Physical health and the onset and persistence of depression in older adults: an eight-wave prospective community-based study

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ABSTRACT

Background. Poor physical health has long been recognized to be one of the most important risk factors for depression in older adults. Since many aspects of physical health can be targeted for improvement in primary care, it is important to know whether physical health problems predict the onset and/or the persistence of depression.

Methods. The study is based on a sample which at the outset consisted of 327 depressed and 325 non-depressed older adults (55–85) drawn from a larger random community-based sample in the Netherlands. Depression was measured using the Center for Epidemiologic Studies Depression scale (CES-D) at eight successive waves.

Results. From all incident episodes, the majority (57%) was short-lived. These short episodes could generally not be predicted by physical health problems. The remaining incident episodes (43%) were not short-lived and could be predicted by poor physical health. Chronicity (34%) was also predicted by physical health problems.

Conclusions. The study design with its frequent measurements recognized more incident cases than previous studies; these cases however did have a better prognosis than is often assumed. The prognosis of prevalent cases was rather poor. Physical health problems were demonstrated to be a predictor of both the onset and the persistence of depression. This may well have implications for prevention and intervention.

INTRODUCTION

Depression is one of the most prevalent psychiatric disorders among older adults (Blazer, 1994). Prevalence rates are a function of both onset and persistence rates. To obtain insight into rate of onset and rate of persistence, and to disentangle which factors are associated with them, prospective longitudinal community-based studies are a prerequisite. Recently, a number of such studies have been conducted (Phifer & Murrell, 1986; Kennedy *et al.* 1990, 1991; Copeland *et al.* 1992; Green *et al.* 1992; Kua, 1993; Henderson *et al.* 1997; Prince *et al.*

1998). Onset rates vary between 7 and 12%, and persistence rates have been reported between 38 and 64%, the higher rates being found in studies with a relatively short follow-up period. Yet, in all these studies, depression is measured only twice. The interval between measurements varies between 1 and 5 years, and no information is given about the intermediate period. The longer this period, the more questionable are the conclusions drawn; most importantly, there may be an over-representation of depressions with a long duration because short lasting depressive episodes may well have been missed. A more detailed study on the onset and the persistence of depression in the community requires more frequent measurements with relatively shorter intervals. In the present study, data on depression were collected at eight successive waves

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with intervals of 5 months, covering a period of 3 years.

In order to support prevention and treatment strategies, it is important to clarify which factors predict the onset and the persistence of depression in older adults. In the literature much emphasis has been laid on the relationship between physical health and depression. Physical health problems such as chronic limiting diseases, which are frequently encountered in old age, are often shown to be closely related to depression in older adults (Berkman et al. 1986; Kennedy et al. 1989; Beekman et al. 1995a, 1997a). It has even been suggested that poor health overwhelms the impact of other risk factors of depression in old age (Kennedy et al. 1989; Prince et al. 1997). Since some aspects of physical health (particularly the long-term consequences of physical pathology) can be targeted for improvement in primary care, it is important to know whether physical health problems are aetiological or prognostic factors or both. In several longitudinal community-based studies, a prospective association between poor physical health and the onset of depression has been found (Phifer & Murrell, 1986; Kennedy et al. 1990; Beekman et al. 1995b; Prince et al. 1998). With respect to the persistence of depression, however, such associations are less well established. Although associations have frequently been found in clinical studies (Murphy, 1983; Cole, 1985), there are only a few community-based studies in which the relation between poor health and the persistence of late-life depression has been studied. In some studies positive associations have been found (Kennedy et al. 1991; Beekman et al. 1995b), whereas in two recent studies (Prince et al. 1998; Sharma et al. 1998) no association was found.

The present study is, to our knowledge, the first community-based study in which depression was measured repeatedly with short intervals over a relatively long period. At baseline a non-depressed cohort and a depressed cohort were available, which gave the opportunity to study the onset of depression in the former cohort and the persistence of depression in the latter one. The aim of the present study was twofold. First, to describe the onset and the persistence of depression in older adults. Secondly, to assess the importance of a set of physical health related risk factors for the onset and the persistence of depression, thereby adjusting for possibly confounding sociodemographic variables.

METHOD

Sampling and procedures

The present study is part of the Longitudinal Aging Study Amsterdam (LASA), which is a 10-year interdisciplinary study on predictors and consequences of changes in autonomy and well-being in the ageing population (Deeg & Westendorp de Serière, 1994). Full details on sampling and response have been described elsewhere (Beekman et al. 1995a). In short, a representative random sample of older adults (55–85), stratified for age and sex, was drawn from the population registers of 11 municipalities in three regions of the Netherlands. The sample was used in two studies. Respondents were first interviewed for the NESTOR program Living Arrangements and Social Networks of older adults (response 62·3%) (Broese et al. 1995). About 10 months later, 3107 (81·7%) of the 3805 respondents to the NESTOR-LSN study took part in the LASA baseline interview. Non-response was related to age ($P < 0.001$) but not to sex. The older-old were more often found to be too ill or cognitively impaired to participate.

All 3107 participants to the baseline interview (t_0) were screened for depression, using the Center for Epidemiologic Studies Depression scale (CES-D, Radloff, 1977, see measurements section below). Due to item non-response on the CES-D 51 subjects (1·6%) were lost, leaving a baseline sample of 3056 subjects. All subjects scoring $\geqslant 16$ on the CES-D at baseline and a similarly sized random sample of those scoring < 16 were approached for a diagnostic interview, scheduled 2 to 8 weeks after LASA baseline. Response was 86·0% relative to LASA baseline. Again, non-response was related to age ($P < 0.001$) but not to sex.

Respondents with a complete diagnostic interview were asked to participate in the present follow-up study concentrating on depression in older adults. The sample participating in the study consisted of a depressed cohort ($N = 327$, CES-D $\geqslant 16$) and a non-depressed cohort ($N = 325$, CES-D < 16). Follow-up data on depressive symptoms were collected at 5-monthly intervals in seven successive waves (t_1

Table 1. *Response to follow-up* (t_1 *to* t_7)

Response	ND cohort ($N = 325$)		D cohort ($N = 327$)	
	N	(%)	N	(%)
t_1	266	(81·8)	220	(67·3)
t_2	276	(84·9)	234	(71·6)
t_3	260	(80·0)	234	(71·6)
t_4	252	(77·5)	227	(69·4)
t_5	204	(62·8)	174	(53·2)
t_6	237	(72·9)	197	(60·2)
t_7	246	(75·7)	224	(68·5)

ND, non-depressed; D, depressed.

to t_7), covering a period of 3 years. At t_1 to t_6 data on depressive symptoms were collected by mail questionnaires, and at the final wave (t_7), the same face-to-face method of interviewing was used as t_0. In Table 1, response to follow-up is described for each cohort. Non-response at follow up was associated with age ($P < 0.001$) but not with sex.

Measurements

Dependent variables

At all occasions, depressive symptoms were measured, using the Center for Epidemiologic Studies Depression scale (CES-D) (Radloff, 1977). This is a 20-item self-report scale developed to measure depressive symptoms in the community. Subjects were asked how often they experienced each symptom during the previous week. Items were scored on a four-point scale, ranging from 0 (rarely or none of the time) to 3 (most of or all the time). The values of these response categories were reversed for the positive affect items. The total CES-D score ranges from 0 to 60. A score of ≥ 16 has generally been used as indicative for clinically relevant depressive syndromes (Berkman *et al.* 1986). The psychometric properties of the scale were found to be good in older populations (Radloff & Teri, 1986; Beekman *et al.* 1994), and in a number of studies the overlap with symptoms of physical illness has been shown to be limited (Berkman *et al.* 1986; Foelker & Schewchuk, 1992).

To study the onset and the persistence of depression, course types were defined applying a definition of a clinically relevant change in depressive symptoms. A relevant change was defined as a decrease or an increase of at least five points on the CES-D between two measurements, thereby crossing the cut-off score of 16.

The difference of five points fits in with the definition of a reliable change (Drenth, 1972; Jacobson & Truax, 1991), which takes into account the reliability of the CES-D, and with the principle of a medium effect size (Cohen, 1988). A similar definition of a relevant change was used in earlier studies (Kennedy *et al.* 1990, 1991; Beekman *et al.* 1995*b*). In the non-depressed cohort, in which the onset of depression was studied, the following four course types were distinguished: 'no depression' (no relevant increase in depressive symptoms); 'short episode of depression' (one CES-D score ≥ 16 preceded by a relevant increase); 'long episode of depression' (two or more consecutive CES-D scores ≥ 16 preceded by a relevant increase); and, 'changeable course' (three or more relevant changes during the study). In the depressed cohort, in which the persistence of depression was studied, the following course types were distinguished: 'chronic depression' (CES-D score ≥ 16 at all measurements or only one CES-D score < 16); 'remission and recurrence' (two or more consecutive CES-D scores < 16 preceded by a relevant decrease and followed by a relevant increase); 'changeable course' (three or more relevant changes during the study); and 'remission' (a relevant decrease followed by two or more CES-D scores < 16 until the end of the study).

Independent variables

All independent variables used in this study were gathered during the LASA baseline interview (t_0).

Physical health can be operationalized in various ways. Verbrugge & Jette (1994) have presented a conceptual scheme of physical health in which the pathway from pathology to

disablement is described. They distinguish the following aspects: pathology, impairment, functional limitations and disability, indicating stages of increasing disablement. In the absence of measurements of impairment, in this study, three aspects of physical health were studied: number of chronic diseases (pathology); functional limitations; and, limited activities due to health problems, which is a rough measure of disability. The presence of chronic diseases was assessed by asking the participants whether they had any of the following diseases: cardiac disease; peripheral atherosclerosis of the abdominal aorta or the arteries of the lower limb; stroke; diabetes mellitus; lung disease (asthma or chronic obstructive pulmonary disease); malignant neoplasms; and, arthritis (rheumathoid arthritis or osteoarthritis) and any other major chronic diseases. The number of chronic diseases was calculated by summing up all specific diseases reported to be present. In a validation study, respondents' self-reports were compared to information obtained from their GPs, and proved to be sufficiently reliable (Kriegsman *et al.* 1996). For this study, the presence of chronic physical diseases was indicated as $0 = $ no disease, $1 = $ one disease, $2 = $ more than one disease. The questionnaire on functional limitations (van Sonsbeek, 1988; Kriegsman *et al.* 1997) included the following activities: climbing up and down a staircase of 15 steps without stopping; cutting one's own toenails; and using one's own or public transportation. Response categories were: 'yes without difficulty'; 'yes with difficulty'; 'only with help'; and, 'no I cannot'. For this study, the presence of functional limitations was indicated as $0 = $ no functional limitations, $1 = $ one functional limitation, and $2 = $ more than one functional limitation. Limited activities due to health problems were addressed by the question 'Are health problems limiting your normal daily activities'. Response categories were 'no', 'yes slightly', and 'yes severely'. Since the number of respondents in the second and the third category was relatively small, for this study, the variable was dichotomized as follows: $0 = $ no, $1 = $ yes.

Covariates in this study have been shown to be related to depression and physical health in previous studies, and thus may act as potential confounders. Sociodemographic variables include sex, age, level of education and marital

status. Education was measured on an eight-point ordinal scale ranging from uncompleted primary school to completed university. For this study, education was dichotomized as follows: low education (uncompleted or completed primary school) and middle to high education (some secondary education up to and including university).

Data analysis

CES-D data were collected by two different modes: face-to-face interviews (t_0/t_7); and, mail questionnaires (t_1 to t_6). The latter mode yielded on average higher scores than the former one. In order to take account of this mode effect and to obtain comparable data, a generalized T-score transformaton of the CES-D was performed before embarking on the analysis (Nunnally, 1978; Kohout *et al.* 1993; Geerlings *et al.* 1999).

Data were analysed using logistic regression analysis in three steps. In the non-depressed cohort, first, odds ratios and 95 % confidence intervals were calculated for the bivariate associations between the sociodemographic and health related variables and the onset of depression, thereby using the course type 'no depression' as the reference category. Secondly, all sociodemographic variables that were significantly associated with the onset of depression in the bivariate analysis were entered together in a regression equation predicting the onset of depression. Thirdly, to adjust for potential confounding, odds ratios for the associations between physical health related variables and the onset of depression were reported after adjustment for those sociodemographic variables that were still significant predictors in the analysis in the second step. In addition, to assess bias due to selective attrition, subjects with less than four measurements were studied separately as if representing a specific course type.

In the depressed cohort, the same procedure as above was repeated, using persistence of depression with reference category 'remission' as dependent variable.

RESULTS

Characteristics of the sample

In Table 2, the characteristics of the baseline sample are presented. Subjects in the depressed

Table 2. *Characteristics of the baseline sample*

Characteristic	ND cohort ($N = 325$)		D cohort ($N = 327$)	
	%	Mean (s.d.)	%	Mean (s.d.)
Sex				
Female	51·7		63·6	
Age	—	69·19 (8·70)	—	71·71 (8·70)
Education				
Low	36·9		48·0	
Marital status				
Not (or no longer) married	34·4		58·4	
No. chronic diseases*				
None	27·7		14·8	
One	37·6		26·2	
More than one	34·8		59·1	
Functional limitations†				
None	67·9		34·8	
One	17·6		21·4	
More than one	14·5		43·8	
Limited activities‡				
Due to health problems, yes	23·7		59·4	
No. of measurements				
1	5·5		10·1	
2	4·6		9·2	
3	4·6		4·9	
4	4·3		6·1	
5	7·4		7·0	
6	9·5		14·7	
7	16·3		13·1	
8	47·7		34·9	

ND, non-depressed; D, depressed.
* Due to (item) non-response $N = 325$ (D cohort).
† Due to (item) non-response $N = 324$ (ND cohort) and $N = 322$ (D cohort).
‡ Due to (item) non-response $N = 325$ (D cohort).

Table 3. *Onset and persistence of depression*

Course types ND cohort: Onset	N	(%)	Course types D cohort: Persistence	N	(%)
No depression	201	(72·6)	Chronic depression	85	(34·3)
Short episode of depression	43	(15·5)	Changeable course	59	(23·8)
Long episode of depression	18	(6·5)	Remission and recurrence	32	(12·9)
Changeable course	15	(5·4)	Remission	72	(29·0)
Total	277	(100)	Total	248	(100)

ND, non-depressed; D, depressed.

cohort were more often female, older, less educated, and less often married than those in the non-depressed cohort. Furthermore, the subjects in the former cohort had relatively more physical health problems (chronic diseases, functional limitations and limited activities due to health problems) than those in the latter. These differences reflect the risk factors associated with the prevalence of depression in cross-sectional studies (Beekman *et al.* 1995*a*).

For the present study, availability of data from the baseline interview (t_0) and a minimum of three follow-up measurements (covering at least 1 year of follow-up) were considered necessary to contribute to the analysis. Defined in this way, in the non-depressed cohort 48 respondents (14·8%) were lost compared with 79 (24·2%) in the depressed cohort. Reasons for attrition were death, refusal and incapacity. In the non-depressed cohort, there were significant associations between loss to follow-up (< 4 *v.* $\geqslant 4$ measurements) and the following baseline characteristics: higher age ($P < 0·001$), a low level of education ($P < 0·05$), not (or no longer)
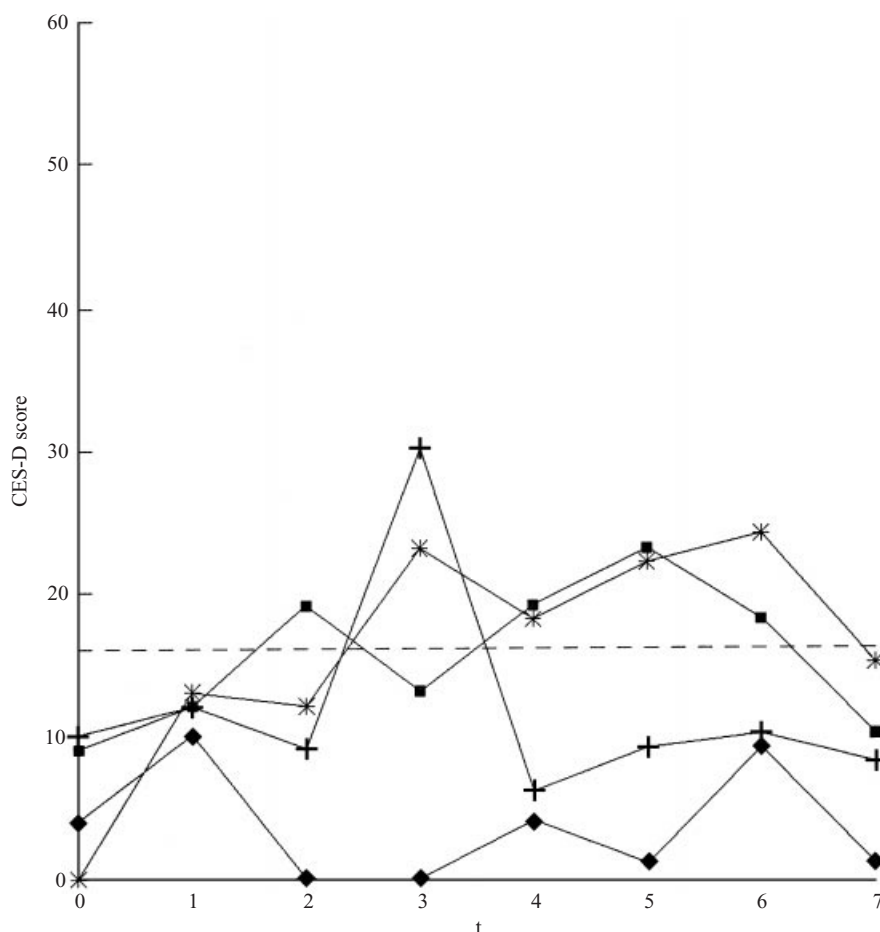
FIG. 1. Course types non-depressed cohort. (◆, No depression; +, short episode; ✳, long episode; ■, changeable course;
– – –, cut-off (16).)

being married $(P < 0.01)$, more depressive symptoms $(P < 0.05)$ and all physical health related variables in this study $(P < 0.05)$. In the depressed cohort, there were only significant associations with higher age $(P < 0.05)$ and not (or no longer) being married $(P < 0.001)$.

The onset and the persistence of depression (course types)

In Table 3 the course types in both cohorts are presented. From those subjects not depressed at baseline, 27.4% developed a depressive syndrome over time: a short episode of depression in 15.5%, a long episode of depression in 6.5%, and a changeable course in 5.4% of the subjects. From all depressive syndromes (76), 43 (57%) were short-lived (remission within a period of 5 months). In those subjects depressed at baseline, chronicity was observed in 34.3%, while a remission was recorded in 29% of the subjects. In between these extremes, for a large number of subjects (37%), CES-D scores were observed to fluctuate around the cut-off score: a remission and recurrence in 12.9% and a changeable course of depression in 23.8% of the subjects. Fig. 1 and Fig. 2 show examples of course types of random respondents in both cohorts.

Risk factors for the onset of depression

Sociodemographic variables and physical health related variables were analysed for their association with the onset of depression. In order to keep the number of respondents in the analysis at an acceptable level, the course types 'long
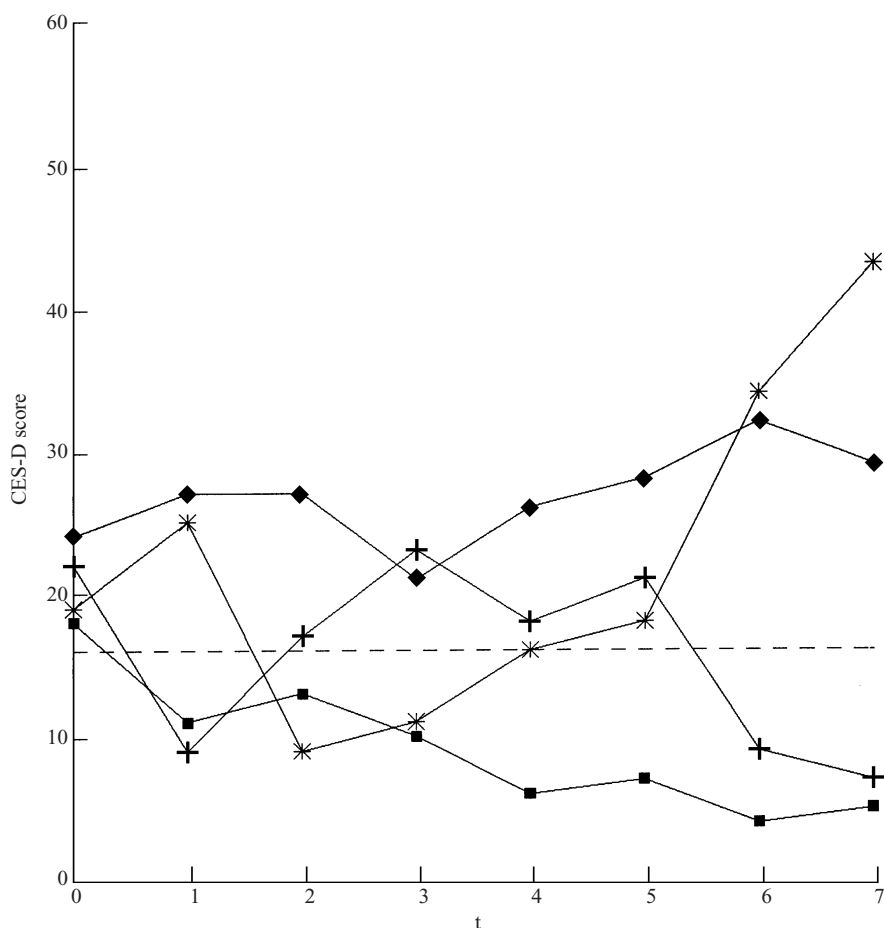
Fig. 2. Course types depressed cohort. (◆, Chronic depression; +, changeable course; ✳, remission + recurrence; ■, remission; – – –, cut-off (16).)

episode of depression' ($N = 18$) and 'changeable course' ($N = 15$) were combined. There were no significant differences in predictor variables for each of these specific course types (results not shown).

The only significant bivariate predictor for the onset of a short episode of depression was having limited activities due to health problems (odds ratio (OR) = 2·29 (95 % confidence interval 1·10–4·77)). The onset of a long episode of depression or a changeable course was bivariately predicted by all variables: being female (OR = 3·22 (1·43–7·28)), being older (OR = 1·07 (1·02–1·12)), having a low level of education (OR = 3·08 (1·44–6·56)), not (or no longer) being married (OR = 2·38 (1·12–5·03)), having more than one chronic disease

(OR = 4·06 (1·41–11·67)), having one functional limitation (OR = 3·57 (1·45–8·77)) or more than one functional limitation (OR = 5·90 (2·13–16·34)), and being limited in activities due to health problems (OR = 2·37 (1·05–5·33)). Having only one chronic disease did not predict the onset of a long episode of depression or a changeable course.

In the next step, the associations between physical health and the onset of depression (long episode of depression/changeable course) were adjusted for confounding sociodemographic variables. Marital status did not reach the significance level anymore when all socio-demographic variables were entered together in a regression equation predicting the onset of depression. Therefore, the associations between

Table 4. *Prospective associations between physical health related variables and the onset of depression, adjusted for potential confounders*

Characteristic (ref.)	Long episode of depression/Changeable course* (N = 33)		
	OR (95% CI) unadjusted	OR† (95% CI) adjusted	OR‡ (95% CI) adjusted
No. of chronic diseases (0)			
1	1·97 (0·65–5·95)	1·31 (0·41–4·19)	0·95 (0·28–3·22)
> 1	4·06 (1·41–11·67)	2·74 (0·91–8·31)	2·24 (0·71–7·06)
Functional limitations (0)			
1	3·57 (1·45–8·77)	2·48 (0·94–6·55)	2·37 (0·87–6·58)
> 1	5·90 (2·13–16·34)	3·27 (1·01–10·61)	2·43 (0·73–8·05)
Limited activities due to health problems (no)			
Yes	2·37 (1·05–5·33)	2·02 (0·84–4·83)	1·39 (0·54–3·58)

* Reference category is 'no depression' (N = 201).
† Adjusted for sex, age, and education.
‡ Adjusted for sex, age education and index depression score.

Table 5. *Prospective associations between physical health related variables and the persistence of depression, adjusted for potential confounders*

Characteristic (ref.)	Chronic depression* (N = 85)		
	OR (9·5% CI) unadjusted	OR† (95% CI) adjusted	OR‡ (95% CI) adjusted
No. of chronic diseases (0)			
1	1·55 (0·51–4·75)	1·84 (0·58–5·83)	2·22 (0·61–8·07)
> 1	2·25 (0·92–7·05)	2·51 (0·89–7·03)	3·64 (1·11–11·94)
Functional limitations (0)			
1	1·97 (0·81–4·80)	1·80 (0·72–4·51)	1·62 (0·61–4·25)
> 1	3·55 (1·68–7·51)	3·09 (1·36–7·03)	2·78 (1·16–6·66)
Limited activities due to health problems (no)			
Yes	2·04 (1·05–3·91)	2·03 (1·03–3·95)	1·99 (0·97–4·04)

* Reference category is 'remission' (N = 72).
† Adjusted for sex and age.
‡ Adjusted for sex, age and index depression score.

physical health related variables and the onset of depression were adjusted for sex, age, and education. The associations between the number of chronic diseases, functional limitations and the onset of depression were drastically weakened after this adjustment (Table 4). Closer inspection of the analysis showed that age and sex were strong confounders, both being positively associated with the number of chronic diseases, functional limitations, and the onset of depression. Finally, since each point of increment on the index CES-D score was also related to the onset of depression (OR = 1·24 (1·14–1·36)), the associations were adjusted for index CES-D score as well (Table 4). All associations were weakened, and were no longer statistically significant.

Subjects in the non-depressed cohort with less than four measurements were studied separately as if representing a specific course type, again with 'no depression' as the reference category. This resulted in significant associations with higher age, a low level of education, not (or no longer) being married, having one or more chronic diseases, having two or more functional limitations, and being limited in activities due to health problems (results not shown).

Risk factors for the persistence of depression

The course types 'remission and recurrence' and 'changeable course' did not differ from the remission course type in any of the independent variables (results not shown). Additional analyses showed that there were also no significant differences in predictor variables for each of these specific course types (results not shown).

Chronic depression was bivariately predicted by being older (OR = 1·04 (1·00–1·08)), having more than one functional limitation (OR = 3·55 (1·68–7·51)), and being limited in activities due to health problems (OR = 2·04 (1·05–3·91)). A trend was observed ($P = 0.07$) for the association between having more than one chronic disease and chronicity of depression.

There was no association with the sex of the respondents but since the LASA sample was stratified for sex and age, associations with physical health were adjusted for both sex and age (Table 5). The associations were weakened after adjustment for sex and age, the latter being positively associated with both physical health related variables and a chronic course of depression. As each point of increment on the index CES-D score was also predictive for chronicity (OR = 1·13 (1·06–1·21)), associations were adjusted for index CES-D score as well (Table 5). The associations with functional limitations and limited activities due to health problems were slightly weakened, the latter just not reaching statistical significance anymore ($P = 0.06$). Yet, the association between chronic diseases and a chronic course of depression was substantially strengthened and reached the significance level after adjustment for index CES-D score. This might be due to the fact that the association between chronic diseases and chronicity of depression is most apparent in the lower regions of the CES-D just above the cut-off score of 16 (results not shown).

Subjects in the depressed cohort with less than four measurements were studied separately as if representing a specific course type with 'remission' as the reference category. This resulted in significant associations with higher age, not (or no longer) being married, and having two or more functional limitations (results not shown).

DISCUSSION

Physical illness has long been recognized to be one of the most important risk factors for depression in older adults (Berkman *et al.* 1986; Kennedy *et al.* 1989; Beekman *et al.* 1995*a*, 1997*a*; Prince *et al.* 1997). Indeed, this dominant role of physical illness may be one of the most significant differences between late-life depression and depression in younger adults. In the present study, the relation between poor physical health and the onset and the persistence of depression was studied. Depression was measured at eight successive waves over a period of 3 years. To our knowledge, this is the first community-based study in which depression was measured so frequently with relatively short intervals in both a depressed and a non-depressed cohort of older adults.

Depression was measured using a self-report rating scale and the results pertain to clinically relevant syndromes and not to depressive disorders as defined in the DSM classification. However, depressive syndromes not fulfilling rigorous diagnostic criteria are highly prevalent in older adults, while their consequences for well-being and disability have been shown to be similar to those of major depressive illness (Wells *et al.* 1989; Beekman *et al.* 1997*b*).

Considering the onset of depression, 27% of the subjects not depressed at baseline experienced a depressive syndrome at some time during the study. This percentage is much higher than the onset rates found in earlier studies and is probably the result of the inclusion of short depressive episodes (15%), which are selectively missed in studies relying on two measurements only. More than half the episodes (57%) were short-lived suggesting a more favourable prognosis than has often been assumed. The remaining 43% did last longer and represents those subjects probably needing treatment.

With respect to the persistence of depression, various course types could be distinguished. Chronicity was observed in 34% of the subjects, and a true remission was recorded in 29% of the subjects. These percentages are much lower than the persistence and remission rates found in studies with only two measurements. The number of measurements in the present study has made it possible to distinguish other course types than 'chronicity' and 'remission of depression' alone. For a large number of subjects (37%) depression scores were observed to fluctuate around the cut-off score: a remission and recurrence in 13% and a changeable course in 24% of the subjects. It may be quite likely with a longer follow-up the former course type evolves into the latter one. If the fluctuating course types are also considered to represent an unfavourable outcome of depression, the percentage of subjects with a poor outcome is even

higher than found in studies with only two measurements. Depression (even when using a broad definition) is thus in many cases not self-limiting. This is somewhat perturbing considering the low level of diagnosis and treatment of depression (Beekman *et al*. 1997*b*; Livingston *et al*. 1997; Sharma *et al*. 1998).

Combining the findings concerning the onset and the persistence of depression leads to some confusion; the incident cases seem to have a rather good prognosis, while the prevalent cases have a much poorer prognosis. The relatively poor outcome of depression in the latter cases is likely to be due to the method of cross-sectional case finding. Respondents with a long episode of depression are more likely to be identified as depressed at the time of case finding, since the chance of being identified is proportional to the duration of the episode.

Physical health was studied in relation to the onset and the persistence of depression. The number of chronic diseases and functional limitations, and disability were used as indicators of physical health. Except for a short episode of depression, which may well be an adaptive brief reaction to an environmental stressor, the onset of depression was predicted by all studied physical health related variables, which is in line with earlier findings (Phifer & Murrell, 1986; Kennedy *et al*. 1990; Beekman *et al*. 1995*b*; Prince *et al*. 1998). After adjusting for potentially confounding sociodemographic variables and index depression score, no associations remained statistically significant, although most associations were still substantial. Type II errors (false negative results) have probably occurred because of the small number of subjects in the onset group.

With respect to the persistence of depression, it was shown that in defining course types more distinctions need to he made than a persistent and a remitted course type alone, which is only possible when depression is repeatedly measured over time. The chronic course type was predicted by practically all physical health related variables, while the 'fluctuating course types' were not predicted by any of the physical health related factors. This may be explained in several ways. First, the fluctuating course types may resemble the remission group, meaning that the former are also remitting, although gradually and with an occasional relapse. Secondly, the

fluctuating course types may be an unfavourable outcome of depression like the chronic course, and may be predicted by variables not examined in this study. For instance, considering the intermittent course, these course types may be more likely to be associated with personality factors such as neuroticism and chronic interpersonal stress. The absence of associations between physical health and persistence of depression in previous studies (Prince *et al*. 1998; Sharma *et al*. 1998) may be partly due to the fact that no distinction was or could be made between chronic and fluctuating course types, the latter not being predicted by physical health.

Since many aspects of physical health may be targeted for improvement in primary care, the relationship between poor physical health and the onset, as well as the persistence, of depression offers opportunities for prevention and intervention. Gurland & Wilder (1988) distinguished three basic types of intervention aimed to ameliorate depression associated with physical illness: primary treatment of depression, treatment of physical impairment, and interventions relevant to both conditions. Primary treatment could be provided relatively easily, since depressed older adults do not seem to withdraw from the health services (Beekman *et al*. 1997*b*). Although this seems promising, it is the very concurrence of physical illness and depression, so common in later life, which poses difficulties for GPs in diagnosis and treatment (Goldberg & Bridges, 1988). Physicians and patients often consider the depressive symptoms to be part of the underlying physical disease (Freeling, 1993), not considering them to be a clinical problem deserving specific attention. In addition, physicians may be more reluctant to prescribe antidepressant drugs to patients with physical health problems because of fear for adverse drug reactions and drug-disease interactions (Passmore *et al*. 1995).

With regard to the present study, some limitations have to be acknowledged. A first concern is the loss of subjects before and during the present follow-up study. Oversampling in the more vulnerable strata has resulted in considerable non-response. Through mortality and a higher attrition rate in the subjects with more compromised health status, the more frail elderly were under-represented. Loss to follow-up is probably an inevitable consequence of

measuring depression repeatedly over a relatively long period of time. In the non-depressed cohort, attrition was related to almost all baseline sociodemographic and health related variables and thus was rather selective. However, subjects who dropped-out differed from the never-depressed subjects in the same direction as those who developed depression over time, implying that the onset rate is probably an underestimation. In the depressed cohort on the other hand, attrition was non-differential with respect to baseline depression and with respect to most risk factors, which strengthens the generalizability of the results. A second potential source of bias is that the probability of various outcomes might have been varied with the number of follow-up measurements. Indeed, in the depressed cohort, respondents with fewer assessments were relatively more likely to be classified as chronically depressed. However, bias was probably limited, since the results of the multivariate models were essentially the same after adjusting for the number of responses (results not shown). A third concern is that physical health was measured by self-report. Thus, the measurement of physical health relied to some extent on the subject's self-appraisal of their health, which is likely to be associated with the subject's mood; subjects with high levels of depressive symptoms may experience their health status as worse than those with relatively few symptoms. However, high levels of agreement have been reported between self-report and objective health status measures (Burvill *et al.* 1990), and in our study, discrepancies between objective and self-reported health were not associated with the level of depressive symptoms (Kriegsman *et al.* 1996). Furthermore, adjusting for index depression score did influence, yet did not drastically weaken, the associations between physical health status and the onset or the persistence of depression.

In conclusion, this study provides a detailed insight into the onset and the persistence of depression in older adults. On the one hand, incident cases do have a better prognosis than is often assumed. However, on the other hand, this study and previous studies have shown that depression is highly prevalent and (even when defined in broad terms) often runs a chronic/ intermittent course. The intimate association of poor physical health (which is a very common problem in old age) with both the onset and the prognosis of depression poses great conceptual and clinical challenges. Future studies should focus on elucidating further the complex interplay between physical illness and depression and on interventions aimed towards a better prognosis.

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