




Relationship between multimorbidity and sociodemographic factors, depressive symptoms, and lifestyle in middle-aged adults

Zależność między wielochorobowością a czynnikami socjodemograficznymi, objawami depresji i stylem życia u dorosłych w średnim wieku

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Słowa kluczowe: objawy depresji, palenie, aktywność fizyczna, wielochorobowość, konsumpcja alkoholu.

Abstract

Introduction: Multimorbidity (MM) is associated with high mortality, disability, more frequent use of both inpatient and outpatient care, lower quality of life, and increased psychological distress and polypharmacy. As a result, MM has recently been recognized as one of the most difficult challenges faced by the global healthcare system. Consequently, identifying the factors that accompany MM may be key for the improvement of overall health in every population, and for the provision of appropriate medical care to patients.

Aim of the research: To assess the prevalence of MM and the associated factors in middle-aged adults.

Material and methods: The research material consisted of 12,113 persons aged from 40 to 64 years. The backward stepwise regression method was used to identify factors associated with MM. Sociodemographic data and information about depressive symptoms and lifestyle were analysed.

Results: A higher likelihood of MM was observed in older individuals of both genders ($p < 0.001$) who declared more problems related to mental health ($p < 0.001$), took painkillers regularly, were former smokers, drank less alcohol, and declared abnormal sleeping time (both too short and too long). In addition, MM was associated with a longer sitting time in men and shorter vigorous physical activity in women.

Conclusions: MM is a frequent problem in adults aged between 40 and 64 years, which necessitates the development of a strategy for the prevention and treatment of MM in middle-aged adults. The complexity of factors related to MM indicates a need to ensure that such patients receive coordinated care from multidisciplinary teams.

Streszczenie

Wprowadzenie: Wielochorobowość wiąże się z wysoką śmiertelnością, niepełnosprawnością, częstszym korzystaniem przez chorych z opieki zarówno szpitalnej, jak i ambulatoryjnej, z niższą jakością życia, zwiększonym stresem psychicznym i polipragmazją, dlatego ostatnio została uznana za jedno z największych wyzwań stojących przed globalnym systemem opieki zdrowotnej. Zidentyfikowanie czynników towarzyszących wielochorobowości może mieć kluczowe znaczenie dla poprawy ogólnego stanu zdrowia każdej populacji i zapewnienia właściwej opieki lekarskiej pacjentom.

Cel pracy: Ocena występowania wielochorobowości i powiązanych z nią czynników u dorosłych w średnim wieku.

Materiał i metody: Materiał badawczy stanowiły dane 12 113 osób w wieku od 40 do 64 lat. W celu wyodrębnienia czynników związanych z wielochorobowością zastosowano metodę regresji krokowej wstecznej. Analizie poddano zmienne socjodemograficzne, a także informacje na temat objawów depresji i stylu życia.

Wyniki: Większe prawdopodobieństwo wielochorobowości u obu płci występowało u osób w starszym wieku ($p < 0,001$), deklarujących większą liczbę problemów związanych ze zdrowiem psychicznym ($p < 0,001$), przyjmujących regularnie tabletki przeciwbólowe, palących w przeszłości, pijących mniej alkoholu i deklarujących nieprawidłowy czas snu (zarówno zbyt krótki, jak i zbyt długi). Dodatkowo z wielochorobowością u mężczyzn był powiązany dłuższy czas przeznaczony na zajęcia sedentaryjne, a u kobiet – krótszy czas intensywnej aktywności fizycznej.

Wnioski: Wielochorobowość jest częstym problemem występującym u dorosłych między 40. a 64. rokiem życia. Niezbędne jest opracowanie strategii zapobiegania i leczenia wielochorobowości u dorosłych w średnim wieku. Złożoność czynników powiązanych z wielochorobowością wskazuje na potrzebę zapewnienia takim pacjentom skoordynowanej opieki multidyscyplinarnej zespołów.

Introduction

Multimorbidity (MM) is most commonly defined as the coexistence of 2 or more multiple chronic diseases in the same individual [1]. A meta-analysis of observational studies estimated the global prevalence of MM at 33.1% [2]. Another meta-analysis, encompassing data from 126 studies that included nearly 15.4 million people aged 56.94 ± 10.84 years, showed that the overall global prevalence of MM was 37.2% [3]. Data concerning the prevalence of MM in individual countries vary and depend primarily on how the authors define MM, the analysed diagnoses, source of data, and age and gender structure of a given population [2]. Most studies indicate that the prevalence of MM is higher among women than men [3–5] and increases with age [2, 3, 6]. Furthermore, significant relationships between MM and socioeconomic status, lifestyle, and depressive symptoms were found in many populations [7–9]. Due to its associations with higher mortality, disability, more frequent use of both outpatient and inpatient care, lower quality of life, increased psychological distress, and polypharmacy [1, 6, 10], MM has recently been recognized as one of the most difficult challenges faced by the global healthcare system [11]. Consequently, identifying the factors that accompany MM may be key for the improvement of overall health in every population and for the provision of appropriate medical care to patients. No extensive research on the prevalence of MM has been conducted to date in Poland, and the available publications mostly concern elderly individuals [12–14].

Aim of the research

The aim of this study was to assess the prevalence of MM and the associated factors in middle-aged adults. The analysis covered sociodemographic factors, depressive symptoms, and lifestyle.

Material and methods

The research material consisted of 12,113 individuals aged from 40 to 64 years, gathered as part of the Polish-Norwegian Study project (PONS), conducted between 2010 and 2012 in Poland in the Świętokrzyskie voivodeship. The study (data collection) was approved by the Ethics Committee of the Cancer Centre and Institute of Oncology in Warsaw, approval No. 69/2009/1/2011. The scope of the project and the recruitment procedure were described in detail in previous publications [15, 16]. In sum: all men and women aged 45–64 years living in Kielce County (Świętokrzyskie Voivodeship) were invited to participate in the study. The response rate was 12%. In addition, a small number of participants responded who were younger (37–44 years)

and older (65–66 years) than the desired age group. These participants were also included in the study. Consequently, the total was 13,172 individuals aged 37–66 years. After omitting individuals aged < 40 and ≥ 65 years, the analysis encompassed a group of 12,113 individuals (including 8091 women). Data analysis was approved by the Bioethics Committee of the Faculty of Health Sciences, Jan Kochanowski University, in Kielce, Poland (approval No. 45/2016).

Face-to-face interviews using structured questionnaires were conducted to collect sociodemographic data and information about chronic diseases, depressive symptoms, and lifestyle. The questionnaire was adapted from the Prospective Urban and Rural Epidemiological (PURE) study [15, 17]. Anthropometric measurements included body height measurements performed using a stadiometer. A body composition analyser (Tanita S.C. 240MA, Tokyo, Japan) was used to measure body weight. The assumed measuring accuracy was 0.1 cm and 0.1 kg, respectively. Body height and weight measurements were used to calculate body mass index (BMI, kg/m^2).

The collected sociodemographic variables comprised sex, age (years), marital status (married or in a stable relationship, single, or widow/widower), place of residence (city or village), and education level (higher, secondary, primary, or vocational). The prevalence of chronic diseases was assessed based on responses provided to the following question: Have you ever been diagnosed with: diabetes, hypertension, stroke, coronary artery disease (ischaemic heart disease)/angina pectoris/myocardial infarction, circulatory failure, asthma, chronic obstructive pulmonary disease, neoplastic disease (cancer), or other chronic disease (gastric and duodenal ulcers, diseases of the intestines, liver, kidneys, etc.)? The analysed diseases also included obesity, defined as $\text{BMI} \geq 30.0 \text{ kg}/\text{m}^2$. MM was defined as the co-occurrence of 2 or more of the aforementioned diseases. The respondents were also asked whether they took antidepressants or painkillers during the last 30 days.

Depressive symptoms were assessed based on the score from responses to 8 questions about the respondents' well-being over the preceding 12 months. The questions concerned: sadness (worry), loss of interest and pleasure, fatigue (loss of energy), weight gain or loss, problems falling asleep, loss of concentration, feeling of helplessness (low self-esteem), and thoughts about death. The respondents answered "yes" (1 point) or "no" (0 points) to each question. The respondents were divided into 3 tercile groups based on their scores: individuals with mild (0–2 points), average (3–5 points), and severe (6–8 points) depressive symptoms. The participants were also asked whether they experienced any stressful life events over the preceding 12 months, such as the death of a loved one, loss of job, etc.

Lifestyle assessment included smoking, alcohol consumption, physical activity (PA), and sleep duration. Respondents who declared smoking every day over the course of the study were classified as current smokers, and those who declared smoking for longer than 6 months were classified as former smokers. The remaining respondents were classified as never smokers. The standardized questionnaire contained items concerning the respondents' ordinary consumption of beer, wine, and high-proof alcohol, such as vodka, over the preceding year. Weekly consumption of ethanol was calculated for each participant based on the average ethanol content in each type of consumed alcohol and the frequency of its consumption. PA was assessed using the long version of the International Physical Activity Questionnaire (IPAQ). Time spent daily on moderate and vigorous PA and sitting time in minutes/day were calculated. Sleep duration was assessed based on the answer to the question: "On average, how many hours do you sleep each night?" The responses were recorded as full hours and analysed according to 3 categories: ≤ 6 h, 7–8 h, and ≥ 9 h per night.

Statistical analysis

The distributions of the main quantitative (continuous) variables were assessed using the Lilliefors (Kolmogorov-Smirnov) test. Arithmetic means and standard deviations were calculated. The reference group for the individuals with MM was those participants who did not declare any of the aforementioned diseases or declared no more than one. Differences between means were assessed using the Mann-Whitney U test. Student's t -test was only used for age. The distributions of categorical variables were estimated using a non-parametric χ^2 test. Backward stepwise regression was used to identify the factors associated with MM. The analyses were conducted separately for each gender. The following categorical variables and reference groups were included: (ref.: married or in a relationship); education level (ref.: higher); place of residence (ref.: city); smoking (ref.: never); regular use of antidepressants (ref.: no); regular use of painkillers (ref.: no); depressive symptoms (ref.: mild (0–2 points)); sleep duration (ref.: 7–9 h/day); and stressful life events over the last 12 months (ref.: no). Statistical significance was assumed at $p \leq 0.05$.

Results

MM was observed in 28.80% of the study participants. The most frequently declared disease was hypertension (37.15%), followed by obesity (BMI ≥ 30.0 kg/m²), found in 30.10% of all participants. The MM group included slightly more women than men (30.06% vs. 26.28%; $p < 0.001$). Men with MM were significantly older than the participants from the reference group (Table 1), but the 2 groups did not

differ in terms of marital status, education level, or place of residence. The prevalence of each of the analysed diseases and regular use of antidepressants and painkillers were many times higher in the MM group. Men from the reference group had less intense depressive symptoms, as analysed both overall (total score) ($p < 0.001$) and individually, and declared stressful life events occurring over the last year less often than the participants with MM. Lifestyle analysis showed that men with MM, compared to men without MM, were former smokers significantly more often, drank less alcohol (average 19.8 g of ethanol per week), exercised at high and moderate intensity less often, and slept too little more often (< 7 h/night) or too long (> 9 h/night). Sitting time did not differ significantly between the two groups.

Women with MM were significantly older, were married in a relationship less often, and more frequently had higher education than women from the reference group (Table 2). However, the groups did not differ in terms of place of residence. The prevalence of each of the analysed diseases and regular use of antidepressants and painkillers were higher in women with MM, while women without MM showed less intense depressive symptoms. Significant differences were observed in both the total score and individual questions ($p < 0.001$); women without MM also declared stressful life events occurring over the last year less often than women with MM. Women with MM were current smokers less often than women without MM, but were former smokers more often, drank less alcohol (an average of 6.8 g of ethanol per week), exercised at high intensity less often, declared shorter sitting time, and slept too little (< 7 h/night). The time spent on moderate PA did not differ significantly between the groups.

The results of the backward stepwise regression analysis showed that the likelihood of MM in men was significantly higher in older individuals, in men with more intense depressive symptoms, and in men who used antidepressants regularly, were former smokers, drank less alcohol, and declared longer sitting time and sleep disorders (sleeping time both too short and too long) (Table 3).

In women, a higher likelihood of MM was associated with old age, secondary education (compared to higher education), more intense depressive symptoms, regular use of antidepressants and painkillers, former smoking, and shorter time spent on high-intensity PA (Table 4). However, the likelihood of MM was lower in women who were current smokers. MM was also associated with drinking less alcohol and sleep disorders (sleeping time too short or too long).

Discussion

The prevalence of MM among middle-aged adults participating in this study was similar to the preva-

Table 1. Characteristics of the male participants

Variable	Total <i>n</i> = 4022	Presence of multimorbidity		<i>P</i> -value	
		No (<i><</i> 2 diseases) <i>n</i> = 2963	Yes (<i>≥</i> 2 diseases) <i>n</i> = 1056		
Sociodemographic factors:					
Age [years] mean ± SD	55.88 ±5.38	55.12 ±5.40	58.00 ±4.71	< 0.001	
Marital status <i>n</i> (%)	Single	440 (10.94)	313 (10.56)	125 (11.84)	0.254
	Married	3582 (89.06)	2650 (89.44)	931 (88.16)	
Place of residence <i>n</i> (%)	City	2486 (61.81)	1810 (61.09)	675 (63.92)	0.104
	Village	1536 (38.19)	1153 (38.91)	381 (36.08)	
Education level <i>n</i> (%)	Higher	1114 (27.70)	1047 (35.34)	406 (38.45)	0.192
	Secondary	1455 (36.18)	1083 (36.55)	370 (35.04)	
	Primary or vocational	1453 (36.13)	833 (28.11)	280 (26.52)	
Chronic disease, <i>n</i> (%):					
Diabetes mellitus	293 (7.28)	58 (1.96)	235 (22.25)	< 0.001	
Hypertension	1540 (38.29)	653 (22.04)	887 (84.00)	< 0.001	
Stroke	78 (1.94)	8 (0.27)	70 (6.63)	< 0.001	
Coronary artery disease	388 (9.65)	42 (1.42)	346 (32.77)	<0.001	
Circulatory failure	210 (5.22)	20 (0.67)	190 (17.99)	< 0.001	
Asthma	104 (2.59)	30 (1.01)	74 (7.01)	< 0.001	
Chronic obstructive pulmonary disease	47 (1.17)	4 (0.13)	43 (4.07)	< 0.001	
Cancer	92 (2.29)	20 (0.67)	72 (6.82)	< 0.001	
Other chronic diseases	1329 (33.08)	618 (20.86)	711 (67.33)	< 0.001	
Obesity	1250 (31.08)	778 (26.26)	472 (44.70)	< 0.001	
Use of painkillers	121 (3.02)	72 (2.43)	49 (4.64)	< 0.001	
Use of antidepressants	73 (1.82)	39 (1.32)	34 (3.22)	< 0.001	
Depressive symptoms, <i>n</i> (%):					
Mild (0–2 points)	2967 (73.77)	2270 (76.61)	697 (66.00)	< 0.001	
Moderate (3–5 points)	817 (20.31)	552 (18.63)	263 (24.91)		
Severe (6–8 points)	238 (5.92)	141 (4.76)	96 (9.09)		
Feeling of sadness or worry in the last year	611 (15.19)	401 (13.53)	209 (19.79)	< 0.001	
Loss of interest in things that I used to enjoy	587 (14.59)	392 (13.23)	193 (18.40)	< 0.001	
Fatigue and loss of energy	1471 (36.57)	1042 (35.17)	426 (40.34)	< 0.002	
Weight gain or loss	693 (17.23)	475 (16.03)	218 (20.64)	< 0.001	
Problems falling asleep (more than usual)	1017 (25.29)	688 (23.22)	327 (30.97)	< 0.001	
Difficulty focusing (more than usual)	892 (22.18)	591 (19.95)	299 (28.31)	< 0.001	
Thoughts of death (my own, family member's, or in general)	691 (17.18)	453 (15.29)	236 (22.35)	< 0.001	
Feeling of helplessness (low self-esteem)	501 (12.46)	315 (10.63)	184 (17.42)	< 0.001	
Depressive symptoms [points] mean ± SD	1.61 ±1.96	1.47 ±1.86	1.98 ±2.18	< 0.001	
Stressful life events in the last year	No	2957 (73.52)	2210 (74.59)	745 (70.50)	0.011
	Yes	1065 (26.48)	753 (25.41)	311 (29.45)	

Table 1. Cont.

Variable		Total n = 4022	Presence of multimorbidity		P-value
			No (< 2 diseases) n = 2963	Yes (≥ 2 diseases) n = 1056	
Lifestyle:					
Smoking n (%)	Never smokers	1426 (35.45)	1094 (36.92)	331 (31.34)	< 0.001
	Former smokers	1726 (42.91)	1202 (40.57)	523 (49.53)	
	Current smokers	870 (21.63)	667 (22.51)	202 (19.13)	
Alcohol [g/week] mean \pm SD		87.21 \pm 147.90	92.44 \pm 152.40	72.64 \pm 133.68	< 0.001
Vigorous PA [min/day] mean \pm SD		18.14 \pm 36.69	18.72 \pm 36.11	15.95 \pm 36.45	< 0.001
Moderate PA [min/day] mean \pm SD		67.45 \pm 72.71	68.65 \pm 68.74	60.09 \pm 67.00	< 0.001
Sitting time [min/day] mean \pm SD		275.9 \pm 129.4	273.3 \pm 128.8	283.4 \pm 130.7	0.058
Sleep duration [h/night] n (%)	7–9 h/day	1023 (25.44)	719 (24.27)	303 (28.69)	< 0.001
	< 7 h/day	2762 (68.67)	2097 (70.77)	663 (62.78)	
	> 9 h/day	237 (5.89)	147 (4.96)	90 (8.52)	

lence of MM among other populations [1, 4]. The MM group included slightly more women than men, and MM intensity increased with age in both genders, which is also consistent with the results obtained by other authors [3–5, 18]. Consequently, this study confirmed that MM prevention should focus not only on older individuals, but also on middle-aged adults [19]. Subject literature also indicates that MM is more prevalent in individuals experiencing a bad socioeconomic situation [20–22]. The men who participated in this study did not show a relationship between education and MM, which may have resulted from the lower share and underrepresentation of men among the participants and a stronger association between MM and factors other than socioeconomic ones. The prevalence of MM among the female participants of this study was significantly lower in the group with higher education than in the group with secondary education, which is consistent with the results obtained by other authors [1, 23, 24]. On the other hand, no significant difference was observed between women with primary or vocational education and women with higher education. This may have resulted from the fact that the participants with lower education underestimated the presence of some diseases. The participants with higher education may have been more aware about health, may have had a higher income and better access to high-quality medical care, and may have been diagnosed earlier and more often.

The results of this study indicated an association between MM and a higher intensity of depressive symptoms in both men and women. The relationship between MM and depression and its symptoms has in recent years been the subject of numerous studies [25], including long-term observational studies

[26–29]. Their results suggest a 2-way relationship between MM and depression, even after the inclusion of potential confounding factors [25–29]. Consequently, MM may constitute a risk factor for future depression, and furthermore, the presence of depressive symptoms may predispose an individual to the development of MM. The mechanisms underlying these associations are complex and require further research. Studies indicate the involvement of biological factors (genetic and immunological), as well as psychosocial and healthcare-related factors [21, 27], due to the fact that the presence of depressive symptoms may affect lifestyle and socioeconomic status, which in turn may contribute to the development and course of later diseases, and affect the time of diagnosis [25]. In addition, MM was associated with regular use of painkillers and, in women, also antidepressants. In both genders, living with MM may be accompanied by various pain disorders and use – and sometimes abuse – of many painkillers, which may interact with other drugs prescribed for the original disease and lead to the development of new chronic diseases. Subject literature confirms that drugs and polypharmacy may also contribute to the development of MM [21]. Furthermore, Rzewuska *et al.* reported that MM in women occurred more frequently with mental disorders [20], which was likely to be the cause of the relationship between the use of antidepressants and MM observed in the female participants of this study.

The obtained results indicate strong relationships between MM and the participants' lifestyle. In both genders, MM showed a significant relationship with former smoking. Subject literature has numerous reports indicating that among lifestyle factors, intense smoking showed the strongest relationship with at

Table 2. Characteristics of the female participants

Variable	Total n = 8091	Presence of multimorbidity		P-value	
		No (< 2 diseases) n = 5657	Yes (≥ 2 diseases) n = 2431		
Sociodemographic factors:					
Age [years] mean ± SD	55.52 ±5.32	54.64 ±5.29	57.55 ±4.81	< 0.001	
Marital status n (%)	Single	2062 (25.49)	1378 (24.36)	684 (28.14)	< 0.001
	Married	6029 (74.51)	4279 (75.64)	1747 (71.86)	
Place of residence n (%)	City	5065 (62.60)	3550 (62.75)	1514 (62.28)	0.685
	Village	3026 (37.40)	2107 (26.05)	917 (37.72)	
Education level n (%)	Higher	2512 (31.05)	1301 (23.00)	780 (32.09)	< 0.001
	Secondary	3496 (43.21)	2441 (43.15)	1055 (43.40)	
	Primary or vocational	2083 (25.74)	1915 (33.85)	596 (24.52)	
Chronic disease, n (%):					
Diabetes mellitus	416 (5.14)	42 (0.74)	374 (15.35)	< 0.001	
Hypertension	2960 (36.58)	1034 (18.28)	1925 (79.19)	< 0.001	
Stroke	121 (1.50)	12 (0.21)	109 (4.48)	< 0.001	
Coronary artery disease	704 (8.70)	65 (1.15)	639 (26.29)	< 0.001	
Circulatory failure	558 (6.90)	84 (1.48)	474 (19.50)	< 0.001	
Asthma	316 (3.91)	70 (1.24)	246 (10.12)	< 0.001	
Chronic obstructive pulmonary disease	42 (0.52)	6 (0.11)	36 (1.48)	< 0.001	
Cancer	324 (4.00)	80 (1.41)	242 (9.95)	< 0.001	
Other chronic diseases	3608 (44.61)	1769 (31.27)	1839 (75.65)	< 0.001	
Obesity	2396 (29.61)	1312 (23.19)	1083 (44.55)	< 0.001	
Use of painkillers	396 (4.90)	218 (3.85)	178 (7.32)	< 0.001	
Use of antidepressants	277 (3.42)	136 (2.40)	134 (5.80)	< 0.001	
Depressive symptoms, n (%):					
Mild (0–2 points)	4658 (57.57)	3456 (61.09)	1201 (49.40)	< 0.001	
Moderate (3–5 points)	2259 (27.92)	1497 (42.73)	761 (31.30)		
Severe (6–8 points)	1174 (14.51)	704 (12.44)	469 (19.29)		
Feeling of sadness or worry in the last year	2146 (26.52)	1356 (23.97)	789 (32.46)	< 0.001	
Loss of interest in things that I used to enjoy	1803 (22.28)	1159 (20.49)	643 (26.45)	< 0.001	
Fatigue and loss of energy	3971 (49.03)	2597 (45.91)	1373 (56.48)	< 0.001	
Weight gain or loss	2018 (24.94)	1300 (22.98)	717 (8.86)	< 0.001	
Problems falling asleep (more than usual)	3313 (40.95)	2098 (37.09)	1213 (49.90)	< 0.001	
Difficulty focusing (more than usual)	2801 (34.62)	1810 (32.00)	989 (40.68)	< 0.001	
Thoughts of death (my own, family member's, or in general)	2216 (27.39)	1428 (25.24)	786 (32.33)	< 0.001	
Feeling of helplessness (low self-esteem)	2034 (25.14)	1277 (22.57)	756 (31.10)	< 0.001	
Depressive symptoms [points] mean ± SD	2.51 ±2.38	2.30 ±2.30	2.99 ±2.48	< 0.001	
Stressful life events in the last year	No	5307 (65.59)	3842 (67.92)	1464 (60.22)	< 0.001
	Yes	2784 (34.41)	1815 (32.08)	967 (39.78)	

Table 2. Cont.

Variable		Total n = 8091	Presence of multimorbidity		P-value
			No (< 2 diseases) n = 5657	Yes (≥ 2 diseases) n = 2431	
Lifestyle:					
Smoking, n (%)	Never smokers	4252 (52.55)	2953 (52.20)	1297 (53.35)	< 0.001
	Former smokers	2347 (29.01)	1572 (27.79)	774 (31.84)	
	Current smokers	1492 (18.44)	1132 (20.01)	360 (14.81)	
Alcohol [g/week] mean ± SD		17.52 ±34.93	19.57±38.00	12.76 ±25.87	< 0.001
Vigorous PA [min/day] mean ± SD		8.33 ±24.67	8.57 ±25.27	7.19 ±22.71	< 0.001
Moderate PA [min/day] mean ± SD		80.84 ±71.67	81.77 ±72.01	78.13 ±69.11	<0.059
Sitting time [min/day] mean ± SD		272.3 ±129.5	276.1 ±131.7	263.5 ±123.6	< 0.001
Sleep duration n (%)	7–9 h/day	2102 (25.98)	1346 (23.79)	753 (30.97)	< 0.001
	< 7 h/day	5335 (65.94)	3879 (68.57)	1456 (59.89)	
	> 9 h/day	654 (8.08)	432 (7.64)	222 (9.13)	

Table 3. Factors associated with multimorbidity in men: results of the backward stepwise regression analysis

Variable		OR	95% CI	P-value
Age		1.11	1.10–1.13	< 0.001
Use of painkillers		1.80	1.22–2.65	0.003
Depressive symptoms	Mild (0–2 points)	Ref.		
	Moderate (3–5 points)	1.53	1.29–1.83	< 0.001
	Severe (6–8 points)	2.33	1.75–3.11	< 0.001
Smoking	Never smokers	Ref.		
	Former smokers	1.28	1.09–1.52	0.003
Alcohol [g/week]		0.999	0.998–1.00	0.003
Sitting time [min/day]		1.001	1.001–1.002	0.004
Sleep duration	7–9 h/day	Ref.		
	< 7 h/day	1.30	1.10–1.54	0.002
	> 9 h/day	1.51	1.13–2.01	0.006

OR – odds ratio, CI – confidence interval.

least one chronic disease [30, 31] and MM [32]. Smoking may increase the risk of MM by contributing to the premature aging of cells through inflammatory effects, oxidative stress, and DNA damage [33]. In addition, the results of this study indicated that the share of women who were current smokers was significantly lower than that of women who had never smoked. This suggests that women who were diagnosed with MM quit smoking more often, whereas women who were current smokers but had better health may have not recognized a need to quit smoking. This study also demonstrated a relationship between MM and drinking less alcohol in both men and women. These results are consistent with those obtained by many other authors, who reported that moderate use of alcohol was

associated with a reduced prevalence of some chronic diseases [30, 34, 35]. The Whitehall II study conducted by Singh-Manoux *et al.* confirmed that cardiometabolic MM was associated with alcohol abstention or heavy alcohol consumption [36]. It should be noted that in a cross-sectional study, non-drinkers might be a heterogeneous group that includes individuals who have never drunk alcohol in their lives as well as individuals who quit drinking for health reasons [30]. Some authors even stated that the prevalence of MM was lower among current binge drinkers than non-binge drinkers [37]. This may result from the fact that individuals with good health tend to drink more than individuals with bad health. Among the participants of this study, MM was associated with longer sitting

Table 4. Factors associated with multimorbidity in women: results of the backward stepwise regression analysis

Variable		OR	95% CI	P-value
Age		1.11	1.10-1.12	< 0.001
Education level	Higher	Ref.		
	Secondary	1.62	1.41-1.86	< 0.001
Use of painkillers		1.79	1.43-2.22	< 0.001
Use of antidepressants		1.78	1.37-2.30	< 0.001
Depressive symptoms	Mild (0–2 points)	Ref.		
	Moderate (3–5 points)	1.34	1.19–1.51	< 0.001
	Severe (6–8 points)	1.59	1.37–1.85	< 0.001
Smoking	Never smokers	Ref.		
	Current smokers	0.76	0.66–0.87	< 0.001
	Former smokers	1.11	1.16–1.46	< 0.001
Alcohol [g/week]		0.994	0.992-0.997	< 0.001
Vigorous PA [min/day]		0.998	0.996-1.000	0.037
Sleep duration	7–9 h/day	Ref.		
	< 7 h/day	1.31	1.16–1.46	< 0.001
	> 9 h/day	1.20	1.002–1.44	0.047

OR – odds ratio, CI – confidence interval.

time in men and shorter time spent on vigorous PA in women. Research on the correlations between PA and MM has been inconclusive. Fortin *et al.* observed no significant relationship between PA and MM [32]. In turn, Vancampfort *et al.* showed that patients with MM were much less physically active than healthy individuals [38]. A long-term study conducted in India demonstrated that the volume of PA was inversely proportional to the prevalence of MM [39]. The same study also showed that the prevalence of MM was lower in individuals who engaged in both moderate and vigorous PA than in those who engaged only in moderate PA. This finding matches the results obtained among the female participants of this study. However, it should be emphasized that patients with MM are sometimes unable to engage in vigorous PA due to medical contraindications [40]. Poses-Ferrer *et al.* observed that daily sitting time might be an independent risk factor of MM regardless of PA [41], which is consistent with the results observed among the male participants of this study. This study also found a relationship between MM and sleep duration both too short and too long compared to the recommended 7–9 h, in both men and women. A long-term observational study conducted among the Chinese population yielded similar results [42]. The relationship between sleep duration and MM may result from the effect of the former on some metabolic risk factors [43].

A limit of this study is the use of a cross-sectional database produced by the PONS project, which assessed the health of the residents of Kielce County

(Świętokrzyskie Voivodeship, Poland) in terms of primary morbidity and mortality indicators. Consequently, the analysis could only encompass those factors and diseases that were available in the database. Furthermore, all participants were volunteers, which means that they may not have constituted a representative group for the Polish population. Conversely, a strength of this study is the large sample size and its homogeneity in terms of age.

Conclusions

Multimorbidity is a relatively common problem among adults aged between 40 and 64 years, which necessitates the development of a strategy for the prevention and treatment of MM among this population.

The complexity of factors related to MM also means that patients should be provided coordinated medical care from multidisciplinary teams. The current healthcare system, which focuses on treating individual diseases, may prove insufficient to provide appropriate care to patients with MM. In particular, the strict relationship between physical MM and depressive symptoms suggests a need to introduce integrated care related to both physical and mental health.

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Conflict of interest

The authors declare no conflict of interest.

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