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**Usefulness of a single-item measure of depression to predict mortality: The GAZEL prospective cohort study**

**Running title:** single-item of depression and mortality

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## ABSTRACT

**Background:** It remains unknown whether short measures of depression perform as well as long measures in predicting adverse outcomes such as mortality. The present study aims to examine the predictive value of a single-item measure of depression for mortality.

**Methods:** A total of 14 185 participants of the GAZEL cohort completed the 20-item Center-for-Epidemiologic-Studies-Depression (CES-D) scale in 1996. One of these items (“I felt depressed”) was used as a single-item measure of depression. All-cause mortality data were available until September 30, 2009, a mean follow-up period of 12.7 years with a total of 650 deaths.

**Results:** In Cox regression model adjusted for baseline sociodemographic characteristics, a one-unit increase in the single-item score (range 0-3) was associated with a 25% higher risk of all-cause mortality (95% CI, 13-37%,  $p < 0.001$ ). Further adjustment for health-related-behaviours and physical chronic diseases reduced this risk by 36% and 8%, respectively. After adjustment for all these variables, every one-unit increase in the single-item score predicted a 15% increased risk of death (95% CI, 5-27%,  $p < 0.01$ ). There is also an evidence of a dose-reponse relationship between reponse scores on the single-item measure of depression and mortality.

**Conclusion:** This study shows that a single-item measure of depression is associated with an increased risk of death. Given its simplicity and ease of administration, a very simple single-item measure of depression might be useful for identifying middle-aged adults at risk for elevated depressive symptoms in large epidemiological studies and clinical settings.

**Keywords:** depression, single-item, mortality

## INTRODUCTION

Depressive disorders are a huge public health issue worldwide with considerable social and economic burden <sup>1</sup>. According to the World Health Organization, by 2020 depression is expected to cause more disability than infectious diseases, cancer, or accidents and to be the second cause of morbidity in the world <sup>2</sup>. Apart from its frequent occurrence, depression is often co-morbid with other disabling chronic disease including diabetes <sup>3</sup>, cardiovascular disease <sup>4,5</sup>, and has been linked to higher mortality risk in healthy individuals and patients with chronic conditions <sup>6-9</sup>.

For these reasons, several clinical guidelines recommend screening and treatment of depression in both primary- and cardiovascular-care settings <sup>7,10-13</sup>. To achieve this goal, brief and simple screening and case-finding tools have been recommended with some guidelines even suggesting the use of one or two simple questions on mood and anhedonia ("Over the past 2 weeks, have you felt down, depressed, or hopeless?" and "Over the past 2 weeks, have you felt little interest or pleasure in doing things?") as the first step for identifying currently depressed patients <sup>7,12,13</sup>. Studies on the relevance of short measures suggest that certain short tools can provide effective screening for a majority of depressed patients and, in some cases, may perform better than the longer tools <sup>14-18</sup>.

However, it remains unknown whether short measures of depression, single-item measure for instance, perform as well as long measures in predicting adverse clinical outcomes such as mortality. The present study was conducted to examine the predictive value, with mortality as the outcome, of the single-item "I felt depressed" derived from the CES-D scale in a large cohort of French employees.

## MATERIAL & METHODS

### Participants

The GAZEL cohort study was established in 1989, details of this study are available elsewhere<sup>19</sup>. The target population consisted of employees of the French national gas and electricity company (EDF–GDF). At baseline, 20 624 (15 010 men and 5614 women), aged 35–50, gave consent to participate in this study. The study design consists of an annual questionnaire used to collect data on health, lifestyle, individual, familial, social and occupational factors and life events<sup>19</sup>. Various sources within EDF–GDF provide additional data on GAZEL participants. For example, the company has an occupational medicine department, its own medical insurance system, and a detailed surveillance system that permits extensive follow-up and linkage of health records with exposure characteristics<sup>20</sup>. All the measures used in the present analysis, apart from mortality, are drawn from the questionnaire sent to all living members of the study in 1996, i.e. the baseline of the present study. The GAZEL study received approval from the national commission overseeing ethical data collection in France (“Commission Nationale de L’Informatique et Libertés”).

### Measures

#### Single-item measure of depression

Depressive symptoms in the present were measured using the validated French version of the CES-D scale<sup>21</sup>. The CES-D scale is a 20-item self-report questionnaire designed to measure depressive symptomatology in community studies<sup>22</sup>. **It measures depressive feelings and behaviours during the past week.** Responses to all items range from 0 (rarely), 1 (sometimes), 2 (occasionally) or 3 (most of the time). The CES-D scores were generally dichotomized (yes/no) as follows: a score  $\geq 16$  from a total possible score of 60 was considered to be indicative of clinically significant depression<sup>22</sup>. **The specific item of the CES-D scale “I felt depressed” (item 6) was considered as the single-item measure of depression and response scores ranged from 0 to 3.**

## **Mortality**

Vital status on all participants is obtained annually from EDF-GDF itself as it pays out retirement benefits. All-cause mortality data were available until September 30, 2009, a mean follow-up period of 12.7 years.

## **Covariates**

Age and sex were obtained from employer's human resources files. Data on occupational position were also drawn from the EDF-GDF records and categorized into low (unskilled workers), intermediate (skilled workers) and high (managers) occupational position. Health-related behaviours were drawn from the 1996 self-report questionnaire. Smoking status was categorized as never-, ex-, and current smoker. Alcohol consumption (in the week preceding the questionnaire completion) was categorized as none, moderate (1-21 drinks per week for men and 1-14 drinks per week for women) and high consumption (>21 drinks per week for men and >14 per week for women). Physical activity was determined by asking the participants if they practiced a physical exercise and categorized as: 1 (at a competitive level), 2 (regular but not at a competitive level), 3 (occasionally, or on holiday) and 4 (none). Body Mass Index (BMI) was calculated by dividing weight in kilograms by height in meters squared and categorized as: <20, 20-24.9, 25-29.9, or  $\geq 30$  kg/m<sup>2</sup>. Prevalent chronic health problems were based on a list of diseases and symptoms experienced in the past twelve months consisting of hypertension, cardiovascular disease (CVD), diabetes and dyslipidemia.

## **Statistical analysis**

Differences in response scores on the single-item measure of depression and survival status as a function of sample characteristics at baseline were assessed using a one-way ANOVA and the chi-square tests, respectively. The associations between the single-item measure of depression and mortality risk over the follow-up period were modelled using the item **as a continuous variable in** four serially adjusted Cox regressions models. In model 1, single-item of depression score, age, sex, and occupational position were the sole predictors. In

model 2, hazard ratios (HRs) were additionally adjusted for health-related behaviours. Models 3 was model 1 additionally adjusted for self-reported chronic diseases. In model 4, HRs were adjusted for all aforementioned variables. Interaction between depression measure and sex in relation to mortality risk was not significant ( $p>0.05$ ), allowing us to combine men and women in the analyses. The time-dependent interaction terms between each predictor and the logarithm of follow-up period (time variable) were all non-significant ( $p>0.05$ ) confirming that the proportional hazards assumption was justified.

## RESULTS

A total of 13757 participants of the GAZEL cohort responded to the entire CES-D scale and 14185 participants responded to the single-item “I felt depressed” (69% of the total study population in 1989). During a mean follow-up of 12.7 years, 650 participants (4.6%) died, consisting of 549 men (5.3%) and 101 women (2.7%).

Table 1 presents the sample characteristic at baseline (1996) as a function of depression measured by the single-item and survival status. Table 2 displays the associations between single-item measure of depression and all-cause mortality. **In model adjusted for sociodemographic characteristics, a one-unit increase in the single-item scores was associated with a 25% greater risk of all-cause mortality (95% CI, 9-49,  $p=0.003$ ).** Further adjustment for health-related behaviours and physical chronic diseases reduced this risk by 36% and 8%, respectively. **After adjustment for all these variables, the risk of death remained 15% higher for one-unit increase in the single-item score (95% CI, 5-27,  $p<0.01$ ).**

### Sensitivity analysis

**In our analysis, the single-item score was entered in models as continuous variable.** In order to assess whether this analytic strategy influenced the results we undertook further analysis using the single-item measure as a four-category variable (rarely, sometimes,

occasionally, most of the time). In the model adjusted for sociodemographic characteristics those who responded “sometimes” (HR=1.11,  $p>0.05$ ) “occasionally” (HR=1.53,  $p=0.001$ ) and “most of the time” (HR=2.53  $p<0.001$ ) had greater risk of death relatively to those who responded “rarely”. Adjustment for all covariates reduced but did not removed away the associations for the latter categories; the corresponding fully HRs being 1.06 ( $p>0.05$ ), 1.31 ( $p=0.036$ ), 1.94 ( $p=0.001$ ).

## DISCUSSION

In this prospective cohort study, we sought to examine the predictive ability of depression assessed using a single single-item for all-cause mortality followed over 12 years. In analysis adjusted only for baseline sociodemographic characteristics, **a one-unit increase in the single-item score (range 0-3) was associated with a 25% higher risk of all-cause mortality**. After further adjustment for health-related behaviours, and self-reported physical chronic diseases, **every one-unit increase in the single-item score predicted a 15% increased risk of death**. We also noted a graded relationship, with participants who reported to feel depressed “occasionally” and “most of the time” being particularly at greater risk of death.

We found one previous study<sup>23</sup> to have examined the association between the single-item measure of depression, also derived from the CES-D scale, and all-cause mortality. The study was conducted among community-dwelling elderly subjects and the authors concluded that the single-item measure predicted 5-year mortality. However, data on health-related behaviours and chronic conditions, likely to be important confounders of this association in the elderly, were not available in this study.

A strength of the present study is its large sample size; roughly ten time the size of the previous study on this topic<sup>23</sup>. We were also able to control for a wide range of potential confounders that are related to both depressive symptoms and mortality, including health-related behaviours, prevalent chronic physical conditions and self-rated health. Finally, our findings are

based on mortality followed over a long period and are likely not to be confounded by illness at baseline.

Our results showing a single-item self-report of depression to predict mortality over an extended period of follow-up lend some support to the potential utility of short measures to identify depressive subjects. Thus, the single-item measure of depression can reasonably replace multiple-item measures in large scale studies that require frequent assessments, or studies of elderly in which the time requested to fulfil a questionnaire needs to be short. In clinical settings, the use of the single-item measure of depression could theoretically provide a simple method to identify patients who might benefit from specific interventions such as intense disease management <sup>7,10-13</sup>.

We found a graded and strong relationship between response scores on the single-item measure of depression and mortality. Thus, the single-item measure of depression as a four-categories rather than a dichotomized variable <sup>23</sup> seems able to separate individuals as a function of the severity of their depression symptoms and should be preferred.

There are some caveats to the present findings. Despite the fact that the data in this study are from employees in a company operating throughout France and comprising a wide range of occupations, it should be noted that the GAZEL cohort is not representative of the general population as it does not include unemployed individuals. This may limit the generalisability of the results. **Indeed, the proportion of participants with more severe psychiatric disorders and somatic diseases is likely to be lower than that in the general population. This may have led to some underestimation of the effect size observed in this study.** Although, it has been suggested that significant depressive symptomatology is a risk factor for clinical depression <sup>22,24</sup>, the single-item measure of depression might merely measure general psychological distress rather than clinical depression.

In conclusion, in this large observational cohort study, we found depression measured by a single-item to be associated with an increased risk of death, mainly explained by health-related

behaviours. Given its simplicity and ease of administration, this single-item measure of depression might be useful for identifying middle-aged adults at risk for elevated depressive symptoms in large epidemiological studies and clinical settings.

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**CONFLICT OF INTEREST:** none declared

### Key points

It remains unknown whether short measures of depression perform as well as long measures in predicting adverse clinical outcomes such as mortality.

This large observational cohort study shows that depression measured by a single-item is associated with an increased risk of death, mainly explained by health-related behaviours.

A very simple single-item measure of depression might be useful for identifying middle-aged adults at risk for **elevated depressive symptoms in large epidemiological studies and clinical settings.**

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**Table 1.** Sample characteristics at baseline as a function of the item “I felt depressed” score and survival status

Variables	N (%) total	“I felt depressed” score		Survival status	
		Mean (SD)	<i>p</i> -value or for trend	Dead	<i>p</i> -value or for trend
<b>Age, Mean (SD)</b>	51.2 (3.5)	<b>-0.13*</b>	<0.001	52.4 (3.3)	<0.001
<b>Sex</b>			<0.001		<0.001
Male	10435 (74)	<b>1.45 (0.70)</b>		549 (5.3)	
Female	3750 (26)	<b>1.92 (0.90)</b>		101 (2.7)	
<b>Employment position</b>			<0.001		0.052
Low	2080 (14.5)	<b>1.74 (0.88)</b>		121 (5.8)	
Intermediate	8239 (58.2)	<b>1.60 (0.79)</b>		366 (4.4)	
High	3847 (27.2)	<b>1.44 (0.68)</b>		161 (4.2)	
Missing	19 (0.1)	<b>2.15 (1.16)</b>		2 (10.5)	
<b>Smoking</b>			0.698		<0.001
Never	6070 (42.8)	<b>1.60 (0.80)</b>		189 (3.1)	
Ex	5274 (37.2)	<b>1.52 (0.74)</b>		241 (4.6)	
Current	2592 (18.3)	<b>1.65 (0.84)</b>		208 (8.0)	
Missing	249 (1.8)	<b>1.59 (0.78)</b>		12 (4.8)	
<b>Alcohol intake</b>			0.797		0.084
None	1733 (12.2)	<b>1.76 (0.89)</b>		101 (5.8)	
Moderate	9305 (65.6)	<b>1.55 (0.77)</b>		356 (3.8)	
High	2764 (19.5)	<b>1.53 (0.74)</b>		171 (6.2)	
Missing	383 (2.7)	<b>1.74 (0.86)</b>		22 (5.7)	
<b>Physical activity</b>			<0.001		<0.001
Competition	679 (4.8)	<b>1.37 (0.62)</b>		18 (2.7)	
>1/week	4134 (29.1)	<b>1.51(0.72)</b>		147 (3.6)	
Only on holidays	3787 (26.7)	<b>1.54 (0.75)</b>		154 (4.1)	
Never	5477 (38.6)	<b>1.69 (0.85)</b>		321 (5.9)	
Missing	108 (0.8)	<b>1.67 (0.91)</b>		10 (9.3)	

<b>BMI (kg/m<sup>2</sup>)</b>			0.130	<0.001
< 20	223 (1.6)	133 (59.6)		14 (6.4)
20-24.9	6526 (46.0)	2834 (43.4)		280 (4.3)
25-29.9	5998 (42.3)	2373 (39.6)		277 (4.6)
≥ 30	1207 (8.5)	546 (45.2)		450 (4.1)
Missing	231 (1.6)	102 (44.2)		29 (12.5)
<b>Hypertension</b>			<0.001	0.001
No	12417 (87.5)	1.57 (0.78)		542 (4.4)
Yes	1768 (12.5)	1.67 (0.83)		108 (6.1)
<b>CVD</b>			0.005	<0.001
No	13949 (98.3)	1.58 (0.78)		623 (4.5)
Yes	236 (1.7)	1.72 (0.85)		27 (11.4)
<b>Diabetes</b>			0.486	0.002
No	13877 (97.8)	1.58 (0.78)		624 (4.5)
Yes	308 (2.2)	1.62 (0.84)		26 (8.4)
<b>Dyslipidemia</b>			0.032	0.910
No	11794 (83.1)	1.57 (0.78)		542 (4.6)
Yes	2391 (16.9)	1.61 (0.80)		108 (4.5)

**CVD: cardiovascular disease**

\* Coefficient of correlation between age and the single-item scores.

**Table 2.** Hazard ratios with 95% confidence intervals for the association between the single-item “I felt depressed” score and mortality.

Depression measure	Risk of mortality		
	n events/n participants	HR (95%CI)	Percentage of reduction
<b>Model 1</b>			
Single-item score	650/14185	1.25 (1.13-1.37) ***	
<b>Model 2</b>			
Single-item score	650/14185	1.16 (1.06-1.28) **	36%
<b>Model 3</b>			
Single-item score	650/14185	1.23 (1.12-1.35) ***	8%
<b>Model 4</b>			
Single-item score	650/14185	1.15 (1.05-1.27) **	40%

\* p<0.05, \*\* p<0.01, \*\*\* p<0.001

Model 1: HR adjusted for sex, age, occupational position

Model 2: model 1 additionally adjusted for alcohol, smoking, physical activity, body mass index

Model 3: model 1 additionally adjusted for hypertension, cardiovascular disease, diabetes, dyslipidemia

Model 4: model 1 additionally adjusted for all aforementioned covariates