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Prevalence and Sociodemographic Correlates of Mental Multimorbidity in Adults: Evidence from a French Population-Based Cohort

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Abstract

The study aimed to assess the prevalence rates and sociodemographic characteristics associated with mental health issues and their co-occurrence. Researchers conducted a descriptive cross-sectional study using data from 25,269 female and 8,389 male participants in the French NutriNet-Santé population-based cohort. Individuals were categorized into eight categories: 1. No mental health issues; 2. Anxiety alone; 3. Insomnia alone; 4. Eating disorders (ED) alone; 5. Co-occurring anxiety and insomnia; 6. Co-occurring anxiety and ED; 7. Co-occurring insomnia and ED; 8. Co-occurrence of all three (anxiety, insomnia, and ED). Analyses involved weighting the data according to the 2016 French national census and applying chi-squared tests for comparisons.

Overall, 40.6% of participants exhibited at least one mental health condition, while 2.3% presented with all three conditions simultaneously. Both isolated and co-occurring conditions were generally more prevalent among women compared to men. Among men, the group with all three conditions showed the highest rates of overweight (52.1%) and current smoking (23.2%). Men with co-occurring insomnia and ED had the highest prevalence of obesity (45.8%) and low levels of physical activity (44.3%). Women with two or more conditions displayed the highest rates of current smoking. These results may guide future investigations, preventive strategies, and public health policies targeting mental health co-occurrence.

Keywords: Mental multimorbidity, General population, Insomnia, Eating disorders, Anxiety

Introduction

The co-occurrence of two or more chronic conditions is commonly described as *comorbidity* when one condition is designated as primary, or as *multimorbidity* when no single condition predominates [1]. Both patterns are associated with more severe clinical presentations, greater reliance on healthcare services, and less favorable health outcomes [2, 3]. Existing research on comorbidity and multimorbidity has predominantly focused on physical diseases among older adults [4, 5]. In contrast, mental health conditions have received comparatively limited attention in public health research across age groups, despite their major contribution to the overall disease burden. This imbalance has been intensified by the COVID-19 pandemic [6] and by evidence showing substantially reduced life expectancy among individuals living with mental disorders compared with the general population [7, 8]. Data from the World Health Organization (WHO) Mental Health Surveys conducted in 27 countries further indicate that experiencing any mental disorder during one's lifetime markedly elevates the risk of developing additional mental conditions, with this increased vulnerability persisting for more than 15 years [9].

This study concentrates on anxiety, insomnia, and eating disorders (ED), three mental health conditions that are widespread in the general population, frequently co-occur, and are responsive to preventive and therapeutic interventions [10–12]. Anxiety disorders—which include generalized anxiety disorder, panic disorder, social

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anxiety disorder, and phobias—are the most prevalent, affecting an estimated 4% to 25% of individuals, with disproportionately higher rates among women, younger adults, and those with chronic medical conditions [13]. Globally, the burden of anxiety disorders has risen sharply, with disability-adjusted life years increasing by nearly 54% between 1990 and 2019 across all age groups [14]. Sleep disturbances are also commonly observed alongside anxiety and other psychiatric disorders, as demonstrated by meta-analytic evidence suggesting dysregulation of arousal processes [15]. Moreover, network analytic approaches have identified complex interrelationships among symptoms of anxiety, sleep disorders, and ED, underscoring shared underlying mechanisms [11].

Large-scale population studies such as the U.S. National Comorbidity Survey (1990–1992) and its subsequent replication (2001–2003) were instrumental in establishing the prevalence and correlates of co-occurring mental disorders [3, 16]. Despite these early contributions, relatively few epidemiological investigations have examined how sociodemographic characteristics differ between individuals with single mental disorders and those with comorbid or multimorbid presentations in the general population [17–20]. Such analyses are crucial for identifying populations at elevated risk. To date, no population-based epidemiological study has specifically explored the simultaneous occurrence of anxiety, sleep disturbances or insomnia, and ED among adults. Evidence addressing all three conditions together is limited to a small cross-sectional study of 130 Brazilian adults with overweight or obesity, which reported that participants younger than 45 years with high trait anxiety also exhibited greater binge eating behaviors and poorer sleep quality, based on pairwise correlations [21].

Given the growing recognition of mental multimorbidity as a public health concern, further research is urgently needed to guide targeted prevention strategies and policy development. Accordingly, the present descriptive study aimed to quantify the prevalence and extent of mental multimorbidity involving anxiety, insomnia, and ED, and to characterize the sociodemographic profiles associated with isolated versus multimorbid conditions. In light of consistently higher prevalence estimates of anxiety [13], insomnia [22], and ED [23] among women, analyses were conducted separately for women and men to explore sex-specific patterns.

Materials and Methods

Research context

The present analysis was conducted within the framework of the MEMORIES Project, a four-year research initiative initiated in France in 2022 (https://memories-anr.univ-paris13.fr/). The project seeks to clarify the associations between mental morbidity, including multimorbidity, and the risk of metabolic conditions such as obesity and type 2 diabetes [24].

Study population

Data for the MEMORIES Project were drawn from the NutriNet-Santé study, an ongoing web-based population cohort established in 2009 (https://etude-nutrinet-sante.fr/). The study's methodology and aims have been described in detail previously [25]. In brief, adults aged 18 years or older who are able to read French and participate in an online study are recruited from the general population through nationwide media outreach. Ethical approval was obtained from the Institutional Review Board of the French Institute for Health and Medical Research as well as from the National Commission on Informatics and Liberty. All participants provide electronic informed consent prior to joining the cohort.

Information is collected using self-administered online questionnaires. At baseline and annually thereafter, participants report sociodemographic characteristics, anthropometric measures, lifestyle behaviors, dietary intake, physical activity, and health status. During follow-up, optional thematic questionnaires related to nutrition or health are also administered. Assessments of mental health, detailed below, were integrated into the routine follow-up procedures of the cohort.

Anxiety assessment

General susceptibility to anxiety was assessed using the 20-item trait anxiety scale of the State-Trait Anxiety Inventory, Form Y (STAI-T), which allows differentiation between anxiety proneness and depressive symptoms [26, 27]. Previous research has demonstrated a strong correlation between STAI-T scores and generalized anxiety disorder [28]. Responses to each item are rated on a four-point Likert scale ranging from "Almost never" to "Almost always," with higher total scores indicating greater trait anxiety. The STAI-T questionnaire was administered once per participant

between 2013 and 2016. Among the 119,451 cohort members invited to complete the questionnaire, 40,809 responded. Consistent with earlier epidemiological studies [29], STAI-T scores were categorized into sex-specific quartiles, with the highest quartile (Q4) defining elevated trait anxiety (Q4 ≥ 41 for men and Q4 ≥ 46 for women).

Insomnia assessment

Sleep characteristics were evaluated through a dedicated questionnaire distributed in 2014, to which 57,105 of the 128,042 invited participants responded within a six-month period. The questionnaire covered multiple dimensions of sleep, including duration, chronotype, napping habits, acute and chronic insomnia, and sleep disturbances related to stress. For the purposes of the present analysis, chronic insomnia was defined in accordance with the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) [30], and the International Classification of Sleep Disorders, Third Edition (ICSD-3) [31]. Questionnaire items reflected these diagnostic criteria, capturing difficulties initiating sleep and/or frequent nocturnal awakenings occurring at least three nights per week for a minimum of three months, as well as associated impairments in daytime functioning.

Assessment of eating disorders (ED)

The presence of any eating disorder—regardless of subtype—was evaluated in 2014 and again in 2017 through the five-question SCOFF screening tool [32, 33]. Items are binary (yes/no), with examples including "Do you feel that you've lost control over your eating?" and "Does food seem to dominate your daily life?" A cutoff of two or more positive responses signals a probable ED, demonstrating sensitivity and specificity above 94% when compared to structured diagnostic interviews [33]. SCOFF results are considered to identify probable cases of ED, offering a close approximation of current prevalence rates [34]. Among the 125,279 cohort participants invited to complete the SCOFF in 2014, 51,073 submitted responses within six months. Those who missed the 2014 assessment but completed it in 2017 (n = 6,570) were also incorporated into the analysis.

Evaluation of sociodemographic characteristics

Baseline and yearly follow-up questionnaires collected details on gender, age, relationship status, educational level, employment, smoking behavior, body measurements, and exercise habits, employing established tools for sociodemographic information [35] and body metrics [36, 37]. Body mass index (BMI in kg/m²) was derived from self-reported height and weight values. Exercise levels were measured via the abbreviated International Physical Activity Questionnaire (IPAQ), processed using the recommended scoring method [38].

For every individual, the midpoint date across the three mental health evaluations (conducted between 2013 and 2017) was computed. Corresponding sociodemographic variables were drawn from data collected within a two-year period centered on that midpoint. Cases lacking complete information for any variable were removed from further examination.

Approach to statistical analysis

Each participant's results from the three mental health tools were converted into binary indicators (present/absent) for the relevant condition, yielding eight distinct categories: absence of any condition, isolated anxiety, isolated insomnia, isolated ED (any form), anxiety combined with insomnia, anxiety combined with ED, insomnia combined with ED, and the presence of all three conditions together. The study then explored overall rates of mental health conditions alongside the sociodemographic features of those experiencing one, two, or all three issues. Variables examined included age (continuous and grouped as 18–39, 40–59, or ≥60 years), relationship status (single vs. partnered/cohabiting), educational attainment (< high school diploma, high school level, postsecondary coursework, bachelor's or higher degree), employment category (unemployed, self-employed/farmer/artisan, manual laborer, clerical/administrative role, managerial/professional role, retired), BMI (continuous and categorized as underweight [<18.5], normal [18.5–24.9], overweight [25.0–29.9], obese [≥30.0]), smoking history (never, past, current), and activity level (low, moderate, high).

To enhance representativeness, weighting adjustments were implemented using the SAS CALMAR procedure developed by the French national statistical office [39]. Weights reflected distributions of gender, age, and socioeconomic indicators from the 2016 French national census. Subsequent comparisons on the adjusted dataset employed chi-squared tests, conducted in SAS 9.4 (SAS Institute, Inc., Cary, NC, United States).

Screening for Eating Disorders (ED)

Any form of eating disorder, irrespective of specific subtype, was screened for in the years 2014 and 2017 by means of the five-item SCOFF questionnaire [32, 33]. The questions are answered with yes or no—for instance, "Do you feel you've lost control over how much you eat?" and "Does food control your life?"—and a total of two or more yes responses meets the threshold for probable ED, achieving sensitivity and specificity greater than 94% against diagnostic interviews as the gold standard [33]. Findings from the SCOFF are taken to represent probable eating disorders and provide a good estimate of point prevalence in the population [34]. Out of 125,279 participants who were sent the SCOFF questionnaire in 2014, 51,073 completed and returned it within a six-month period. Those who skipped the 2014 administration but filled it out in 2017 (n = 6,570) were likewise included in the research sample.

Collection of sociodemographic information

Information regarding gender, age, relationship status, level of education, job type, smoking habits, body measurements, and levels of physical activity was obtained at study entry and every year afterward through well-established questionnaires covering sociodemographic details [35] and anthropometric data [36, 37]. Body mass index (BMI, expressed in kg/m²) was determined based on the height and weight reported by participants. Levels of physical activity were determined with the short version of the International Physical Activity Questionnaire (IPAQ) and calculated according to the official guidelines [38].

For every participant, the average completion date of the three mental health questionnaires (which took place from 2013 to 2017) was first established. Sociodemographic variables were then taken from questionnaire responses provided within a two-year period before and after this average date. Any participant missing data for one or more of these variables was not included in the final analyses.

Statistical methods

The results of the three mental health screening tools were turned into yes/no indicators for each condition in every participant, leading to the formation of eight separate groups: no condition present, anxiety by itself, insomnia by itself, eating disorder (of any kind) by itself, anxiety together with insomnia, anxiety together with eating disorder, insomnia together with eating disorder, and all three conditions occurring simultaneously. The analysis then focused on the overall occurrence of these mental health issues and on the sociodemographic traits of individuals who had one, two, or all three conditions. The variables studied were age (used both as a continuous measure and divided into three categories: 18–39 years, 40–59 years, and 60 years or older), relationship status (living alone versus married or cohabiting), educational background (less than high school, high school diploma or equivalent, some postsecondary education, bachelor's degree or higher), occupational category (no paid work, self-employed/farmer/craftsperson, manual worker, clerical or administrative employee, managerial or professional role, retired), BMI (kg/m², both continuous and grouped into underweight [<18.5], normal weight [18.5–24.9], overweight [25.0–29.9], obese [≥30.0]), smoking behavior (never smoked, ex-smoker, current smoker), and physical activity category (low, moderate, high).

To make the sample more representative of the general population, statistical weighting was carried out using the CALMAR macro in SAS, created by the French national statistics authority [39]. The weights were based on the 2016 French census distributions for gender, age, and socioeconomic position. All subsequent statistical tests on the weighted dataset were chi-squared tests performed with SAS version 9.4 (SAS Institute, Inc., Cary NC, United States).

Results and Discussion

A total of 33,658 participants—comprising 25,269 women and 8,389 men—had complete data on mental health measures and all covariates and were therefore retained for analysis **(Figure 1)**. Crude and census-weighted prevalence estimates of mental morbidity, overall and stratified by sex, are reported in **Table 1**. Overall, 40.6% of participants experienced at least one mental health condition, with a lower prevalence observed among men (37.4%) than women (43.6%). The simultaneous presence of anxiety, insomnia, and eating disorders was identified in 2.3% of the sample, affecting 1.4% of men and 3.1% of women.

Among both sexes, the most frequently observed comorbid pattern was the co-occurrence of anxiety and insomnia (6.1% in men and 6.4% in women), whereas the combination of insomnia and eating disorders was the least common (0.9% in men and 1.6% in women). Sex-stratified sociodemographic characteristics associated with mental morbidity are displayed using both

unweighted and weighted data in **Table 2** for women and **Table 3** for men.

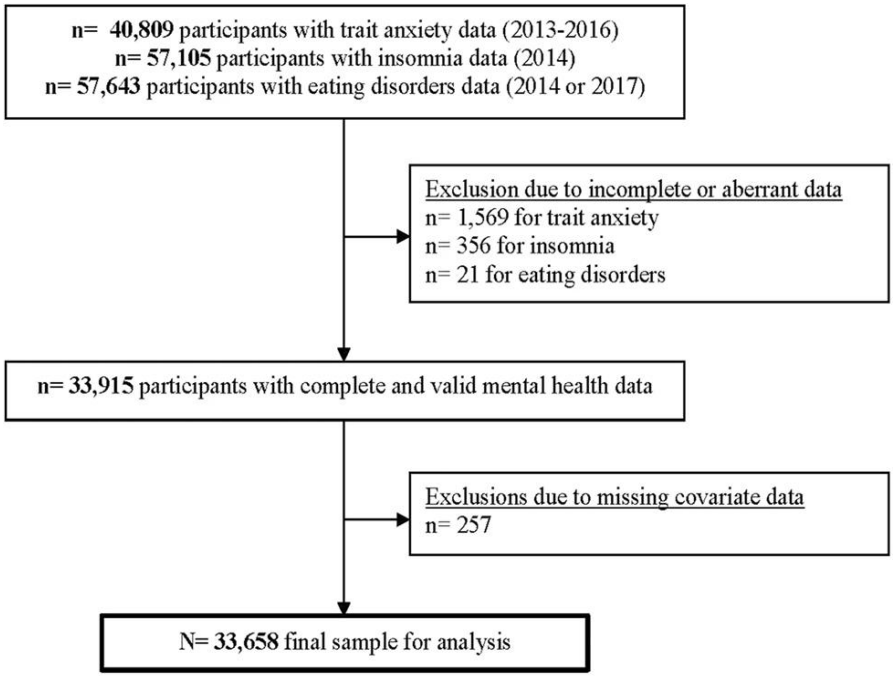

Figure 1. Flow diagram illustrating participant inclusion and exclusion in the NutriNet-Santé cohort analysis (France, 2013–2017).

Table 1. Prevalence of insomnia, anxiety, and eating disorders in the NutriNet-Santé cohort, overall and by sex (France, 2013–2017).

Mental Health Condition	p-value	Overall Raw No.	Overall %	Overall Weighted %	Men Raw No.	Men %	Men Weighted %	Women Raw No.	Women %	Women Weighted %
Chronic insomnia	<0.0001									
No		26,933	80.0	81.5	7,274	86.7	85.2	19,659	77.8	78.2
Yes		6,725	20.0	18.5	1,115	13.3	14.8	5,610	22.2	21.8
General (trait) anxiety	0.42									
No		25,056	74.4	74.6	6,273	74.8	74.1	18,783	74.3	75.0
Yes		8,602	25.6	25.4	2,116	25.2	25.9	6,486	25.7	25.0
Degree of mental multimorbidity	<0.0001									
None		19,508	58.0	59.4	5,413	64.5	62.6	14,095	55.8	56.4
General (trait) anxiety only		4,453	13.2	13.6	1,368	16.3	15.8	3,085	12.2	11.7
Chronic insomnia only		3,235	9.6	8.7	508	6.1	6.5	2,727	10.8	10.6

Eating disorder only (any type)		1,824	5.4	5.2	300	3.6	4.1	1,524	6.0	6.3
Anxiety and insomnia		2,180	6.5	6.3	468	5.6	6.1	1,712	6.8	6.4
Anxiety, insomnia, and eating disorders		**821**	**2.4**	2.3	**87**	**1.0**	1.4	**734**	**2.9**	3.1
Insomnia and eating disorders		489	1.5	1.3	52	0.6	0.9	437	1.7	1.6
Eating disorder (any type)	<0.0001									
No		29,376	87.3	87.9	7,757	92.5	91.0	21,619	85.6	85.1
Yes		4,282	12.7	12.1	632	7.5	9.0	3,650	14.4	14.9

[a] Weighted percentages calculated using calibration weights based on sex, age, and socioeconomic status distributions from the 2016 French Census.

[b] Trait anxiety assessed using the STAI-T, with high anxiety defined by sex-specific upper-quartile thresholds (≥41 for men and ≥46 for women).

[c] Chronic insomnia identified in accordance with diagnostic criteria from the DSM-5 and the ICSD-3.

[d] Likely eating disorder defined by endorsement of at least two items on the SCOFF screening instrument.

Table 2. Sociodemographic characteristics of female participants by mental morbidity category in the NutriNet-Santé cohort (France, 2013–2017; n = 25,269).

Characteristic	No mental morbidity (n=14,095)	Pure anxiety[a] (n=3,085)	Pure insomnia ^b^ (n=2,727)	Pure eating disorders ^c^ (n=1,524)	Anxiety and insomnia (n=1,712)	Anxiety and eating disorders (n=955)	Insomnia and eating disorders (n=437)	Anxiety, insomnia, and eating disorders (n=734)
Marital status								
Married/cohabiting	10,564 (75.0) Weighted: 72.5%	2,201 (71.4) Weighted: 69.4%	2,053 (75.3) Weighted: 77.2%	1,121 (73.6) Weighted: 71.8%	1,211 (70.7) Weighted: 71.6%	656 (68.7) Weighted: 65.9%	321 (73.5) Weighted: 71.8%	494 (67.3) Weighted: 66.6%
Living alone	3,531 (25.0) Weighted: 27.5%	884 (28.6) Weighted: 30.6%	674 (24.7) Weighted: 22.8%	403 (26.4) Weighted: 28.2%	501 (29.3) Weighted: 28.4%	299 (31.3) Weighted: 34.1%	116 (26.5) Weighted: 28.2%	240 (32.7) Weighted: 33.4%
Age, years (mean ± SD)	51.1 ± 13.9	48.3 ± 14.0	52.7 ± 12.1	49.3 ± 13.8	51.0 ± 12.6	46.4 ± 14.0	51.9 ± 11.6	47.9 ± 12.7
Age categories								
18–39 years	3,521 (25.0) Weighted: 30.4%	985 (31.9) Weighted: 39.2%	464 (17.0) Weighted: 20.3%	423 (27.8) Weighted: 39.5%	367 (21.5) Weighted: 30.6%	344 (36.0) Weighted: 45.9%	72 (16.5) Weighted: 19.9%	211 (28.8) Weighted: 37.3%
40–59 years	5,825 (41.3) Weighted: 40.2%	1,282 (41.6) Weighted: 40.7%	1,396 (51.2) Weighted: 52.8%	654 (42.9) Weighted: 42.7%	865 (50.5) Weighted: 52.2%	392 (41.1) Weighted: 42.1%	237 (54.2) Weighted: 58.9%	376 (51.2) Weighted: 52.2%
60+ years	4,749 (33.7) Weighted: 29.4%	818 (26.5) Weighted: 20.1%	867 (31.8) Weighted: 26.9%	447 (29.3) Weighted: 17.8%	480 (28.0) Weighted: 17.2%	219 (22.9) Weighted: 12.0%	128 (29.3) Weighted: 21.2%	147 (20.0) Weighted: 10.5%

Educational level								
Undergraduate/graduate	5,130 (36.4) Weighted: 31.6%	1,146 (37.2) Weighted: 32.8%	919 (33.7) Weighted: 32.7%	477 (31.3) Weighted: 29.8%	527 (30.8) Weighted: 27.3%	292 (30.6) Weighted: 28.0%	129 (29.5) Weighted: 21.7%	203 (27.7) Weighted: 24.4%
< High school	2,315 (16.4) Weighted: 19.2%	527 (17.1) Weighted: 21.3%	432 (15.8) Weighted: 19.7%	314 (20.6) Weighted: 21.4%	320 (18.7) Weighted: 21.4%	173 (18.1) Weighted: 19.4%	92 (21.0) Weighted: 27.5%	153 (20.8) Weighted: 24.9%
High school or equivalent	1,854 (13.2) Weighted: 15.8%	458 (14.8) Weighted: 16.8%	375 (13.8) Weighted: 15.6%	214 (14.0) Weighted: 16.6%	283 (16.5) Weighted: 20.2%	153 (16.0) Weighted: 22.2%	71 (16.3) Weighted: 21.8%	124 (16.9) Weighted: 20.6%
Some college	4,796 (34.0) Weighted: 33.4%	954 (30.9) Weighted: 29.1%	1,001 (36.7) Weighted: 32.0%	519 (34.1) Weighted: 32.2%	582 (34.0) Weighted: 31.1%	337 (35.3) Weighted: 30.4%	145 (33.2) Weighted: 29.0%	254 (34.6) Weighted: 30.1%
Occupation/employment								
Retired	4,546 (32.3) Weighted: 17.6%	771 (25.0) Weighted: 11.6%	841 (30.8) Weighted: 16.6%	442 (29.0) Weighted: 13.0%	447 (26.1) Weighted: 11.2%	201 (21.0) Weighted: 7.1%	112 (25.6) Weighted: 11.2%	150 (20.4) Weighted: 6.4%
No professional activity [e]	1,409 (10.0) Weighted: 28.8%	458 (14.8) Weighted: 35.1%	313 (11.5) Weighted: 29.6%	148 (9.7) Weighted: 22.9%	246 (14.4) Weighted: 31.7%	151 (15.8) Weighted: 33.6%	60 (13.7) Weighted: 31.2%	137 (18.7) Weighted: 36.5%
Self-employed/artisan	283 (2.0) Weighted: 2.5%	38 (1.2) Weighted: 1.4%	65 (2.4) Weighted: 3.1%	30 (2.0) Weighted: 2.5%	34 (2.0) Weighted: 2.6%	22 (2.3) Weighted: 2.8%	7 (1.6) Weighted: 1.9%	11 (1.5) Weighted: 1.9%
Blue-collar worker	2,116 (15.0) Weighted: 26.7%	597 (19.4) Weighted: 30.5%	413 (15.2) Weighted: 26.8%	310 (20.3) Weighted: 38.2%	351 (20.5) Weighted: 34.3%	230 (24.1) Weighted: 37.2%	83 (19.0) Weighted: 31.5%	166 (22.6) Weighted: 36.8%
Administrative staff	2,425 (17.2) Weighted: 7.9%	531 (17.2) Weighted: 7.2%	492 (18.0) Weighted: 8.5%	244 (16.0) Weighted: 7.8%	293 (17.1) Weighted: 7.3%	161 (16.9) Weighted: 6.5%	88 (20.2) Weighted: 9.9%	126 (17.2) Weighted: 6.7%
Executive staff	3,316 (23.5) Weighted: 16.5%	690 (22.4) Weighted: 14.2%	603 (22.1) Weighted: 15.4%	350 (23.0) Weighted: 15.6%	341 (19.9) Weighted: 12.9%	190 (19.9) Weighted: 12.8%	87 (19.9) Weighted: 14.3%	144 (19.6) Weighted: 11.7%
BMI, kg/m² (mean ± SD)	23.4 ± 4.1	23.8 ± 4.4	25.8 ± 5.7	25.3 ± 6.4	23.6 ± 4.9	26.4 ± 5.7	25.9 ± 6.4	25.9 ± 6.4
BMI categories								
Obesity (≥30.0)	992 (7.1) Weighted: 6.8%	208 (6.7) Weighted: 6.3%	249 (9.1) Weighted: 9.0%	320 (21.0) Weighted: 19.2%	174 (10.1) Weighted: 12.0%	184 (19.2) Weighted: 17.2%	100 (22.8) Weighted: 23.0%	179 (24.7) Weighted: 22.5%
Overweight (25.0–29.9)	2,678 (19.0) Weighted: 20.1%	587 (19.0) Weighted: 21.3%	584 (21.4) Weighted: 19.6%	393 (25.8) Weighted: 25.4%	330 (19.3) Weighted: 18.8%	232 (24.3) Weighted: 22.4%	135 (30.9) Weighted: 32.0%	168 (22.9) Weighted: 21.5%
Normal weight (18.5–24.9)	9,689 (68.7) Weighted: 67.0%	2,081 (67.5) Weighted: 65.0%	1,755 (64.4) Weighted: 65.1%	755 (49.5) Weighted: 51.0%	1,080 (63.1) Weighted: 60.4%	456 (47.8) Weighted: 50.3%	193 (44.2) Weighted: 41.7%	331 (45.1) Weighted: 46.9%

Underweight (<18.5)	736 (5.2) Weighted: 6.1%	209 (6.8) Weighted: 7.4%	139 (5.1) Weighted: 6.3%	56 (3.7) Weighted: 4.4%	128 (7.5) Weighted: 8.8%	83 (8.7) Weighted: 10.1%	9 (2.1) Weighted: 3.3%	56 (7.3) Weighted: 9.1%
Physical activity level [f]								
High	4,910 (34.8) Weighted: 33.7%	852 (27.6) Weighted: 26.0%	918 (33.7) Weighted: 32.3%	523 (34.3) Weighted: 33.5%	569 (33.3) Weighted: 35.5%	270 (28.3) Weighted: 31.8%	153 (35.0) Weighted: 32.4%	211 (28.8) Weighted: 29.7%
Moderate	6,182 (43.9) Weighted: 44.3%	1,292 (41.9) Weighted: 40.7%	1,149 (42.1) Weighted: 44.3%	629 (41.3) Weighted: 42.0%	687 (40.1) Weighted: 36.9%	402 (42.1) Weighted: 36.2%	151 (34.6) Weighted: 39.1%	285 (38.8) Weighted: 37.3%
Low	3,003 (21.3) Weighted: 22.0%	941 (30.5) Weighted: 33.3%	660 (24.2) Weighted: 23.4%	372 (24.4) Weighted: 24.5%	456 (26.6) Weighted: 27.6%	283 (29.6) Weighted: 32.0%	133 (30.4) Weighted: 28.5%	238 (32.4) Weighted: 33.0%
Smoking status								
Current smoker	1,440 (10.2) Weighted: 11.3%	376 (12.2) Weighted: 12.6%	283 (10.4) Weighted: 11.0%	172 (11.3) Weighted: 11.9%	195 (11.4) Weighted: 12.3%	139 (14.5) Weighted: 18.8%	52 (11.9) Weighted: 15.1%	112 (15.3) Weighted: 16.7%
Former smoker	4,951 (35.1) Weighted: 34.7%	997 (32.3) Weighted: 30.2%	1,063 (39.0) Weighted: 40.6%	603 (39.6) Weighted: 36.1%	645 (37.7) Weighted: 38.1%	313 (32.8) Weighted: 31.8%	206 (47.1) Weighted: 46.9%	297 (40.4) Weighted: 37.3%
Never smoker	7,704 (54.7) Weighted: 54.0%	1,712 (55.5) Weighted: 57.2%	1,381 (50.6) Weighted: 48.4%	749 (49.1) Weighted: 52.0%	872 (50.9) Weighted: 49.6%	503 (52.7) Weighted: 49.4%	179 (41.0) Weighted: 38.0%	325 (44.3) Weighted: 46.0%

Data are presented as counts and percentages unless otherwise specified. Differences across mental morbidity categories were examined using chi-square tests for categorical variables; all comparisons yielded p values < 0.0001.

BMI indicates body mass index.

[a] Trait anxiety assessed with the STAI-T, with elevated anxiety defined using sex-specific upper-quartile thresholds (≥41 for men and ≥46 for women).

[b] Chronic insomnia determined based on diagnostic criteria from the DSM-5 and the ICSD-3.

[c] Probable eating disorder identified by at least two positive responses on the SCOFF screening questionnaire.

[d] W denotes weighted percentages calculated using calibration weights reflecting the sex, age, and socioeconomic composition of the 2016 French Census.

[e] This category comprises participants who were unemployed, homemakers, on medical leave, students, or interns.

[f] Physical activity levels were assessed using the short version of the International Physical Activity Questionnaire (IPAQ), with classification based on a validated scoring algorithm.

Table 3. Sociodemographic characteristics of male participants by mental morbidity category in the NutriNet-Santé cohort (France, 2013–2017; n = 8,389).

Characteristic	No mental morbidity (n=5,413)	Pure anxiety[a] (n=1,368)	Pure insomnia[b] (n=508)	Pure eating disorders[c] (n=300)	Anxiety and insomnia (n=468)	Anxiety and eating disorders (n=193)	Insomnia and eating disorders (n=52)	Anxiety, insomnia, and eating disorders (n=87)
Age, years (mean ± SD)	58.7 ± 12.9	54.2 ± 14.4	58.8 ± 12.2	60.4 ± 11.5	54.2 ± 12.6	55.1 ± 13.4	57.8 ± 12.3	54.9 ± 11.5
Age categories								

18–39 years	584 (10.8) Weighted: 31.9%	268 (19.6) Weighted: 41.0%	41 (8.1) Weighted: 12.5%	22 (7.3) Weighted: 15.6%	58 (12.4) Weighted: 27.2%	34 (17.6) Weighted: 31.7%	6 (11.5) Weighted: 8.3%	12 (13.8) Weighted: 29.0%
40–59 years	1,660 (30.7) Weighted: 43.8%	513 (37.5) Weighted: 43.5%	187 (36.8) Weighted: 64.1%	88 (29.3) Weighted: 58.2%	231 (49.4) Weighted: 60.5%	70 (36.3) Weighted: 56.5%	20 (38.5) Weighted: 72.0%	44 (50.6) Weighted: 61.0%
60+ years	3,169 (58.5) Weighted: 24.3%	587 (42.9) Weighted: 15.5%	280 (55.1) Weighted: 23.4%	190 (63.4) Weighted: 26.2%	179 (38.4) Weighted: 12.3%	89 (46.1) Weighted: 11.8%	26 (50.0) Weighted: 19.7%	31 (35.6) Weighted: 10.0%
Educational level								
Undergraduate/graduate	2,086 (38.5) Weighted: 31.0%	559 (40.9) Weighted: 36.6%	213 (41.9) Weighted: 32.1%	92 (30.7) Weighted: 21.4%	183 (39.1) Weighted: 33.7%	52 (26.9) Weighted: 14.5%	15 (28.8) Weighted: 20.6%	27 (31.0) Weighted: 24.2%
< High school	1,377 (25.4) Weighted: 24.0%	297 (21.7) Weighted: 23.6%	115 (22.7) Weighted: 30.7%	113 (37.7) Weighted: 35.6%	99 (21.1) Weighted: 30.3%	64 (33.2) Weighted: 52.9%	20 (38.5) Weighted: 60.1%	26 (29.9) Weighted: 22.8%
High school or equivalent	620 (11.5) Weighted: 15.6%	174 (12.7) Weighted: 14.1%	55 (10.8) Weighted: 13.9%	37 (12.3) Weighted: 22.7%	65 (13.9) Weighted: 12.2%	27 (14.0) Weighted: 17.2%	7 (13.5) Weighted: 6.6%	14 (16.1) Weighted: 26.1%
Some college	1,330 (24.6) Weighted: 29.4%	338 (24.7) Weighted: 25.7%	125 (24.6) Weighted: 23.3%	58 (19.3) Weighted: 20.3%	121 (25.9) Weighted: 23.8%	50 (25.9) Weighted: 15.4%	10 (19.2) Weighted: 12.7%	20 (23.0) Weighted: 26.9%
Marital status								
Married/cohabiting	4,595 (84.9) Weighted: 73.4%	1,045 (76.4) Weighted: 59.8%	423 (83.3) Weighted: 76.3%	260 (86.7) Weighted: 83.0%	340 (72.7) Weighted: 59.3%	139 (72.0) Weighted: 39.3%	45 (86.5) Weighted: 85.0%	70 (80.5) Weighted: 79.2%
Living alone	818 (15.1) Weighted: 26.6%	323 (23.6) Weighted: 40.2%	85 (16.7) Weighted: 23.7%	40 (13.3) Weighted: 17.0%	128 (27.3) Weighted: 40.7%	54 (28.0) Weighted: 60.7%	7 (13.5) Weighted: 15.0%	17 (19.5) Weighted: 20.8%
Occupation/employment								
Retired	3,090 (57.1) Weighted: 16.6%	560 (40.9) Weighted: 9.5%	274 (53.9) Weighted: 14.4%	183 (61.0) Weighted: 16.2%	167 (35.7) Weighted: 7.5%	88 (45.6) Weighted: 7.5%	28 (53.9) Weighted: 11.4%	32 (36.8) Weighted: 5.2%
No professional activity [e]	155 (2.9) Weighted: 23.7%	92 (6.7) Weighted: 35.2%	20 (3.9) Weighted: 25.3%	9 (3.0) Weighted: 19.9%	35 (7.5) Weighted: 35.5%	17 (8.8) Weighted: 41.9%	3 (5.8) Weighted: 28.6%	8 (9.2) Weighted: 39.2%
Blue-collar worker	323 (6.0) Weighted: 29.5%	131 (9.6) Weighted: 30.0%	29 (5.7) Weighted: 29.9%	25 (8.3) Weighted: 43.6%	48 (10.3) Weighted: 28.8%	24 (12.4) Weighted: 32.5%	6 (11.5) Weighted: 43.7%	12 (13.8) Weighted: 30.4%
Self-employed/artisan	109 (2.0) Weighted: 7.9%	30 (2.2) Weighted: 4.4%	10 (2.0) Weighted: 6.3%	3 (1.0) Weighted: 2.1%	19 (4.1) Weighted: 8.1%	2 (1.0) Weighted: 2.1%	0 (0.0) Weighted: 0.0%	3 (3.4) Weighted: 7.5%
Executive staff	1,247 (23.0) Weighted: 10.2%	381 (27.9) Weighted: 9.4%	125 (24.6) Weighted: 10.2%	54 (18.0) Weighted: 6.7%	129 (27.5) Weighted: 8.4%	31 (16.1) Weighted: 4.2%	9 (17.3) Weighted: 6.2%	18 (20.7) Weighted: 5.6%
Administrative staff	489 (9.0) Weighted: 12.1%	174 (12.7) Weighted: 11.5%	50 (9.9) Weighted: 13.9%	26 (8.7) Weighted: 11.5%	70 (14.9) Weighted: 11.7%	31 (16.1) Weighted: 11.8%	6 (11.5) Weighted: 10.1%	14 (16.1) Weighted: 12.1%

BMI, kg/m² (mean ± SD)	25.2 ± 3.5	24.8 ± 3.8	25.3 ± 3.6	28.3 ± 4.4	25.4 ± 3.9	28.2 ± 5.0	29.0 ± 5.8	28.4 ± 4.8
BMI categories								
Obesity (≥30.0)	476 (8.8) Weighted: 7.5%	126 (9.2) Weighted: 9.8%	49 (9.6) Weighted: 11.0%	91 (30.3) Weighted: 30.2%	47 (10.0) Weighted: 14.2%	56 (29.0) Weighted: 44.9%	19 (36.5) Weighted: 45.8%	27 (31.0) Weighted: 37.6%
Overweight (25.0–29.9)	1,990 (36.8) Weighted: 30.4%	448 (32.7) Weighted: 32.1%	198 (39.0) Weighted: 34.2%	137 (45.7) Weighted: 36.9%	169 (36.1) Weighted: 34.9%	79 (40.9) Weighted: 40.4%	17 (32.7) Weighted: 28.1%	39 (44.8) Weighted: 52.1%
Normal weight (18.5–24.9)	2,920 (53.9) Weighted: 60.7%	760 (55.6) Weighted: 54.9%	255 (50.2) Weighted: 53.4%	72 (24.0) Weighted: 32.9%	248 (53.0) Weighted: 47.1%	57 (29.6) Weighted: 14.5%	16 (30.8) Weighted: 26.1%	21 (24.2) Weighted: 10.3%
Underweight (<18.5)	27 (0.5) Weighted: 1.4%	34 (2.5) Weighted: 3.2%	6 (1.2) Weighted: 1.4%	0 (0.0) Weighted: 0.0%	4 (0.9) Weighted: 3.8%	1 (0.5) Weighted: 0.2%	0 (0.0) Weighted: 0.0%	0 (0.0) Weighted: 0.0%
Physical activity level [f]								
High	2,686 (49.6) Weighted: 47.2%	522 (38.2) Weighted: 36.3%	223 (43.9) Weighted: 43.4%	135 (45.0) Weighted: 33.4%	185 (39.5) Weighted: 37.7%	69 (35.8) Weighted: 34.4%	21 (40.4) Weighted: 18.9%	35 (40.2) Weighted: 47.8%
Moderate	1,804 (33.3) Weighted: 35.4%	528 (38.6) Weighted: 39.0%	199 (39.2) Weighted: 38.3%	97 (32.3) Weighted: 36.4%	160 (34.2) Weighted: 29.2%	72 (37.3) Weighted: 30.7%	14 (26.9) Weighted: 36.8%	36 (41.4) Weighted: 33.3%
Low	923 (17.1) Weighted: 17.4%	318 (23.2) Weighted: 24.7%	86 (16.9) Weighted: 18.3%	68 (22.7) Weighted: 30.2%	123 (26.3) Weighted: 33.1%	52 (26.9) Weighted: 34.9%	17 (32.7) Weighted: 44.3%	16 (18.4) Weighted: 18.9%
Smoking status								
Current smoker	472 (8.7) Weighted: 13.6%	135 (9.9) Weighted: 11.6%	48 (9.4) Weighted: 15.6%	23 (7.7) Weighted: 13.1%	62 (13.2) Weighted: 13.6%	18 (9.3) Weighted: 4.6%	4 (7.7) Weighted: 7.8%	10 (11.5) Weighted: 23.2%
Former smoker	2,744 (50.7) Weighted: 40.5%	611 (44.6) Weighted: 36.0%	289 (56.9) Weighted: 43.3%	175 (58.3) Weighted: 41.4%	217 (46.4) Weighted: 44.6%	105 (54.4) Weighted: 47.1%	35 (67.3) Weighted: 62.9%	49 (56.3) Weighted: 32.2%
Never smoker	2,197 (40.6) Weighted: 45.9%	622 (45.5) Weighted: 52.4%	171 (33.7) Weighted: 41.1%	102 (34.0) Weighted: 45.5%	189 (40.4) Weighted: 41.8%	70 (36.3) Weighted: 48.3%	13 (25.0) Weighted: 29.3%	28 (32.2) Weighted: 44.6%

Unless otherwise indicated, results are expressed as counts with corresponding percentages. Comparisons between mental morbidity categories for categorical variables were performed using chi-square tests, with all associations reaching statistical significance ($p < 0.0001$).

BMI refers to body mass index.

[a] Disposition toward anxiety was measured using the STAI-T, with elevated anxiety defined by sex-specific upper-quartile thresholds (≥41 for men and ≥46 for women).

[b] Chronic insomnia was identified based on diagnostic criteria from the DSM-5 and the ICSD-3.

[c] Likely eating disorder was defined by endorsement of at least two items on the SCOFF screening tool.

[d] W indicates weighted percentages derived from calibration based on sex, age, and socioeconomic status distributions from the 2016 French Census.

[e] This group includes participants who were unemployed, homemakers, on medical leave, students, or interns.

[f] Physical activity was assessed using the short version of the International Physical Activity Questionnaire (IPAQ), with categorization based on a validated scoring method.

Sociodemographic profiles of anxiety, insomnia, and eating disorders among women

Among women, the highest concentration of younger adults aged 18–39 years (45.9%) was observed in the group with co-occurring anxiety and eating disorders, whereas the lowest proportion of women aged 60 years or older (10.5%) was found among those experiencing combined anxiety, insomnia, and eating disorders. The multimorbidity group was also characterized by the smallest shares of women holding executive-level positions and those who were retired (11.7% and 6.4%, respectively). Women with concurrent anxiety and eating disorders showed the greatest prevalence of underweight status (10.1%) and current smoking (18.8%). In contrast, women with comorbid insomnia and eating disorders exhibited the highest proportions of overweight and obesity (31.9% and 23.0%, respectively).

Sociodemographic profiles of anxiety, insomnia, and eating disorders among men

Clear differences in sociodemographic characteristics were also evident among men across mental morbidity categories **(Table 3)**. The group experiencing anxiety, insomnia, and eating disorders simultaneously included the lowest percentages of men aged 60 years or older (10.0%) and of those without a high school diploma (22.8%). Conversely, this group showed the highest proportions of men classified as overweight (52.1%) and current smokers (23.2%). Men with co-occurring anxiety and eating disorders were most frequently without professional employment (41.9%) and were more likely to live alone (60.7%). Meanwhile, the combination of insomnia and eating disorders among men was associated with the greatest prevalence of obesity (45.8%) and low levels of physical activity (44.3%).

Mental disorders are common worldwide and remain insufficiently treated and resourced, as emphasized by the World Health Organization [6]. In response to this public health challenge, the present large-scale descriptive investigation focused on anxiety, insomnia, and eating disorders (ED), selected because of their relatively high prevalence, frequent co-occurrence in the adult general population, and the availability of preventive and therapeutic strategies [10–12]. In this sample of 33,658 adults, weighted analyses indicated that 40.6% experienced at least one mental disorder, while 821 individuals presented with concurrent anxiety, insomnia, and ED. This form of multimorbidity was observed approximately twice as often in women as in men (3.1% versus 1.4%). Across most isolated and combined conditions, women consistently exhibited higher prevalence than men.

Distinct sex-related sociodemographic patterns were identified. Among women, the presence of two or more mental health conditions was associated with higher rates of smoking compared with women with none or only one condition, a pattern not observed in men. The highest proportions of younger adults (18–39 years) were seen among women with combined anxiety and ED and among men with anxiety alone. In contrast, obesity was most prevalent among individuals with comorbid insomnia and ED, regardless of sex. Notably, mental multimorbidity appeared to be linked to a greater clustering of behavioral risk factors in men than in women. Men with anxiety–insomnia–ED multimorbidity showed particularly high levels of overweight (52.1%) and current smoking (23.2%), whereas comparable patterns were not evident among women. These observations differ somewhat from previous findings in student populations, where anxiety and/or mood disorders were associated with increased daily tobacco use [40].

Overall, the results align with earlier epidemiological evidence demonstrating that psychiatric comorbidity is widespread in the general population and that sociodemographic and behavioral risk profiles differ substantially between individuals with single versus multiple mental disorders, with important implications for prevention and clinical care [17]. Prior studies examining 12-month comorbidity of anxiety, mood, and substance use disorders have shown that parental psychiatric history and childhood adversity were more strongly associated with comorbid anxiety–mood disorders than with either disorder alone, suggesting greater vulnerability and severity [17]. Consistent with the present findings, earlier research has also linked mental comorbidity to female sex, living alone, and lower socioeconomic status [17–20]. Furthermore, low levels of physical activity and obesity have each been independently associated with anxiety, ED, and insomnia or other sleep disorders [41–45]. Although ED subtypes were not distinguished in this study, the observed obesity prevalence suggests that restrictive ED forms were unlikely to be the primary drivers of the associations.

The frequent overlap of mental disorders, along with shared risk factors, genetic pathways, and activation of overlapping brain regions—particularly those involved

in emotion regulation, learning, and memory [7, 9, 46]—has led to challenges to the traditional categorical classification of mental illnesses. In this context, some scholars have proposed a general psychopathology dimension, often referred to as the "p factor," to account for the shared variance across mental disorders [47]. Similarly, the WHO conceptualizes mental health along a multidimensional continuum rather than as discrete categories [6]. Multiple biological and psychological mechanisms have been implicated in mental multimorbidity. For instance, the co-occurrence of anxiety and insomnia has been attributed to shared genetic susceptibility, alterations in circadian rhythm gene expression, dysregulation of neurotransmitters such as serotonin and dopamine, inflammatory processes, and cognitive features including rigidity, negative interpretation biases, rumination, and impaired social functioning [48–50]. Growing interest has also focused on the gut microbiome and the gut–brain axis, given their involvement in neuroendocrine, immune, inflammatory, and neurotransmitter systems [51]. Communication between the gut and brain occurs through both neural and humoral pathways, and existing evidence suggests a bidirectional relationship between intestinal dysbiosis and behavioral disturbances [51].

This study provides weighted prevalence estimates, supporting the external validity of the findings and reducing concerns about selection bias. The application of census-based weighting largely corrected for discrepancies between the cohort and the general French population in terms of age, sex, and educational attainment. Nevertheless, the cross-sectional nature of the analysis precludes causal inference, and the temporal sequencing of anxiety, insomnia, and ED could not be established. Prior research indicates complex, bidirectional, and potentially mediated relationships among these conditions [52–55], underscoring the need for longitudinal investigations. Additional limitations include the reliance on self-reported data from volunteer participants. Although insomnia was assessed using DSM-5 and ICSD-3 criteria and anxiety and ED were evaluated with validated instruments (STAI-T and SCOFF), these measures cannot replace clinical diagnoses. Moreover, the SCOFF questionnaire does not allow differentiation among ED subtypes. Finally, although race and ethnicity are important sociodemographic determinants, such data were not available in the present dataset.

Conclusion

In summary, this weighted population-based analysis provides detailed estimates of the prevalence and extent of mental multimorbidity involving anxiety, insomnia, and ED in adults. The identification of distinct sex-specific sociodemographic profiles may inform targeted prevention strategies and guide future cross-sectional and longitudinal research, including the development of moderation and mediation hypotheses. The substantial burden of mental comorbidity and multimorbidity also highlights the need for methodological advances, such as composite measures of mental multimorbidity. More broadly, the findings support adaptations in medical training, public health recommendations, and healthcare delivery systems to better address multimorbidity [56, 57]. As artificial intelligence applications in mental health continue to expand, these developments will further require the establishment of updated regulatory frameworks, guidelines, and policies [58].

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