ v. $\beta=-0.44$, $P<0.001$, $t=3.2$).

The socio-economic variables that were significant in Table 2 were categorised into three groups: no change (reference group), reduction in socio-economic status and increase in socio-economic status. Results (Table 3) showed that reduced financial strain had a positive effect on depression score whereas increased strain had a

negative effect. The effect, in absolute value, of a reduction in financial strain was smaller than the effect for an increased strain ($F=10.9$, $P<0.001$). Reduction in poverty reduced depression score whereas an increase in poverty led to an increase of depression score. Although the effect of a reduction in poverty was higher, in absolute value, than the effect of an increase in poverty, this difference was not statistically different ($F=1.4$, $P>0.05$). Similar results were found for deprivation and income: the effect of worsening conditions was greater, in absolute value, than the effect of an improvement, but the tests were not statistically significant (deprivation $F=2.2$; $P>0.05$; income $F=1.2$, $P>0.05$). Finally, the effect of ceasing to live with a partner was greater in absolute terms ($\beta=0.94$) than starting to live with a partner ($\beta=-0.44$) and the difference of the two coefficients, in absolute value, was statistically different ($F=4.8$, $P=0.03$). Finally, we carried out a multivariate analysis (results not shown) in which we jointly tested whether the worsening effects of financial strain, poverty, deprivation, income, civic participation and living arrangements were different from the improving effect of the same variables: the test was significant ($F=3.6$, $P<0.01$). Turning to cases of major depression, we found similar results: increases in financial strain or in deprivation raised the risk of depression. Ceasing to cohabit also increased the risk of depression. Improved socio-economic circumstances had no significant effect on the risk of depression.

Our analyses focused on changes in socio-economic status and changes in depression occurring during the same year. However, it could be that a change in depression is due to an earlier change in socio-economic circumstances. Additional analyses indicated (results not shown) that changes in financial strain, in poverty and in deprivation in the previous year had no significant effect on current changes in depression.

Table 2 Bivariate fixed-effect analysis of time-varying socio-economic circumstances predicting depression score and caseness of major depression

Change in[1]	Depression score[1]		Depression caseness	
	β[2]	(95% CI)	OR[3]	(95% CI)
Subjective financial strain (score)	0.36	(0.26 to 0.45)***	1.25	(1.19 to 1.32)***
Poverty (dummy variable)	0.32	(0.15 to 0.49)***	1.12	(0.97 to 1.30)
Deprivation index (score)	0.15	(0.08 to 0.22)***	1.11	(1.04 to 1.18)**
Household income equivalent (log €)	−0.05	(−0.21 to 0.11)	0.95	(0.83 to 1.09)
Unemployment (dummy)	−0.03	(−0.27 to 0.20)	1.06	(0.87 to 1.30)
Civic participation (dummy)	−0.12	(−0.24 to −0.01)*	0.91	(0.81 to 1.02)
Living with a partner or spouse (dummy)	−0.75	(−0.96 to −0.53)***	0.60	(0.51 to 0.71)***

*$P<0.05$, **$P<0.01$, ***$P<0.001$.
1. Difference between socio-economic circumstances (or depression) at each year and the average socio-economic circumstances (or depression) during the whole period.
2. Bivariate unstandardised coefficient controlled for the inverse Mill's ratio.
3. Conditional logit odds ratio controlled for the inverse Mill's ratio.

DISCUSSION

Using a 7-year follow-up of a population survey, we analysed the effects of change in socio-economic status on depression. We found that 1-year increases in material hardship such as financial strain, deprivation and poverty led to an increase in risk of depressive symptoms, and often the risk

Table 3 Bivariate fixed-effect analysis of time-varying socio-economic circumstances predicting depression score and depression caseness: analysis by change sign

Sign of the changes	Depression score		Depression caseness	
	β[1]	(95% CI)	OR[2]	(95% CI)
Financial strain				
No change[3]	0		I	
Reduced financial strain	−0.21	(−0.33 to −0.09)***	0.90	(0.80 to 1.02)
Increased financial strain	0.53	(0.41 to 0.65)***	1.47	(1.30 to 1.66)***
Poverty				
No change[3]	0		I	
Reduced poverty	−0.46	(−0.75 to −0.17)**	0.81	(0.60 to 1.08)
Increased poverty	0.24	(0.03 to 0.45)*	1.06	(0.86 to 1.30)
Deprivation				
No change[3]	0			
Reduced deprivation	−0.07	(−0.20 to 0.06)	0.96	(0.84 to 1.10)
Increased deprivation	0.22	(0.10 to 0.35)***	1.19	(1.04 to 1.35)**
Civic participation				
No change[3]	0		I	
Reduced participation	0.25	(0.07 to 0.43)**	1.12	(0.90 to 1.38)
Increased participation	−0.01	(−0.18 to 0.16)	0.92	(0.78 to 1.10)
Living arrangements				
No change[3]	0		I	
Ceasing to live with partner	0.94	(0.67 to 1.21)***	2.06	(1.61 to 2.62)***
Starting to live with a partner	−0.44	(0.79 to −0.09)*	0.83	(0.60 to 1.14)

*$P<0.05$, **$P<0.01$, ***$P<0.001$.
1. Bivariate unstandardised coefficient controlled for the inverse Mill's ratio.
2. Conditional logit odds ratio controlled for the inverse Mill's ratio.
3. Reference.

of caseness of major depression; ceasing to cohabit with a partner increased the level or risk of depression; change in unemployment did not influence the level or the risk of depression; in general, the (adverse) effects of worsening socio-economic conditions on rates of depression were far greater than the (beneficial) offsetting effects of improving conditions; moreover, worsening socio-economic conditions affected women and those living in low-income households to statistically significant degrees. The results are consistent with numerous cross-sectional studies reporting associations between individuals with lower socio-economic status and depression, using a variety of outcome measures (Kessler *et al*, 1994). As expected, the associations we found were smaller than those found in previous prevalence studies but more similar to the results of incidence studies (Weich & Lewis, 1998*b*; Lorant *et al*, 2003). The design almost certainly explains this discrepancy. Our analyses considered *change* in socio-economic status and in rates of depression, leaving aside factors that did not change over time. Whereas most previous studies have focused on

between-individual socio-economic differences or on time-invariant socio-economic status covariates, we were concerned primarily with the effects of within-individual socio-economic change. Our results suggest that the short-term effect of change in socio-economic status is more modest than the between-individual effects. This is presumably because a good deal of the difference found in much previous research is owing to the longer-term effects of time-invariant factors. Indeed, a previous cross-sectional study had shown that coping styles, which tend to be rather time-invariant, greatly reduced the socio-economic gradient in depression (Turner & Lloyd, 1999).

Our results are also consistent with other experimental and longitudinal studies. A natural experiment in North Carolina showed a small and borderline significant effect of moving out of poverty on emotional symptoms (Costello *et al*, 2003), and a British longitudinal study showed that a decrease in income had a slight impact on General Health Questionnaire score (Benzeval & Judge, 2001). Ceasing to cohabit with a partner increased

the level and the risk of depression, particularly among women. This is consistent with previous longitudinal studies of marital transition (Hope *et al*, 1999; Wu & Hart, 2002). Our study adds to this previous body of knowledge that these effects are greater among women and among individuals of lower socio-economic status. Moreover, because we have excluded time-invariant features, our results also support the notion that the risk of depression attached to such transitions is probably not a result of some personal vulnerability or lack of resilience.

The lack of association between unemployment and depression contrasts with studies of the mental health consequences of unemployment, which show that unemployed individuals are more at risk of major depression than those who are employed (Lennon, 1995). However, the results of longitudinal studies are mixed. Although loss of a job has been shown to be a predictor of depression in the Alameda follow-up study (Kaplan *et al*, 1987), this finding was not replicated in two more recent longitudinal studies (Bromberger & Matthews, 1994; Weich & Lewis, 1998*a*). The divergence in results between cross-sectional and longitudinal studies has already been highlighted and has been explained by specific characteristics that make some individuals unable to maintain employment (Bromberger & Matthews, 1994). Another possible explanation has to do with the timing of data collection: because our analyses used data collected at annual intervals we might have missed short-term fluctuations in mental health occurring between assessments. It is possible, although unlikely, that we have underestimated the effects of changes in employment status if there were significant numbers of participants who moved into and out of work between waves. Indeed, previous evidence suggests that the risk of depression increases steadily for 6 months after the individual becomes unemployed, then reaches a plateau and is reversed almost immediately on finding work (Warr & Jackson, 1985). Given that we had only one observation a year, this selection effect of unemployment on depression might thus have been underestimated.

Limitations

Our measures of depression and socio-economic status have limitations. The results are thus vulnerable to the drawbacks of some symptoms inventories. Previous

research suggests that association between low socio-economic status and major depression is greatest when the latter is addressed using standardised clinical interviews rather than self-report questionnaires (Miech *et al*, 1999; Turner & Lloyd, 1999). However, because there is a monotonic relationship between symptom severity and risk of major depression (Kendler & Gardner, 1998), problems of this sort are unlikely to have significantly affected our results. Further studies should replicate our analysis with clinical interview schedules. Our socio-economic status variables might also have limitations, particularly civic participation – a concept that has recently been widely debated (McKenzie *et al*, 2002). Our measure is defined at the individual level and captures bonding relationships. As such it does not fully describe either the civic participation of the community (such as collective efficacy) or the resources provided by social policies.

A second limitation arises from the modest baseline participation rate and from the attrition rate, which might have made the sample increasingly upward-biased in terms of socio-economic status and downward-biased in terms of depression. External validation of the Belgian Households Panel Survey suggested that the baseline sample did reflect correctly the Belgian population in terms of age, gender and household type distribution (Jacobs & Marynissen, 1993). Moreover, baseline participation should not be a major issue here, as we were interested in longitudinal effects and not in cross-sectional inference. However, it is also possible that some personality traits might be related to both a lower baseline participation rate and a stronger association between socio-economic status and depression, particularly for individuals having poorer coping styles. Also, the study of attrition rates showed that attrition was higher in low-status individuals. Our analysis took care to correct for such bias and the loss to follow-up remains similar to that of panels in other European countries (Peracchi, 2002). Nevertheless, underestimation of the longitudinal effect of socio-economic status cannot be totally ruled out. Although a previous study has shown that such underestimation was slight (de Graaf *et al*, 2000), we must remain cautious regarding the precise size of our estimations.

Third, the principal aim of this study was to estimate the effect of change in socio-economic status on the change in depression. As such, the risk factors of interest were those that were most likely to change during the interval between assessments. Given that the mean age of the sample at baseline was 46 years, there was not much longitudinal variance in education. This should not be viewed as implying that lack of education is not an important determinant of psychopathology, rather that our sample displayed little longitudinal variance. Besides, our study took as a starting point the causation assumption, consistent with previous studies (Dohrenwend *et al*, 1992; Ritsher *et al*, 2001; Costello *et al*, 2003). However, selection cannot be totally ruled out because, for example, depression 3 months before interview could lead to loss of job the week before the interview, or because depressed mood at the time of interview could lead respondents to rate their circumstances (such as their financial strain) more pessimistically. Given the temporality of our measurement, we must remain cautious regarding the part of the association that could be the result of a selection effect.

Finally, the context might have influenced our results, particularly Belgium's performance in promoting equity. On the one hand, Belgium has a welfare system that performs well in avoiding poverty in comparison with other European countries (Heady *et al*, 2001). On the other hand, educational segregation in Belgium appears to be greater than elsewhere (Gorard & Smith, 2004). Cross-national comparison suggests that Belgium has a mental health inequality that is close to the average inequality in the EU (Lorant *et al*, 2005).

Implications

This study should be extended in order to identify more groups that are placed at greater risk of depression or, conversely, that are protected. After all, the majority of people who live in poverty, or are confronted with a sudden drop in their income, do not develop depression. Further studies should investigate protective factors such as religion, culture, self-esteem and coping styles.

Because a short-term change in financial strain or poverty is associated with higher depression level, our results suggest that improving social and economic circumstances on a short-term basis would have an effect on mental health inequalities. This should be considered in the design of strategies to tackle such inequalities, particularly income maintenance policies that might help to alleviate the effect of worsening socio-economic circumstances. These could include microcredit schemes (Patel & Kleinman, 2003), local economic development (Costello *et al*, 2003) and policies aimed at improving women's participation in the labour market (Gordon & Shaw, 1999).

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