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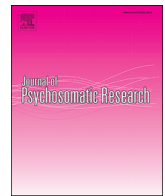
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# Obesity moderates the benefit of retirement on health: A 21-year prospective study in the GAZEL cohort

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## ABSTRACT

**Objectives:** Self-rated health and depressive symptoms have been shown to improve upon retirement. Participants with obesity might benefit more of retirement because of the extra work-related burden they are carrying. The present study aimed to investigate whether the association between retirement and health changes may depend upon obesity in the large French GAZEL occupational cohort during 21 years of follow-up.

**Methods:** 17,655 men and women were included in the analyses. Self-rated health was measured on a scale from 1 to 8 with 8 being very bad. Depressive symptoms were measured at four time points by the CES-D score. Mixed models examined the association of self-rated health or depressive symptoms with time (i.e. from –10 years before to +10 years after retirement), retirement, body mass index (BMI), and their interactions.

**Results:** Regardless of retirement, BMI was associated with poorer health. Positive BMI by time interactions showed a less favorable time course of both health indicators in the presence versus the absence of obesity (0.024 versus 0.014 and –0.19 versus –0.07 points per year for self-rated health and depressive symptoms, respectively). However, negative BMI by retirement interactions showed that the improvement of health observed upon retirement was stronger in with the presence versus the absence of obesity (–0.4 versus –0.3 and –2.42 versus –1.70 points for self-rated health and depressive symptoms, respectively).

**Conclusion:** Improvement upon retirement was observed in the presence of obesity and was even higher than in the presence of normal weight and overweight.

## 1. Introduction

Transition to retirement is a major event followed by significant alterations at psychological and physical levels in a person's life and profoundly affects health [1–3]. For instance, data from the GAZEL cohort that comprises employees from the French national gas and electricity company, show that retirement is associated with a substantial improvement in self-rated health, corresponding to an 8–10 year gain in self-rated health [4]. This pattern was remarkably consistent across occupational grades and sex, and, although the effect was stronger for people who had a poor work environment or health problems before retirement, a significant improvement in other groups was also recorded, apart from those with ideal working conditions. Moreover, results from the GAZEL cohort, showed that a major decrease

in depressive symptoms (assessed with the Center of Epidemiologic Studies Depression Scale, CES-D) occurred around retirement [5].

Conflicting results have nonetheless been reported as to whether these changes are positive or negative: some studies have shown that retirement is associated with a change in lifestyle and adoption of new routines which may have a positive influence on health and behaviors [6,7]. Other studies however, report that retirement might be associated with deterioration or no effect on health [8,9] when self-rated health or intake of medications were assessed. For instance, retirement has been shown to have a positive effect on physical activity [10], but not on alcohol consumption [11], which has been shown to increase following retirement. These inconsistencies might stem from the fact that different methodologies have been used such as disparities in age, the time of follow-up, as well as the factors preceding retirement (e.g.

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occupational status and marital status) taken into consideration. In general the association of retirement with health is complex in terms of health-related problems, health perception and psychological factors. This implies that large studies covering long periods of retirement years are essential in order to investigate the effect of retirement on health taking into account the interplay between factors.

Here, we examine whether obesity may moderate (i.e. be an effect modifier of) the association between retirement and health changes.

Obesity is a global pandemic constantly increasing in all socioeconomic categories and affecting populations' health [12]. It concerns a large majority of the population worldwide. Results published in 2017 show a global prevalence of 12% in adults, which amounts to 604 million obese adults in the world. The prevalence of obesity has also increased in children since the 1980s to reach 5% globally [13].

Data from the French Constances cohort has shown that the prevalence of obesity concerns 15.8% and 15.6% of men and women respectively. In older ages of > 60 years, these numbers are even higher and the prevalence of obesity reaches 20.8% in men and 18.8% in women [14]. Weight changes occur with aging and might be associated to subsequent physical functioning. For instance, a study using data from the Helsinki Health Study Cohort, which includes Finnish municipal employees, examined whether obesity and change of body mass index (BMI) among women and men with normal weight, overweight and obesity associate with changes in physical and mental health functioning. Overall, the results show a weight gain among both men and women across time. Individuals that gained weight, especially those with obesity, had a greater decline in physical functioning but weight changes did not affect mental functioning. Preventing weight gain helps maintaining a good physical health functioning according to authors [15]. Additionally, prevalence of obesity has been shown to peak around retirement age [16]. Obesity is adversely related to health problems such as cardio metabolic disorders such as type 2 diabetes [17] and hypertension [18], as well as depression [19] and some cancers [20] among others. This suggests that health changes during transition to retirement might differ in participants with obesity. Specifically, two scenarios may be expected: 1) Should the burden of obesity substantially increase the burden of work (e.g. making physical tasks harder, adding fear of stigma from peers), individuals with obesity might benefit more of retirement, or 2) should this burden be mostly independent of the burden of work itself, individuals with obesity might not experience health improvement as their counterparts with normal or overweight. For instance, individuals suffering from diabetes, which is highly prevalent in individuals with obesity, had less improvement in mental fatigue around the timing of retirement [5].

The present study aimed to investigate whether the association between retirement and health changes may depend upon obesity in the large French GAZEL occupational cohort. Specifically, we took advantage of the longitudinal data, including BMI, collected during 21 years of follow-up (i.e. from -10 years before to +10 years after retirement) to perform time-dependent analyses. We expected 1) that retirement will be associated with favorable changes in both self-rated health and depressive symptoms and 2) that obesity will moderate (i.e. be an effect modifier of) this association.

## 2. Methods

### 2.1. Study population

Details of the GAZEL cohort study are available elsewhere [21]. Participants are employees of the French national gas and electricity company, Electricité de France-Gaz de France (EDF-GDF), from which the name of the cohort is derived (GAZEL). The GAZEL Cohort Study was launched in January 1989 and continued until 2014. At baseline, 20,625 employees (15,010 [73%] men), aged 35–50 years, gave written consent to participate. EDF-GDF employees hold civil-servant-like status. Information about anthropometrics, health, lifestyle and

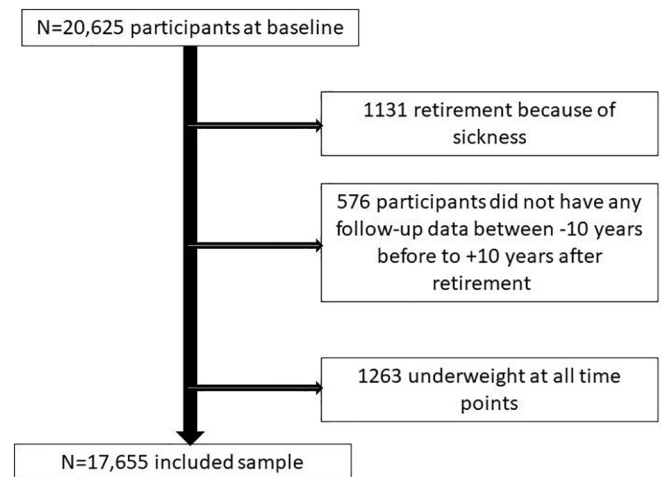


Fig. 1. Selection of participants.

occupational characteristics of the GAZEL participants is collected by yearly surveys undertaken by INSERM (Institut National de la Santé et de la Recherche Médicale). The study protocol was approved by the French Data Confidentiality Authority ("Commission Nationale Informatique et Liberté") and by the Ethics Evaluation Committee of INSERM (IRB0000388, FWA00005831). In the current study, we analyzed data from GAZEL participants who returned at least one yearly questionnaire during 21 years of follow-up. 1131 individuals retired because of sickness, a group of 576 participants did not have their follow-up period between -10 years before to +10 years after retirement and 1263 were underweight at all-time points. Finally 17,655 subjects were included in the analyses. Fig. 1 summarizes the selection and the inclusion of participants.

### 2.2. Retirement and sample selection

Data on date of retirement were provided by the company. Very few participants were lost to follow-up for mortality data (1%) and most retired between 55 and 60 years of age (mean age of retirement of  $55.2 \pm 2.72$ ). Some of the participants retired earlier due to sickness. Since there might be a difference in those who retired normally versus those who retired due to a certain condition or disability, retirement was defined as official retirement versus retirement due to illness; the way it was defined in previously published papers from the GAZEL cohort, [4,5]. Official retirement is defined as statutory retirement which is usually between 55 and 60 years old depending mainly on the type of job. Some workers might retire earlier such as women with three or more children who can retire after 15 years of work. Participants were considered in disability if they had been granted a pension for disability or longstanding illness, or if they had been on sick leave for > 365 consecutive days. All participants who retired early due to a sickness were not included in the analyses ( $n = 1131$ , 5.4% of total participants). Individuals with a chronic and/or mental illness were not excluded from the analyses.

### 2.3. Anthropometrics

Weight and height were self-reported and were previously validated in the GAZEL cohort [22]. Height was self-reported once at inclusion whereas weight was self-reported each year. To determine obesity status, BMI was calculated at each time point using the following formula: weight (kg)/height ( $m^2$ ) and three categories were determined: 1-normal weight BMI [18.5–24.9  $kg/m^2$ ]; 2-overweight BMI [25–29.9  $kg/m^2$ ] and 3-individuals with obesity BMI  $\geq 30$   $kg/m^2$ . Individuals who were underweight (BMI < 18.5  $kg/m^2$ ) at all-time points were not included in the analyses. BMI was modeled as a time-

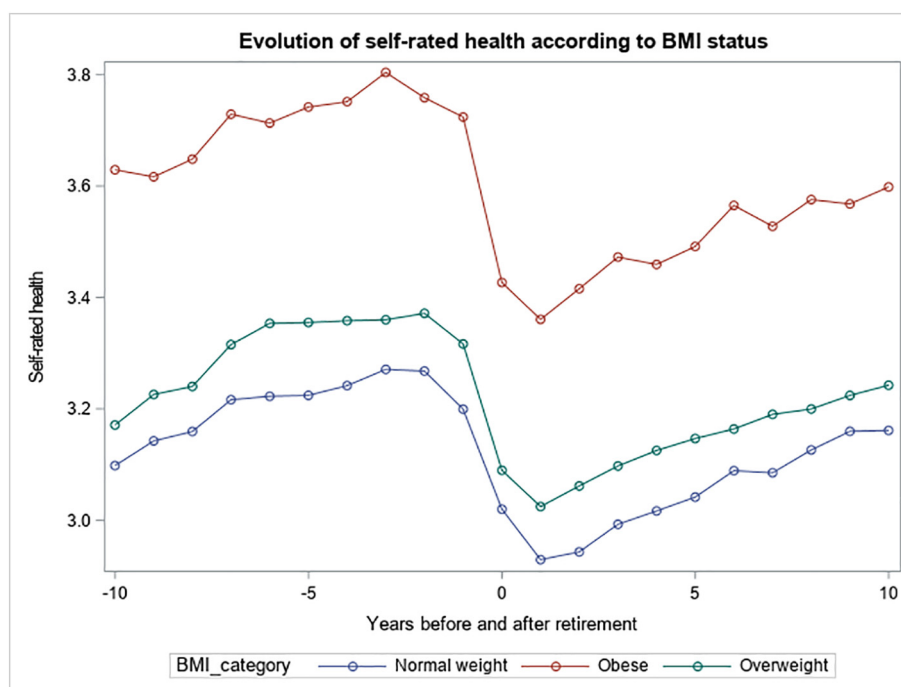


Fig. 2. Evolution of self-rated health according to BMI status.

dependent, categorical variable including three categories, normal weight, overweight and obese.

#### 2.4. Health components

**Self-rated health:** Assessment of self-rated health in the GAZEL cohort is performed by use of a standard measure included in the yearly questionnaires sent to all participants: “How would you judge the state of your general health?” The participants respond on an 8-point like scale (1 = very good, 8 = very poor). This simple question has been increasingly employed as a general health indicator in epidemiological and medical research since the 1970s, and has demonstrated a strong relationship with several health outcomes [23]. Self-rated health was analyzed as a continuous variable.

**Depressive symptoms:** Depressive symptoms were measured at several study phases in 1996, 1999, 2002, 2005, 2008 and 2012 using the Center for Epidemiologic Studies Depression scale (CES-D) [24]. This 20-item questionnaire has been designed for use in community studies and has a high internal consistency ( $\alpha = 0.8$  to  $\alpha = 0.9$  across samples) [25]. The CES-D asks participants how often they have experienced specific symptoms during the previous week (e.g., “I felt depressed,” “I felt everything I did was an effort,” “My sleep was restless”). Responses range from 0 (“hardly ever”) to 3 (“most of the time”). Depressive symptoms were analyzed as a continuous variable.

#### 2.5. Covariates

Sex, marital status and occupational status were obtained from company records and were adjusted for in the analyses. Time (i.e. the year in relation to retirement) is highly collinear with age, so age was not added to the model.

Marital status was defined as single or living in couple.

Occupational status was recorded at inclusion as 1) low: blue-collar workers or clerks; 2) medium: first-line supervisors or sales representatives; 3) high: management.

Alcohol consumption, as drinks per week, was categorized as non-drinkers, occasional drinkers (1–13 for men, 1–6 for women), moderate drinkers (14–27 for men, 7–20 for women) or heavy drinkers ( $\geq 28$  for

men,  $\geq 21$  for women).

Smoking status in the same period was categorized as non-smoker and as smoker of 1–10, 11–20 or  $\geq 21$  cigarettes per day and other.

Physical activity was not included in the models because of a large number of missing data (95%) in the included sample.

For descriptive purpose, we also collected the following self-reported chronic health conditions: cardiovascular diseases (i.e. angina pectoris, myocardial infarction, stroke, peripheral artery disease, atherosclerosis, cardiac failure or chronic cardiac disease); cancer (all types); diabetes; hypertension). These data were not included in the analyses because it would have constituted overadjustment in analyses taking self-rated health as an endpoint.

#### 2.6. Statistical analyses

Analyses were based on a 21-year observation period. Individuals were considered retired if they had already taken their retirement and non-retired otherwise. Descriptive statistics were performed to provide characteristics of the participants by BMI categories on retirement and are presented as means  $\pm$  SD or percentages as adequate. To test the difference in individuals with obesity versus individuals with overweight and normal weight regarding health components we used mixed models. All variables except sex and occupational status were considered as time-dependent, including BMI. Estimates and standard errors were computed. Separate models for each health variable (i.e. self-rated health and CES-D score) were conducted. Model 1 included time, retirement and an interaction between time and retirement, controlling for sex, occupational status and marital status. Model 2 included variables in model 1 plus BMI, and interactions between BMI and 1) retirement; 2) time 3) double interaction with retirement and time.

Evolutions of the means of health variables in the year in relation to retirement were plotted by BMI categories and are presented in Figs. 2 and 3. All tests were two-tailed and  $p < .05$  was considered significant. All analyses were undertaken using SAS 9.3 software (SAS, Cary, NC, USA).

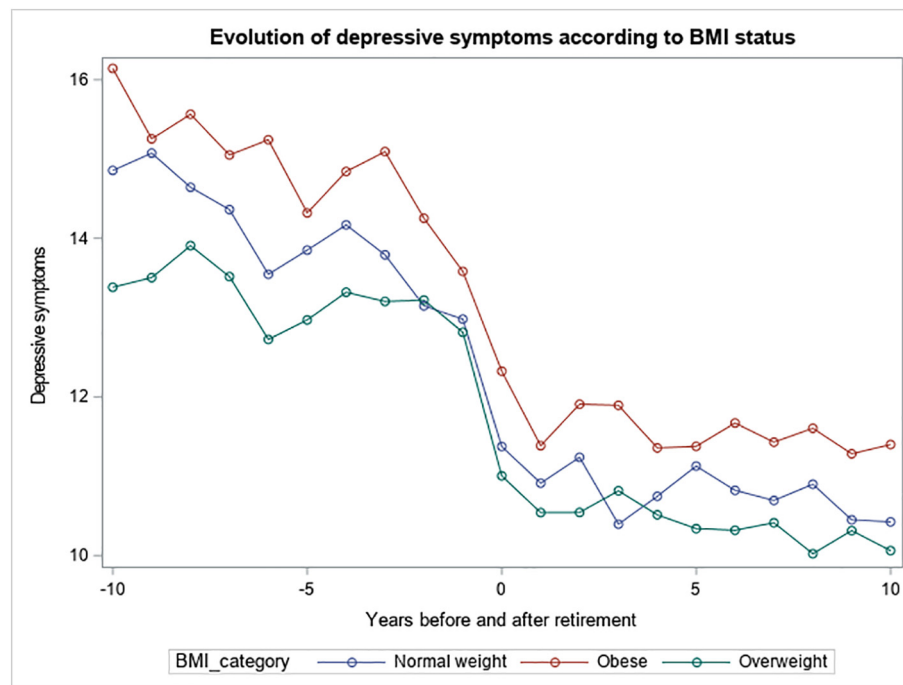


Fig. 3. Evolution of depressive symptoms according to BMI status.

## 2.7. Supplementary analyses

In order to test if the change upon retirement is not due to regression to the mean, sensitivity analyses included the associations between retirement, BMI and health variables from fixed effects models with percentage of deviation from individual mean over years of follow-up for CES-D and self-rated health.

Further sensitivity analyses included alcohol intake and smoking status in the models.

In addition, the main analyses were repeated in men and women, separately.

Finally, for exploratory purpose, mental and physical fatigues were assessed using the questions “are you currently mentally tired?” and “are you currently physically tired?” The participants respond on a scale from 1 to 8 with 1 being not tired at all and 8 being very tired.

Mental and physical fatigues were analyzed as continuous variables in the same models used for self-rated health and depressive symptoms.

## 3. Results

Table 1 presents the characteristics of the participants at retirement for each health variable by BMI category at retirement. Supplementary Table 3 presents the characteristics of those who were excluded because they retired for sickness. The mean (SD) of the BMI at retirement for included participants were 25.8 (3.4) versus 26.1 (4.2) kg/m<sup>2</sup> for excluded participants ( $t$ -test =  $-1.95$ ,  $DF = 667.3$ ,  $p = .051$ ). Most of the respondents were men and were married. Participants with obesity had higher mean scores of self-rated health, physical mental fatigue and depressive symptoms, indicating poorer status than individuals with normal and overweight. Mean age of retirement was 55.2 years across

**Table 1**  
Sample characteristics on the year of retirement by BMI categories.

	Normal weight (N = 5906)	Overweight (N = 6225)	Obesity (N = 1404)
Age at retirement	55.2 (3.14)	55.1 (2.6)	55.1 (2.7)
Mean BMI (kg/m <sup>2</sup> )	22.94 (1.52)	27.02 (1.34)	32.57 (2.83)
Men %	65.93	85.64	78.13
Marital status (% living in couple)	81.54	85.96	82.06
Occupational status (%)			
Low: blue-collar workers or clerks	13.05	13.30	18.63
Medium: first-line supervisors or sales representatives	59.25	58.30	59.67
High: management	27.70	28.41	21.70
Self-rated health	3.02 (1.17)	3.08 (1.15)	3.42 (1.22)
Depressive symptoms (CES-D)	13.79 (9.01)	13.14 (8.50)	14.62 (9.37)
Cardiovascular diseases (%)	1.59	2.41	3.93
Hypertension	8.98	15.22	26.32
Diabetes	1.42	2.98	7.15
Cancer	1.11	0.86	0.70

Results are mean (SD) or % as appropriate.

Self-rated health measured on a scale from 1 to 8, 8 being very bad health.

Physical fatigue and mental fatigue measured on a scale from 1 to 8, 8 being very tired.

Center for Epidemiological Studies-Depression (CES-D) ranging from 0 to 55.

Cardiovascular diseases (i.e. angina pectoris, myocardial infarction, stroke, arteritis of the lower limbs, atherosclerosis, cardiac failure or chronic cardiac disease); cancer (all types).



**Table 2**  
Associations between retirement, body mass index and health variables from Mixed models.

	Self-rated health		Depressive symptoms	
	Model1	Model2	Model1	Model2
Time	0.018 (0.0009)*	0.014 (0.001)*	−0.153 (0.016)*	−0.193 (0.02)*
Retirement	−0.346 (0.007)*	−0.309 (0.01)*	−1.939 (0.09)*	−1.704 (0.13)*
Time × Retirement	0.003 (0.001)*	0.006 (0.001)*	0.073 (0.018)*	0.100 (0.02)*
Sex	0.06 (0.01)*	0.08 (0.01)*	2.95 (0.12)*	2.99 (0.12)*
Marital status	−0.09 (0.009)*	−0.09 (0.009)*	−2.34 (0.11)*	−2.34 (0.11)*
Occupational status	−0.14 (0.01)*	−0.14 (0.01)*	−1.11 (0.1)*	−1.10 (0.1)*
BMI		0.086 (0.01)*		0.375 (0.13)*
BMI × Time		0.005 (0.001)*		0.066 (0.02)*
BMI × Retirement		−0.053 (0.01)*		−0.369 (0.14)*
BMI × Time × Retirement		−0.002 (0.001)		−0.050 (0.02)

Time is the year number in relation to retirement.

BMI: Body Mass Index analyzed as a categorical variable (0 refers to individuals with normal weight, 1 refers to individuals with overweight and 3 refers to individuals with obesity).

Retirement categorized as 0 is not retired and 1 if retired.

Values are regression coefficients (standard deviations).

\*p < 0.05

The models are controlled for sex, marital status and occupational status.

Occupational status categorized as 1 for low wage position, 2 for middle wage position and 3 for high wage position.

Sex: 1 for men and 2 for women.

Marital status: 1 single and 2 living in couple.

all BMI groups.

Table 2 shows the estimates of the mixed models for both self-rated health and depressive symptoms.

### 3.1. Self-rated health

Beside the effects of the covariates, there was a main effect of time with a slight increase of poor self-rated health through the follow-up (0.018 point per year). There was also a main effect of retirement with a sharp decrease of poor self-rated health (i.e. health amelioration) of −0.34 point. The positive interaction between time and retirement shows that self-rated health deteriorated more quickly after retirement. Specifically, the slope of poor self-rated health by time was of 0.018 points per year before retirement versus 0.021 points (i.e.  $0.018 + 0.003$ ) after retirement (Model 1, Table 2).

The inclusion of time-dependent BMI categories into Model 2 did not change these main effects and the interaction but showed that BMI was not only associated with poorer self-rated health but also a significant moderator of the main effects of time and retirement.

First, there was a positive interaction between BMI and time, showing that self-rated health deteriorated faster in the presence of overweight or obesity (Table 2, Fig. 2). Specifically, the gain in poorer self-rated health was of 0.014 points per year over time in the presence of normal weight, whereas this gain was of 0.019 (i.e.  $0.014 + 1*0.005$ ) and 0.024 (i.e.  $0.014 + 2*0.005$ ) points in the presence of overweight and obesity, respectively.

However, there was also a negative interaction between BMI and retirement, showing a stronger improvement of self-rated health upon retirement in the presence of overweight or obesity (Table 2, Fig. 2). Specifically, a reduction in poorer self-rated health of −0.30 points upon retirement was observed in the presence of normal weight, whereas a reduction of −0.35 (i.e.  $-0.30 - 1*0.05$ ) and −0.40 (i.e.  $-0.30 - 2*0.05$ ) was observed in the presence of overweight and obesity, respectively.

The double interaction between BMI, time and retirement was not significant, showing that the slope of self-rated health by time increased after retirement to a similar extent irrespective of BMI.

### 3.2. Depressive symptoms

Beside the effects of the covariates, there was a main effect of time

with a decrease of depressive symptoms through the follow-up (0.15 points per year). There was also a main effect of retirement with a sharp decrease of depressive symptoms of −1.93 points. The positive interaction between time and retirement shows that depressive symptoms deteriorated more quickly after retirement. Specifically, the slope of depressive symptoms was of −0.15 points per year before retirement versus −0.08 points (i.e.  $-0.15 + 0.07$ ) after retirement (Model 1, Table 2).

The inclusion of BMI categories into Model 2 did not change these main effects and the interaction but showed that BMI was not only associated with depressive symptoms but also a significant moderator of the main effects of time and retirement.

First, there was a positive interaction between BMI and time, showing that depressive symptoms deteriorated faster in participants in the presence of overweight and obesity (Table 2, Fig. 3). Specifically, individuals in the case of normal weight had a loss in depressive symptoms (i.e. amelioration) of −0.19 points per year over time, whereas those in the case of overweight and obesity had only a loss of −0.13 (i.e.  $-0.19 + 1*0.06$ ) and −0.07 (i.e.  $-0.19 + 2*0.06$ ) points, respectively.

However, there was also a negative interaction between BMI and retirement, showing a stronger improvement of depressive symptoms upon retirement in participants in the presence of overweight and obesity (Table 2, Fig. 3). Specifically, individuals in the case of normal weight had a reduction in depressive symptoms of −1.70 points upon retirement, whereas those in the presence of overweight and obesity had a reduction of −2.06 (i.e.  $-1.70 - 1*-0.36$ ) and −2.42 (i.e.  $-1.70 - 2*-0.36$ ), respectively.

The double interaction between BMI, time and retirement was not significant, showing that the slope of depressive symptoms by time increased after retirement to a similar extent irrespective of BMI (Model 2, Fig. 3).

### 3.3. Supplementary analyses

To check whether the higher improvement upon retirement in the presence of obesity could be explained by a regression toward the mean, sensitivity analyses used the percentage of deviation to the mean as the outcome variable (for self-rated health and depressive symptoms) also found a significant and negative interaction between BMI and retirement (Supplementary Table 2).

Further sensitivity analyses included alcohol intake and smoking status in the models and showed similar results, except for the interaction between BMI and time for self-rated health, which was no longer significant ( $p = .38$ , Supplementary Table 4). The parameter estimate of this interaction between BMI and time became 0.0014 (0.0056 in the original model). In addition, the main analyses were repeated in men and women, separately, and yielded similar results regarding effect sizes, though some results were no longer significant in women regarding depressive symptoms (Supplementary Tables 5a and b).

Finally, exploratory analyses showed the same interpretations with mental and physical fatigues in both models (Supplementary Table 1 and Supplementary Figs. S1 and S2).

## 4. Discussion

### 4.1. Main findings

To our knowledge, this longitudinal study is the first to investigate whether health changes associated with retirement – which have been found positive in previous studies [4,5,26,27] – may depend upon obesity. Although self-rated health and depressive symptoms tended to be higher and have a less favorable course over time in the presence of obesity, improvement upon retirement was also observed in this case and was even higher than in the presence of normal weight.

### 4.2. Strengths and limitations

One of the main strengths of this study is the yearly follow-up of the participants during 21 years around retirement. An additional strength is the sample composition consisting of > 17,000 workers with a large diversity sample population in terms of occupational grade, representing all regions of France. Moreover, the longitudinal aspect and the thorough assessment of data gathered in the GAZEL cohort, makes it unique in terms of the interdisciplinary aspects of the study and the credibility of the results. One more advantage is that data collection comes from different sources: self-reported and extracted from company.

One limitation is that depressive symptoms were only measured on selected years. Second, although a large sample size offers statistical power, the clinical significance of our results might be challenged. However, the difference in self-rated health changes upon retirement between in the case of normal weight versus obesity was similar to the effects of seven years of age (i.e.  $-2 \times 0.05/0.014$ ). In addition, it has been shown that individuals with poor self-rated health have a two-fold higher mortality risk compared with persons with “excellent” self-rated health [28]. Third, since healthy participants usually participate, our results might have underestimated the strength of the association between obesity and health components [22]. Fourth, one may argue that self-rated health is a crude indicator of health status. Despite its simplicity, however, it has demonstrated a strong relationship with several health outcomes, including mortality [23]. For instance, results from a Finnish study showed that poor self-rated health was a strong predictor of mortality, and that the association is only partly explained by medical history, cardiovascular disease risk factors, and education [29]. Moreover, positive self-rated health has been shown to be associated with a decreased risk of hospitalization for any cause among older individuals [30]. Additionally, self-rated health has been shown to be a strong predictor of incident fatal and non-fatal cardiovascular events among adults even after adjustment of socio-demographic, clinical and behavioural risk factors after 10 years of follow-up [31]. Finally, self-rated health offers two advantages over reporting the presence or absence of several conditions by a “yes” or “no” answer: it may index the severity of the physical conditions; it may also capture the presence of physical conditions not assessed in the survey (e.g. multiple sclerosis). Fifth, many confounding factors such as diet or physical activity were not adjusted for in the present study. For instance, data on ethnicity was

not available because it is not allowed by French law. As regards tobacco and alcohol consumption, their inclusion was only considered in sensitivity analyses because these variables might also act as mediators of the associations. However, their inclusion in the model did not affect our results much, except for the interaction between BMI and time for self-rated health, which was no longer present; this does not change the interpretations of the results regarding the interaction of BMI with retirement. Sixth, the number of female participants was three-fold lower than that of male participants and our analyses might have been underpowered in women, as suggested by a lack of statistical significance for some effects, despite similar or even greater effect sizes. Finally, participants come from the same company which limits generalization of the results to different populations (e.g. individuals retired quite early in the GAZEL cohort).

### 4.3. Explanatory hypotheses

The association between BMI and poor physical or mental health has received extensive support from the literature for instance obesity has been linked with depression with several explanatory hypotheses, ranging from purely psychological ones (e.g. the emotional impact of stigma on obesity related stigma on mood) [32] to purely biological ones (e.g. the role of inflammation) [33]. This relationship has been comprehensively discussed elsewhere so that we will focus our results with the interaction with retirement). It has been shown in the GAZEL cohort, that retirement decreases the risk of bad health as well as of depressive symptoms and of mental and physical fatigues [4,5]. Our results show that the positive effects of retirement are observed even in the presence of obesity. This might be due to the removal of work-related sources of stress as well as more time to engage in pleasurable or meaningful activities [4]. Even though, the interaction between BMI and retirement was significant for both self-rated health and depressive symptoms, so obesity was associated with a better amelioration than normal weight and overweight. Sensitivity analyses suggested that this interaction was robust and not explained by a regression toward the mean. Therefore, this interaction suggests that the burden of work might have been substantially worsened by obesity, thus accounting for a higher improvement upon retirement in this case. In fact, studies on obesity in the workplace have shown that obesity can modify job demands and affect worker capacity in terms of muscular work which may lead to fatigue among workers who are obese [34]. Moreover, physical working conditions have been shown to increase the risk of injuries in individuals with overweight and individuals with obesity, in the case of sedentary job, which applies to GAZEL participants, obesity adding more risk such as impaired circulation [34]. Obesity may be associated with cognitive impairment. Studies have shown that even when controlling for cognitive aging, there is a negative correlation between BMI and global cognitive performance. Even though different cognitive domains make it difficult to draw a conclusion, but across studies short-term memory and executive function have been found to be affected in obese compared to normal weight counterparts [35]. The impairment of cognitive function makes several tasks more demanding. In addition, obesity may not only make physical or mental tasks harder or more hazardous, but may also increase emotional demands. Emotional job demand is an occupational risk that could lead to high levels of interpersonal stress in the workplace. More precisely, emotional job demand refers to displaying demands (i.e., expressing positive, negative, and neutral emotions toward public), facing sensitivity demands (e.g., guessing what the public is feeling), and dealing with potential emotional mistreatments (e.g., facing the dissatisfaction of a client) [36]. Moreover, individuals with obesity face more stigmatization. Results from a meta-analysis show that perceptions of weight discrimination by individuals with obesity are common and have negative consequences [37].

## 5. Conclusions

Accounting for BMI at all-time points, we have observed that all individuals were likely to experience significant improvements in both self-rated health and depressive symptoms; obesity was even associated with a higher amelioration upon retirement. Obviously, these findings should not be interpreted as advantages of obesity, which is by itself associated with poorer health outcomes, as shown in the present study. On the contrary, these findings rather highlight the extra work-related burden carried by individuals with obesity and thus the extra relief brought to upon retirement. Should these results be replicated in different settings, they could be considered when anticipating the effects of retirement on health, for instance during retirement preparation programs. Retirement preparation programs were implemented in order to make the work-retirement transition more smoothly. They usually consist of activities in the near retirement phase and assist people for the future, not only in terms of financial aspects but also on the psychological level [38]. Our findings also suggest taking extra care when evaluating the burden of work for workers in the presence of overweight and obesity.

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.jpsychores.2020.109938>.

## Contributorship statement

JM takes responsibility for all aspects of the reliability and freedom from bias of the data presented and their discussed interpretation; JM, CL and SC designed the study; MZ and MG acquired the data; JM and CL performed statistical analysis; all authors contributed to the interpretation of data; JM, CL and SC drafted the article; CC, MZ and MG revised it critically for important intellectual content. All authors have read and approved the final manuscript.

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## Patient and Public Involvement

The participants of the GAZEL cohort were not part of the study design.

The results are disseminated through a bi-yearly journal that is sent to the participants.

## Data sharing statement

No additional data available.

## Declaration of Competing Interest

CL reports personal fees and non-financial support from Boehringer Ingelheim, Janssen-Cilag, Lundbeck and Otsuka Pharmaceutical, outside the submitted work. SC reports personal fees from Novo, Lilly, Servier, BMS, outside the submitted work. SC holds share of MyGoodLife. Other authors have nothing to disclose.

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