Social Psychiatry and Psychiatric Epidemiology (2019) 54:255–276
https://doi.org/10.1007/s00127-018-1545-7

ORIGINAL PAPER

Associations between untreated depression and secondary health care utilization in patients with hypertension and/or diabetes

Anita Pálinkás[1] · János Sándor[1] · Magor Papp[2] · László Kőrösi[3] · Zsófia Falusi[3] · László Pál[3] · Zsuzsanna Bélteczki[4] · Zoltán Rihmer[5,6] · Péter Döme[5,6]

Received: 18 October 2017 / Accepted: 6 June 2018 / Published online: 15 June 2018

Abstract

Purpose We determined the prevalence of untreated depression in patients with hypertension (HT) and/or diabetes (DM) and estimated the extra health care use and expenditures associated with this comorbidity in a rural Hungarian adult population. We also assessed the potential workload of systematic screening for depression in this patient group.

Methods General health check database from a primary care programme containing survey data of 2027 patients with HT and/or DM was linked to the outpatient secondary care use database of National Institute of Health Insurance Fund Management. Depression was ascertained by Beck Depression Inventory score and antidepressant drug use. The association between untreated depression and secondary healthcare utilization indicated by number of visits and expenses was evaluated by multiple logistic regression analysis controlled for socioeconomic/lifestyle factors and comorbidity. The age-, sex- and education-specific observations were used to estimate the screening workload for an average general medical practice.

Results The frequency of untreated depression was 27.08%. The untreated severe depression (7.45%) was associated with increased number of visits (OR 1.60, 95% CI 1.11–2.31) and related expenses (OR 2.20, 95% CI 1.50–3.22) in a socioeconomic status-independent manner. To identify untreated depression cases among patients with HT and/or DM, an average GP has to screen 42 subjects a month.

Conclusion It seems to be reasonable and feasible to screen for depression in patients with HT and/or DM in the primary care, in order to detect cases without treatment (which may be associated with increase of secondary care visits and expenditures) and to initiate the adequate treatment of them.

Keywords Comorbid depression · Hypertension · Diabetes · Health care utilization · Linkage study

Introduction

Ischaemic heart disease ranked 4th, stroke 5th, and diabetes mellitus (DM) 24th in the causes of global health loss, as measured in disability adjusted life years (DALY) in 1990. The importance of these causes increased by 2015, when they were ranked 1st, 2nd, and 11th in the DALY ranking system, respectively [1]. The aetiological background of these disorders is well known. Accordingly, the proportions of health loss attributable to known risk factors are estimated to be 95% for ischaemic heart diseases, 88% for stroke, and 100% for DM [2]. Taking into consideration that—according to the data of the World Health Organisation (WHO)—great proportions of strokes and coronary heart diseases are attributable to hypertension (HT) (62 and 49%, respectively), we used HT as a proxy for cardiovascular diseases (CVDs) in the current study [3]. Besides CVDs and DM, mental illness

✉ János Sándor
sandor.janos@sph.unideb.hu

1 Department of Preventive Medicine, Faculty of Public Health, University of Debrecen, Debrecen, POB. 400, 4002, Hungary

2 National Institute of Health Promotion, Budapest, Hungary

3 Department of Financing, National Institute of Health Insurance Fund Management, Budapest, Hungary

4 Santha Kalman Mental Health Centre and Special Hospital, Nagykallo, Hungary

5 Department of Psychiatry and Psychotherapy, Faculty of Medicine, Semmelweis University, Budapest, Hungary

6 Laboratory for Suicide Research and Prevention, National Institute of Psychiatry and Addictions, Budapest, Hungary

contributes in a significant manner to global burden of disease; first and foremost, major depression currently is estimated as the second most frequent cause of years lived with disability (YLDs) [4].

Taking into account that the CVDs and DM-related health loss is mainly elicited by their complications, the future trend of health loss due to CVDs and DM depends significantly on how effective will be the interventions against their negative prognostic factors that hinder the application of evidence-based long-term care methods. Although the top priority for these diseases in policy agendas cannot be debated, the prognostic role of accompanying depression needs further investigation to enable discussion of the adequate recommendations for depression-related health care activities in guidelines for CVDs and DM.

Depression is quite frequent among patients with CVDs and DM (e.g. the prevalence of depression is increased by at least threefold in patients with coronary artery disease or stroke and by almost twofold among patients with type 2 DM compared to the general population) [5–8]. Comorbid depression is a negative prognostic factor for these disorders (i.e. patients with CVD and comorbid depression have a higher chance of recurrent cardiovascular events and an elevated risk of mortality); moreover, depression is a risk factor for incident CVDs and DM [5, 6, 9–11]. Several reasons underlie the frequent comorbidity of depression and CVDs and DM. For instance, some mood disorder-associated behavioural factors (unhealthy diet, smoking, physical inactivity, and poor compliance with medications for somatic disorders) are risk factors for CVDs and DM [7, 9–11]. Furthermore, several biological processes associated with depression (e.g. elevated thrombocyte activity, hypercortisolaemia, inflammation, and endothelial dysfunction) may contribute to a poor prognosis of CVDs and DM [9, 12]. In agreement with these findings, the life expectancy of patients with depression is approximately 7–10 years shorter than that of the general population, and somatic comorbidities (e.g. CVDs and DM) rather than suicide are responsible for excess mortality in this patient population [13]. The mortality risk is increased by almost twofold in depressed patients compared to the general population, and approximately 8 million deaths worldwide are attributable to mental disorders in every year [14]. Although there are observations suggesting that effective treatment of depression among CVD patients can improve the prognosis [15–17], the evidence is not convincing enough yet, to insert depression treatment into the CVD guidelines [9].

Altogether, the consideration of depression as a negative prognostic factor should be similar to other known factors (e.g. obesity, smoking, and a sedentary lifestyle) among patients with CVDs and DM. This idea is reflected in a recommendation of the American Heart Association (AHA), which suggests routine screening for depression in patients with coronary heart disease at different levels of the health care system (inter alia in primary health care) [18]. Moreover, the AHA also recently released a scientific statement in which depression achieved formal recognition as a risk factor for a poor prognosis in patients with acute coronary syndrome [19]. The application of the AHA recommendation is variable across countries. In Europe, only 1 country has organized screening, 13 countries have achieved opportunistic screening, and 12 countries have no screening for depression among cardiovascular patients [20].

Considering that comorbid depression frequently leads to an unfavourable prognosis of CVDs and DM, we may expect that health care utilization is higher for patients with CVDs and DM and comorbid mental illness (including depression) than for patients without a comorbid mental illness. The results of international investigations strongly support this conjecture [21–24].

Although the toll of CVDs and DM is exceptionally high in Hungary [25, 26] and the prevalence of depressive symptoms is also unexpectedly elevated [27–29], only a few Hungarian studies have investigated the frequency of comorbid depression in patients with CVDs and DM, the rate of antidepressant treatment within the depressed patient subpopulation and the impact of comorbid depression on health care utilization [8, 30]. The per capita financing of Hungarian primary health care impedes the required research in this field, since the general practitioner (GP) activities are not quantified in this structure. On the other hand, the secondary care is financed by fee for performance system, which makes it possible to evaluate the specific activities without thorough targeted data collection.

Bearing in mind the scarcity of published results in these fields, our study took the opportunity of a primary health care development programme and determine (1) the prevalence of untreated comorbid depression among patients with HT and/or DM in Hungary, (2) whether untreated comorbid depression modified secondary outpatient health care utilization, (3) how this utilization was reflected in health care financing, and (4) what sociodemographic factors modified outpatient care use. (5) An auxiliary aim was to estimate the primary health care workload of systematic depression screening among patients with HT and/or DM.

Methods

Study design and sample

Our study was a subproject of the Public Health Focused Model Programme for Organising Primary Care Services Backed by a Virtual Care Service Centre. This programme aimed to elaborate a new operation model for Hungarian primary health care that enables GPs and their co-workers

to provide effective preventive services, contribute to improvement of the general health status of the population, and reduce social health inequality [31]. The intervention area of the Model Programme was located in 16 settlements (6 cities and 10 villages) of the two most disadvantaged regions of Hungary (North Hungary and the North Great Plain) as it was discussed elsewhere in detail [32]. An element of the new services developed by the programme was a population-based organized general health check for all adults above 18 years of age irrespective of their health status that belonged to one of the general medical practices (GMPs) involved in the programme. The health check surveyed the sociodemographic status, lifestyle, health attitude, mental health, and history of chronic diseases and screens for cardio-metabolic risk factors and hidden diseases. The health check was implemented by a team of a trained nurse and a trained public health practitioner [32]. The project was launched on 1 November, 2013. The goal of the Model Programme was to reach all adults in the intervention area by health check. Regular (monthly) calls were organized according to a plan, which ensured even distribution of health checks in the study period (from 1/11/2013 to 30/6/2016) [33]. The whole target population comprised of 32,655 adults, and 4567 health checks had been documented by complete records in the database of the Model Programme by 30/9/2014, when a permission had been issued to link health check records to the secondary service use and medicine consumption database of National Institute of Health Insurance Fund Management (NIHIFM). The results of the health check up to the date of permission were analysed in our investigation.

The health check records are linked to the secondary outpatient service use and medicine consumption databases of the NIHIFM by the health insurance identifier. NIHIFMs' databases can be considered as national data stores because NIHIFM is the only nationwide health insurance company, which is responsible for financing the whole primary and secondary care in Hungary. Voluntary health insurance represents a negligible proportion of Hungarian health care financing (e.g. in 2009, it added up only to 7.4% of private health expenditure and 2.7% of total health expenditure) [34]. Database merging was conducted within the NIHIFM according to the internal rules for personal data handling. The health insurance numbers were removed from the linked database before starting the analysis. The personal identifiers were handled only by NIHIFM staff members.

The records of adults with a positive history of HT and/or DM recorded by the health check were selected for the study. Establishing the diagnosis of HT and DM was based on patients' self-report at health check and/or on electronic health records of GMPs, which contain ICD codes from outpatient and inpatient discharge records, drug prescriptions, and illnesses diagnosed by the GPs. Patients with suspected but not confirmed disease and those who were uncooperative (i.e. patients without at least one outpatient service use in the 12-month period before the health check) were deleted from the database (the Hungarian guidelines for HT and DM primary care prescribe an annual investigation that requires laboratory examinations not available at primary care in Hungary). Patients with diagnosed cancer and pregnant women were also rejected from the analysis to prevent the potential confounding effects associated with these conditions.

The process of health check sampling, linkage to the NIHIFM database, and preparation of the dataset for statistical analysis is summarized in Fig. 1.

Variables

Explanatory variable

The presence of depressive symptoms was evaluated by the Hungarian abbreviated (9-item) version of the Beck Depression Inventory (BDI) as part of the health check. This 9-item version of the BDI is a recommended tool for depression screening in Hungarian primary care practices [35]. Using Diagnostic Interview Schedule (DIS) as the gold standard, with a cut-off score of 16, the sensitivity and the specificity of the Hungarian 9-item version of BDI are found to be 91.2% and 91.0%, respectively [36]. According to the recommendations, scores achieved by the participants on the abbreviated BDI were multiplied by 2.3; then, the depression severity was established based on the resulting scores using the cut-off scores of the original BDI (normal: 0–9, mild depression: 10–18, moderate depression: 19–25, severe depression: > 25) [37–39]. Another indicator of probable depression in our study was an antidepressant drug (AD) purchase within the 12 months prior to the health check. The NIHIFM drug consumption database provided data on ATC N06AA, N06AB, N06AG, and N06AX drug consumption. The following eight groups were defined based on the AD consumption classification and the BDI scores: no depression (by BDI) and no AD purchase; no depression and AD purchase; mild depression and no AD purchase; mild depression and AD purchase; moderate depression and no AD purchase; moderate depression and AD purchase; severe depression and no AD purchase; and severe depression and AD purchase.

Confounding variables

The sociodemographic statuses of the patients were described based on gender, age, ethnicity (Roma and non-Roma were distinguished because Roma is the largest minority ethnic group in Hungary [40]), and education (less than

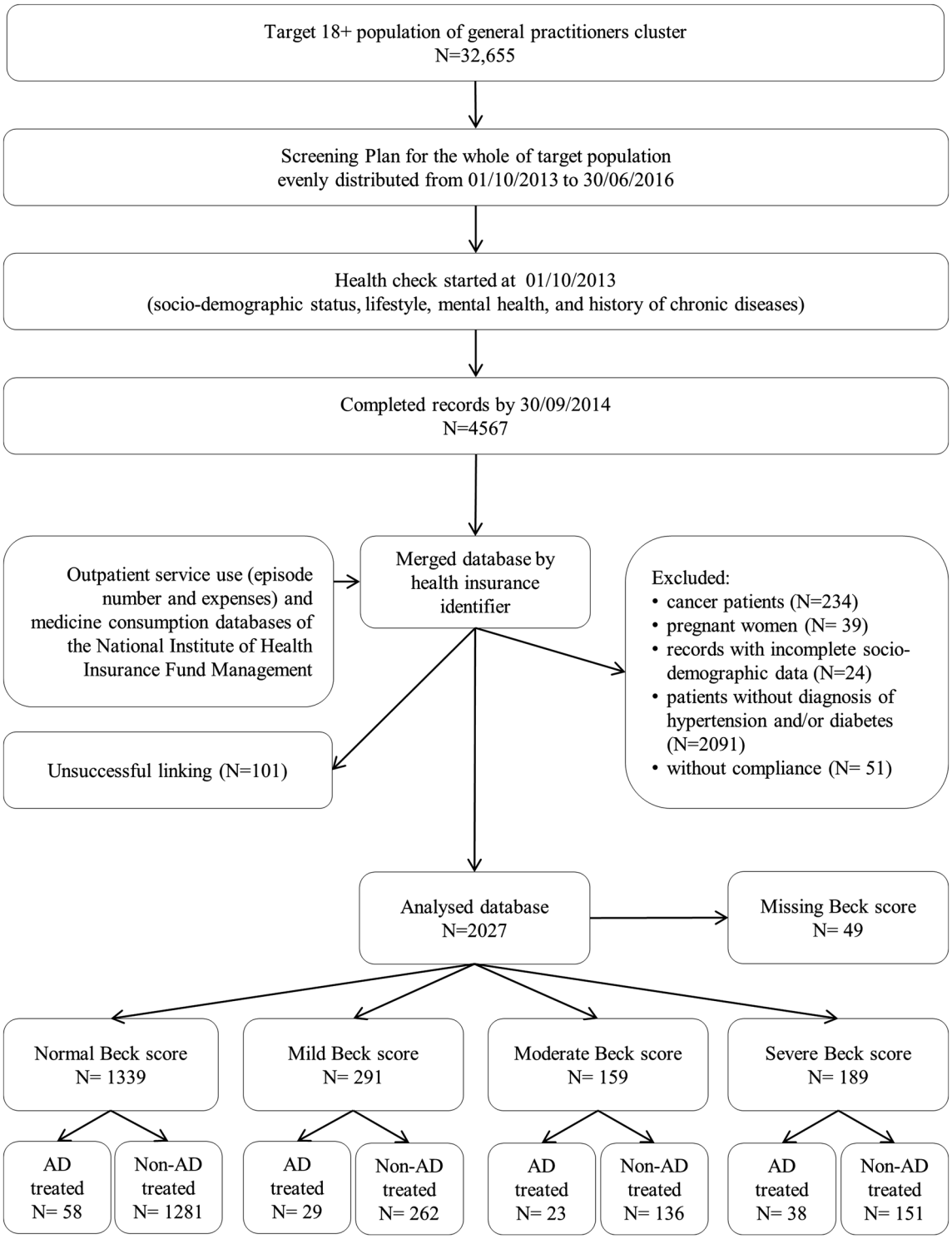

Fig. 1 Sampling procedure of health check and linkage to National Institute of Health Insurance Fund Management database. *AD* antidepressant drug

primary, primary, vocational, high school and tertiary levels were classified).

Hazardous alcohol drinking was screened using the Alcohol Use Disorders Identification Test (AUDIT). Persons who required at least a short intervention (AUDIT score > 7) were classified as problem drinkers [41]. The smoking status was recorded as never, occasional, regular and former smoker based on questions in the EUROSTAT Health Interview

Survey [42, 43]. Obesity and central obesity were defined as a BMI ≥ 30 kg/m^2 and a waist circumference ≥ 94 cm for males and ≥ 80 cm for females [44, 45]. Each lifestyle indicator was ascertained at the health check.

Using the health check database, the presence of chronic kidney diseases, chronic musculoskeletal disorders, osteoporosis, visual acuity impairment and hearing loss as accompanying disorders was determined for the patients.

A NIHIFM protocol evaluates the drug consumption of patients. According to their compliance with antihypertensive and antidiabetic medications, participants with at least four and fewer than four drug purchases during the period from October 1, 2013, to September 30, 2014 (which included the interval when the health checks were conducted), were distinguished. Since the maximum amount of a drug that can be prescribed by one prescription corresponds to 90 days of treatment (DOT), fewer than four purchases a year indicates reduced compliance. Conversely, a patient was considered compliant if the number of his/her antihypertensive and/or antidiabetic drug purchases was at least four. Because pharmacological treatment is essential in the care of HT and DM, compliance with that treatment can be used as a proxy indicator of collaborative attitudes of the patients, which can influence the use of the secondary care.

Outcome variables

The number of episodes (visits) to any type of outpatient secondary health care from October 1, 2013, to September 30, 2014, and the sum of the reimbursements for these episodes were calculated for all patients (the diagnostic and therapeutic activities of the outpatient centres reimbursed by the NIHIFM were included, whereas the drug-related expenses were not). Median values were determined both for the number of episodes per year and for the summarized expenses per year. Patients were sorted into groups above and under the median based on both the episode numbers and summarized expenses.

Statistical analysis

Descriptive statistics for the patients' sociodemographic, lifestyle, compliance, accompanying disease, and depression were calculated as proportions with corresponding 95% confidence intervals (95% CIs) or means with standard deviations (SD).

The number of HT and/or DM patients with different forms of depression in Hungary was estimated. First, the age-, gender-, and education-specific prevalences of depression were calculated for our investigated sample. The number of cases for each investigated depression categories (created by AD treatment and BDI score) was determined, separately. Then, using the demographic structure of the Hungarian population by age, gender and education, and the prevalences of HT and/or DM in Hungary for the same strata, the number of adults with different forms of depression among HT and/or DM patients in Hungary could be computed. Demographic structure of the Hungarian population by age, gender and education was available from the last census in 2011. The age-, gender-, and education-specific prevalences of HT and/or DM in Hungary were known from the Health Interview Survey 2014, which was a part of the European health interview surveys, supervised by the EUROSTAT, and implemented in a representative sample of Hungarian adult population [42].

To assess the GPs' workload due to the systematic screening for depressive symptoms among HT and/or DM patients in care, the number of incident and prevalent HT and/or DM cases per GMP was calculated. (The number of incident HT and/or DM cases per year in an average GMP was assessed by the General Practitioners' Morbidity Sentinel Stations Program (GPMSSP) [46].) The workload was calculated as number of screening per month per GMP.

The relationship between depression and outpatient care use indicators was evaluated by mixed effects logistic regression analysis controlling for the above-mentioned confounding factors, and for the clustering effect of GMPs. (The database contained data from 15 different GMPs.) Regarding depression as the explanatory variable of the statistical models, patients with HT and/or DM with a normal BDI score and without a purchase of AD drugs were defined as the reference group. A simpler (non-stratified) and a broader (stratified) statistical model was used, where three-level (AD-treated patients; non-AD-treated adults with depressive symptoms; reference group) and eight-level (the groups are defined in details in Sect. "Explanatory variable") depression classifications were applied, respectively. We used multiple imputation by fully conditional specification to handle missing data. The imputation model included all the above-mentioned confounders of the multivariate model. In these analyses, five different datasets had been imputed and the pooled results of multiple imputation analyses have been used as a basis for conclusion. The results were presented as odds ratios (ORs) with corresponding 95% CIs. The statistical analyses were conducted using PASW Statistics 18.

Ethical approval

The study protocol was approved by the Ethics Committee of the Hungarian National Scientific Council on Health (TUKEB 16676-3/2016/EKU, 0361/16). All enrolled patients signed an informed consent form contributing to the storage and analysis of their data before the data collection of health check started. Furthermore, the legal staff of the National Institute of Health Insurance Fund Management checked each signed informed consent before issuing the

permission for record linkage. The health insurance numbers of the patients were handled exclusively on computers of and within the National Institute of Health Insurance Fund Management by this institution's own staff members dedicated to handling these sensitive data as their usual job. Nobody else from the study personnel obtained permission to handle these data.

Results

Sample

The health check database contained 4567 completed records by 30 September, 2014. A total of 101 persons were excluded because their health insurance number was not registered by the NIHIFM. Additionally, 234 persons with cancer, 39 pregnant women and 24 persons without sociodemographic parameters in their health check record were deleted from the merged database. Among them, 2078 patients had HT and/or DM, of which 51 patients did not use any outpatient service in the year prior to the health check and were also excluded. The analysis was conducted in the database of 2027 patients whose secondary health care was organized into 19,775 episodes a year. The summarized reimbursement for these events was 118,872 EURO (Fig. 1).

Descriptive statistics

The descriptive statistics of our sample are summarized in Table 1 and Appendix 5. The average (± SD) age of the patients was 60.43 years (± 12.96). The sample was dominated by women (63.99%). The share of Roma adults was 6.46%. The proportions of patients with less than primary, primary, vocational, high school, and tertiary levels education were 11.45, 33.60, 23.33, 24.12, and 7.50%, respectively.

Most of the patients had only HT (76.42%). The presence of DM with and without HT was 19.83 and 3.75%, respectively.

Approximately two-thirds (63.20%) of the patients were free of depression according to the BDI score and the 1-year AD purchase history (64.17% among the hypertensive patients, 64.47% among the diabetic patients, and 59.20% among the hypertensive and diabetic patients). The proportion of AD-treated subjects was 7.30% among the patients with HT and/or DM (7.30% among the hypertensive patients, 5.26% among the diabetic patients, and 7.71% among the hypertensive and diabetic patients). The proportions of non-AD-treated mild and moderate/severe depression were 12.93% (12.40% among the hypertensive patients, 14.47% among the diabetic patients, and 14.68% among the hypertensive and diabetic patients) and 14.16% (13.49% among the hypertensive patients, 13.16% among the diabetic patients, and 16.92% among the hypertensive and diabetic patients), respectively. In the studied sample, of 27.08% of patients had depressive symptoms based on their BDI score without taking any ADs.

Women were overrepresented among both the AD-treated and non-AD-treated patients with mild or severe BDI scores. The ages of the AD-treated and the mildly or severely depressed but non-AD-treated patients were significantly lower than the ages of the patients without depression. A less than primary level of education and the Roma ethnicity were associated with higher risks for moderate and severe untreated depressed states, but these categories did not show any significant associations with the AD treatment probability. A similar pattern was observed among the primary educated patients, but these patients were not overrepresented among the non-AD-treated moderately depressed subjects. Regular smokers were also overrepresented among the patients with at least a moderate BDI score and among the AD-treated subjects. Underrepresentation of never smokers among the non-AD-treated depressed subjects was also observed. Hearing loss and chronic musculoskeletal disorders were more prevalent among the patients with depression (Table 1).

Multivariate analysis with a non-stratified depression classification

In the multivariate logistic models, the AD-treated depressed patients had elevated risks according to the adjusted ORs for higher episode numbers ($OR_{AD(+)}$: 3.24, 95% CI 2.21–4.75) and higher expenses ($OR_{AD(+)}$: 4.17, 95% CI 2.78–6.25) compared to the reference group (non-AD-treated patients with normal BDI score).

Among patients who did not purchase ADs but had depressive symptoms according to their BDI scores, the expenses were higher than the reference group (non-AD-treated patients with normal BDI score) ($OR_{BDI>9-AD(-)}$: 1.52, 95% CI 1.21–1.90) and the result of the episode numbers was borderline significant ($OR_{BDI>9-AD(-)}$: 1.25, 95% CI 1.00–1.56) (Figs. 2, 3).

Regarding confounding factors, the age (OR 1.01, 95% CI 1.00–1.02), occasional and former smoking status ($OR_{occasional}$: 1.86, 95% CI 1.01–3.42; OR_{former}: 1.35, 95% CI 1.03–1.77) compared to the never smokers, chronic musculoskeletal disorders (OR 1.58, 95% CI 1.27–1.95) were associated with higher-than-median outpatient service use. A similar association was also observed for the expenses former smoking status (OR 1.41, 95% CI 1.08–1.86), chronic musculoskeletal disorders (OR 1.56, 95% CI 1.26–1.94) and osteoporosis (OR 1.50, 95% CI 1.03–2.18). Detailed results from the multivariate regression models are presented in Appendices 1 and 2.

Table 1 Sociodemographic, lifestyle and clinical characteristics of the patients by depression classifications, and the deviation from the depression-free BDI (normal) AD(−) reference group characteristics

	BDI (normal) AD(−)	BDI (mild) AD(−)	BDI (moderate) AD(−)	BDI (severe) AD(−)	AD(+)	Missing	Total
Gender							
Male	503 (39.27%)	**85 (32.44%)****	49 (36.03%)	**42 (27.81%)****	**35 (23.65%)*****	16 (32.65%)	**730 (36.01%)**
Female	778 (60.73%)	177 (67.56%)	87 (63.97%)	109 (72.19%)	113 (76.35%)	33 (67.35%)	**1297 (63.99%)**
Age							
Year (mean ± SD)	61.41 (± 13.07)	**59.60 (± 13.18)****	60.42 (± 12.61)	**56.89 (± 11.27)*****	**58.51 (± 12.41)****	56.18 (± 13.34)	**60.43 (± 12.96)**
Education							
Less than primary	117 (9.13%)	29 (11.07%)	**21 (15.44%)****	**38 (25.17%)*****	19 (12.84%)	8 (16.33%)	**232 (11.45%)**
Primary	414 (32.32%)	79 (30.15%)	51 (37.50%)	**64 (42.38%)****	55 (37.16%)	18 (36.73%)	**681 (33.60%)**
Vocational	297 (23.19%)	75 (28.63%)	36 (26.47%)	26 (17.22%)	27 (18.24%)	12 (24.49%)	**473 (23.33%)**
High school	340 (26.54%)	61 (23.28%)	**22 (16.18%)****	**20 (13.25%)*****	37 (25.00%)	9 (18.37%)	**489 (24.12%)**
Tertiary	113 (8.82%)	18 (6.87%)	6 (4.41%)	**3 (1.99%)****	10 (6.76%)	2 (4.08%)	**152 (7.50%)**
Ethnicity							
Roma	55 (4.29%)	17 (6.49%)	**18 (13.24%)*****	**29 (19.21%)*****	11 (7.43%)	1 (2.04%)	**131 (6.46%)**
Non-Roma	1223 (95.47%)	245 (93.51%)	117 (86.03%)	122 (80.79%)	137 (92.57%)	48 (97.96%)	**1892 (93.34%)**
Missing	3 (0.23%)	0 (0.00%)	1 (0.74%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	**4 (0.20%)**
Alcohol consumption by AUDIT							
Problem drinker	15 (1.17%)	1 (0.38%)	3 (2.21%)	0 (0.00%)	1 (0.68%)	1 (2.04%)	**21 (1.04%)**
Non-problem drinker	1263 (98.59%)	259 (98.85%)	133 (97.79%)	151 (100.00%)	147 (99.32%)	48 (97.96%)	**2001 (98.72%)**
Missing	3 (0.23%)	2 (0.76%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	**5 (0.25%)**
Smoking							
Occasional	25 (1.95%)	6 (2.29%)	4 (2.94%)	**7 (4.64%)****	2 (1.35%)	0 (0.00%)	**44 (2.17%)**
Regular	231 (18.03%)	59 (22.52%)	**40 (29.41%)****	**56 (37.09%)*****	**45 (30.41%)*****	12 (24.49%)	**443 (21.85%)**
Former	266 (20.77%)	51 (19.47%)	31 (22.79%)	25 (16.56%)	26 (17.57%)	11 (22.45%)	**410 (20.23%)**
Never	653 (50.98%)	**114 (43.51%)****	**50 (36.76%)****	**45 (29.80%)*****	64 (43.24%)	22 (44.90%)	**948 (46.77%)**
Missing	106 (8.27%)	32 (12.21%)	11 (8.09%)	18 (11.92%)	11 (7.43%)	4 (8.16%)	**182 (8.98%)**
BMI							
Obese	660 (51.52%)	121 (46.18%)	67 (49.26%)	71 (47.02%)	73 (49.32%)	18 (36.73%)	**1010 (49.83%)**
Normal	611 (47.70%)	136 (51.91%)	68 (50.00%)	72 (47.68%)	72 (48.65%)	30 (61.22%)	**989 (48.79%)**
Missing	10 (0.78%)	5 (1.91%)	1 (0.74%)	8 (5.30%)	3 (2.03%)	1 (2.04%)	**28 (1.38%)**
Central obesity							
Central obesity	1181 (92.19%)	240 (91.60%)	125 (91.91%)	142 (94.04%)	139 (93.92%)	44 (89.80%)	**1871 (92.30%)**
Normal	97 (7.57%)	20 (7.63%)	11 (8.09%)	9 (5.96%)	9 (6.08%)	4 (8.16%)	**150 (7.40%)**
Missing	3 (0.23%)	2 (0.76%)	0 (0.00%)	0 (0.00%)	0 (0.00%)	1 (2.04%)	**6 (0.30%)**

Table 1 (continued)

	BDI (normal) AD(−)	BDI (mild) AD(−)	BDI (moderate) AD(−)	BDI (severe) AD(−)	AD(+)	Missing	Total
Accompanying disease							
Chronic kidney disorder	75 (5.85%)	17 (6.49%)	10 (7.35%)	13 (8.61%)	8 (5.41%)	2 (4.08%)	**125 (6.17%)**
No accompanying chronic kidney disorder	1206 (94.15%)	245 (93.51%)	126 (92.65%)	138 (91.39%)	140 (94.59%)	47 (95.92%)	**1902 (93.83%)**
Osteoporosis	87 (6.79%)	26 (9.92%)	6 (4.41%)	13 (8.61%)	15 (10.14%)	6 (12.24%)	**153 (7.55%)**
No accompanying osteoporosis	1194 (93.21%)	236 (90.08%)	130 (95.59%)	138 (91.39%)	133 (89.86%)	43 (87.76%)	**1874 (92.45%)**
Loss of visual acuity or hearing	444 (34.66%)	**114 (43.51%)****	46 (33.82%)	**70 (46.36%)****	58 (39.19%)	11 (22.45%)	**743 (36.66%)**
No accompanying loss of visual acuity or hearing	837 (65.34%)	148 (56.49%)	90 (66.18%)	81 (53.64%)	90 (60.81%)	38 (77.55%)	**1284 (63.34%)**
Chronic musculoskeletal disorders	399 (31.15%)	**114 (43.51%)*****	**57 (41.91%)****	**71 (47.02%)*****	**63 (42.57%**)**	20 (40.82%)	**724 (35.72%)**
No accompanying chronic musculoskeletal disorders	882 (68.85%)	148 (56.49%)	79 (58.09%)	80 (52.98%)	85 (57.43%)	29 (59.18%)	**1303 (64.28%)**
Compliance							
Purchased medicine* at least four times a year	1023 (79.86%)	204 (77.86%)	103 (75.74%)	122 (80.79%)	121 (81.76%)	39 (79.59%)	**1612 (79.53%)**
Purchased medicine* less than four times a year	258 (20.14%)	58 (22.14%)	33 (24.26%)	29 (19.21%)	27 (18.24%)	10 (20.41%)	**415 (20.47%)**
Total	**1281 (63.20%)**	**262 (12.93%)**	**136 (6.71%)**	**151 (7.45%)**	**148 (7.30%)**	**49 (2.42%)**	**2027 (100.00%)**

The significant results have been highlighted in bold

AD antidepressant drug purchase, *BDI* Beck Depression Inventory, *SD* standard deviation

*Antihypertensive and/or antidiabetic medicine

**$p < 0.05$ in the χ^2 test/t test

***$p < 0.001$ in the χ^2 test/t test

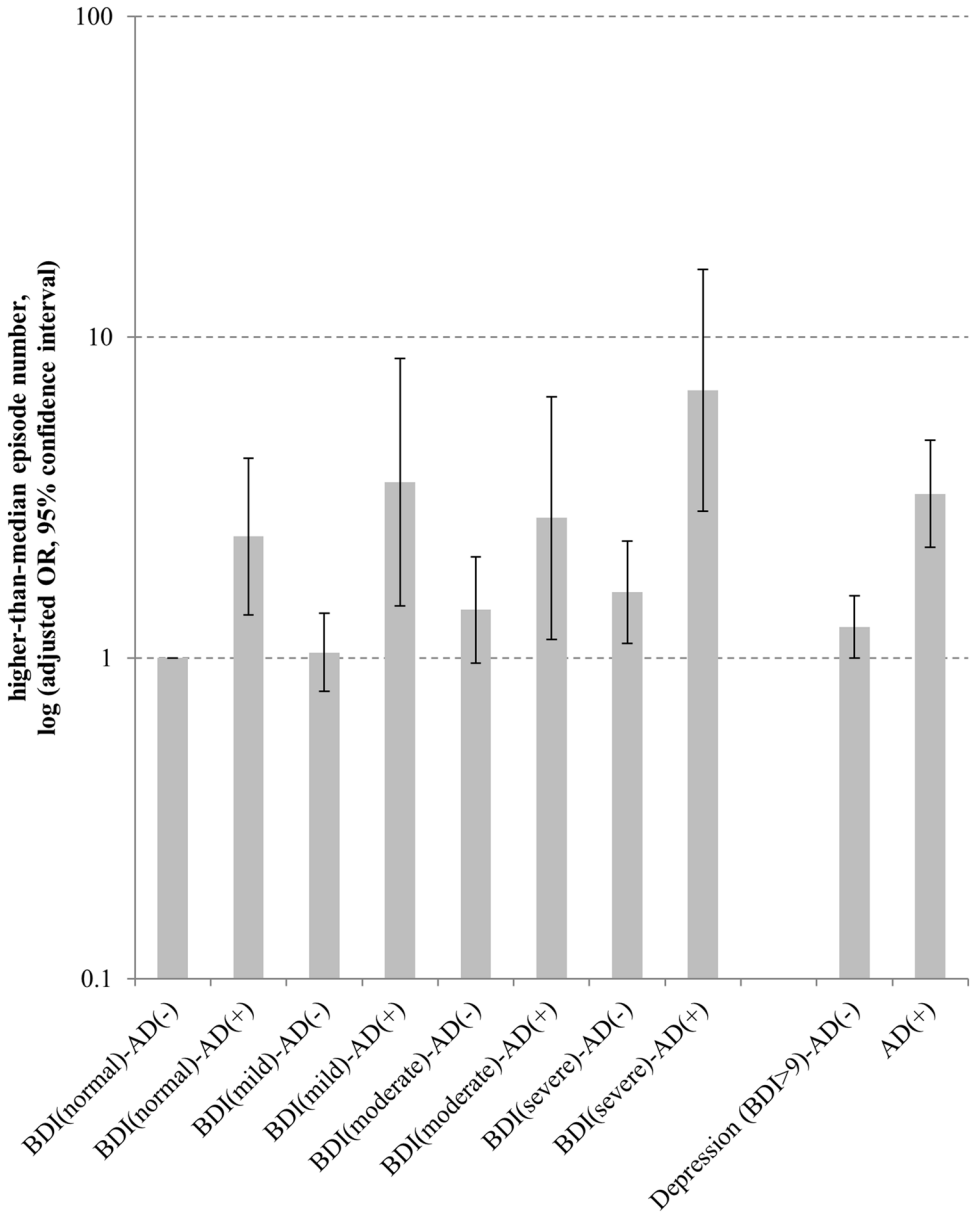

Fig. 2 Association between a higher-than-median episode number per year in outpatient institutions and depression ascertained by the abbreviated version of the Beck Depression Inventory (BDI) and the 1-year history of antidepressant drug (AD) purchasing among patients with hypertension and/or diabetes according to the multivariate logistic regression analysis

Multivariate analysis with a stratified depression classification

According to the adjusted odds ratios from the multivariate logistic regression analysis, the patients with AD-treated depression more frequently used outpatient services compared to the reference group (non-AD-treated patients with normal BDI score) ($OR_{BDI(normal)-AD(+)}$: 2.39, 95% CI 1.36–4.19, $OR_{BDI(mild)-AD(+)}$: 3.53, 95% CI 1.45–8.58, $OR_{BDI(moderate)-AD(+)}$: 2.72, 95% CI 1.14–6.50, and $OR_{BDI(severe)-AD(+)}$: 6.80, 95% CI 2.85–16.21).

A similar association was also observed for the expenses and we found that the more severe the depression is, the higher are expenses in the outpatient services ($OR_{BDI(normal)-AD(+)}$: 2.37, 95% CI 1.35–4.19, $OR_{BDI(mild)-AD(+)}$: 4.78, 95% CI 1.67–13.71, $OR_{BDI(moderate)-AD(+)}$: 8.76, 95% CI 1.62–47.47, and $OR_{BDI(severe)-AD(+)}$: 9.62, 95% CI 3.55–26.08) (Figs. 2, 3).

Among patients who did not purchase ADs but had mild depressive symptoms according to their BDI scores, the episode numbers were similar to the reference group ($OR_{BDI(mild)-AD(-)}$: 1.04, 95% CI 0.79–1.38). The result was borderline significant for untreated moderate depressive symptoms ($OR_{BDI(moderate)-AD(-)}$: 1.41, 95% CI 0.96–2.06). The combination of a negative AD history and severe depressive symptoms according to the BDI was significantly associated with elevated episode numbers ($OR_{BDI(severe)-AD(-)}$: 1.60, 95% CI 1.11–2.31).

Among patients with untreated mild depressed state, expenses were higher than the patients who did not purchase

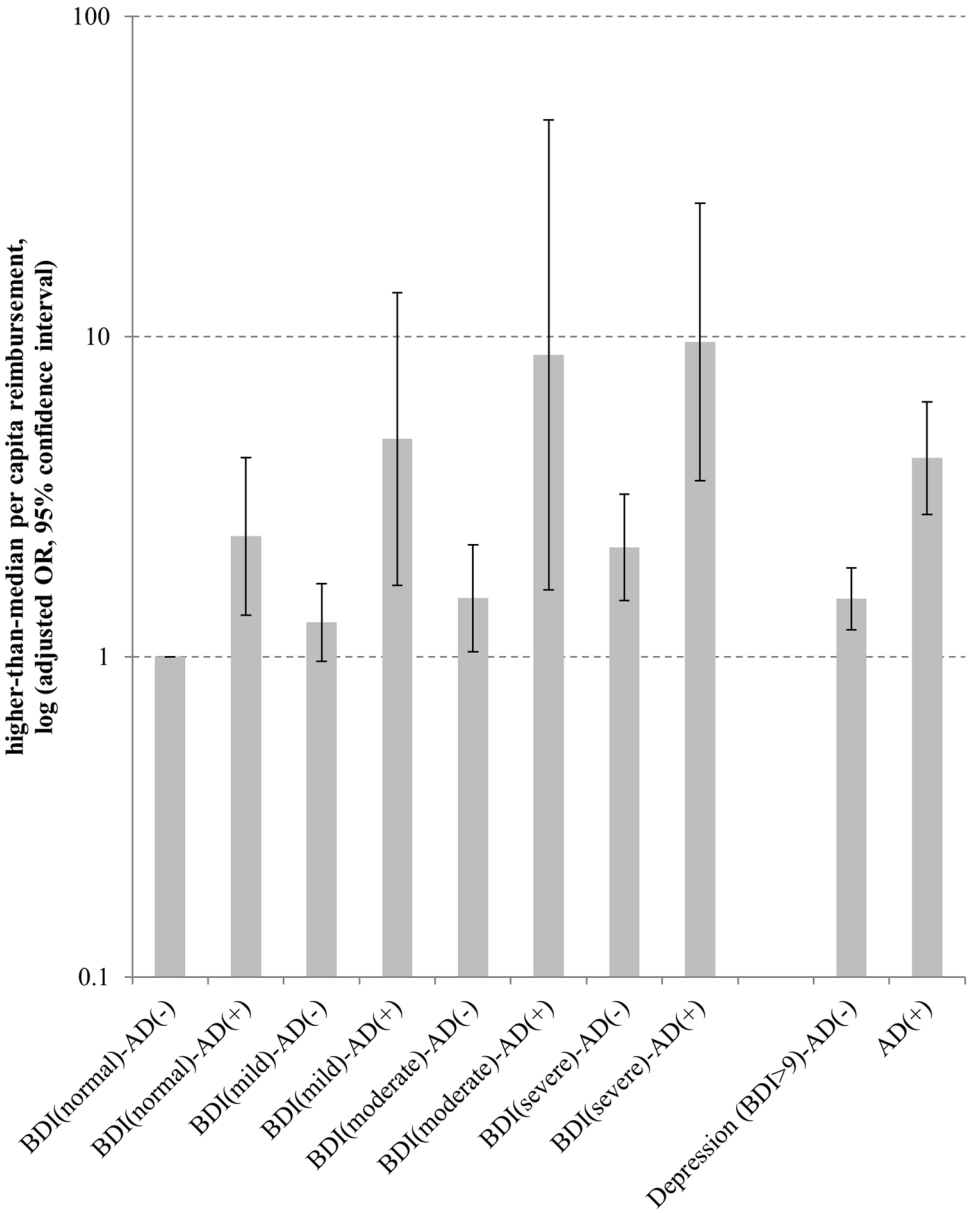

Fig. 3 Association between a higher-than-median per capita reimbursement per year in outpatient institutions and depression ascertained by the abbreviated version of the Beck Depression Inventory (BDI) and the 1-year history of antidepressant drug (AD) purchasing among patients with hypertension and/or diabetes according to the multivariate logistic regression analysis

AD and had normal BDI score, the result was borderline significant ($OR_{BDI(mild)-AD(-)}$: 1.28, 95% CI 0.97–1.69). According to the adjusted odds ratios, in patients who did not purchase ADs but had moderate or severe depressive symptoms, the expenses were higher than the reference values ($OR_{BDI(moderate)-AD(-)}$: 1.52, 95% CI 1.04–2.23, $OR_{BDI(severe)-AD(-)}$: 2.20, 95% CI 1.50–3.22) (Figs. 2, 3).

In these models, the age (OR 1.01, 95% CI 1.00–1.02), education ($OR_{vocational}$: 1.46, 95% CI 1.01–2.10; $OR_{high\ school}$: 1.45, 95% CI 1.01–2.09), former smoking status (OR 1.35, 95% CI 1.03–1.77), and chronic musculoskeletal disorders (OR 1.58, 95% CI 1.28–1.96) were associated with higher-than-median outpatient service use.

According to the adjusted odds ratios, age (OR 1.01, 95% CI 1.00–1.02), former smoking status (OR 1.40, 95% CI 1.06–1.83), chronic musculoskeletal disorders (OR 1.57, 95% CI 1.26–1.95) and osteoporosis (OR 1.49, 95% CI 1.02–2.17) were associated with elevated expenses. The results are summarized in Appendices 3 and 4.

Estimation of workload

By extrapolating our age-, sex-, and education-specific findings, 0.20 million of HT and/or DM patients have AD-treated depression and 2.55 million patients with HT and/or DM who do not receive AD treatment in Hungary (they are the target group for depression screening in primary care).

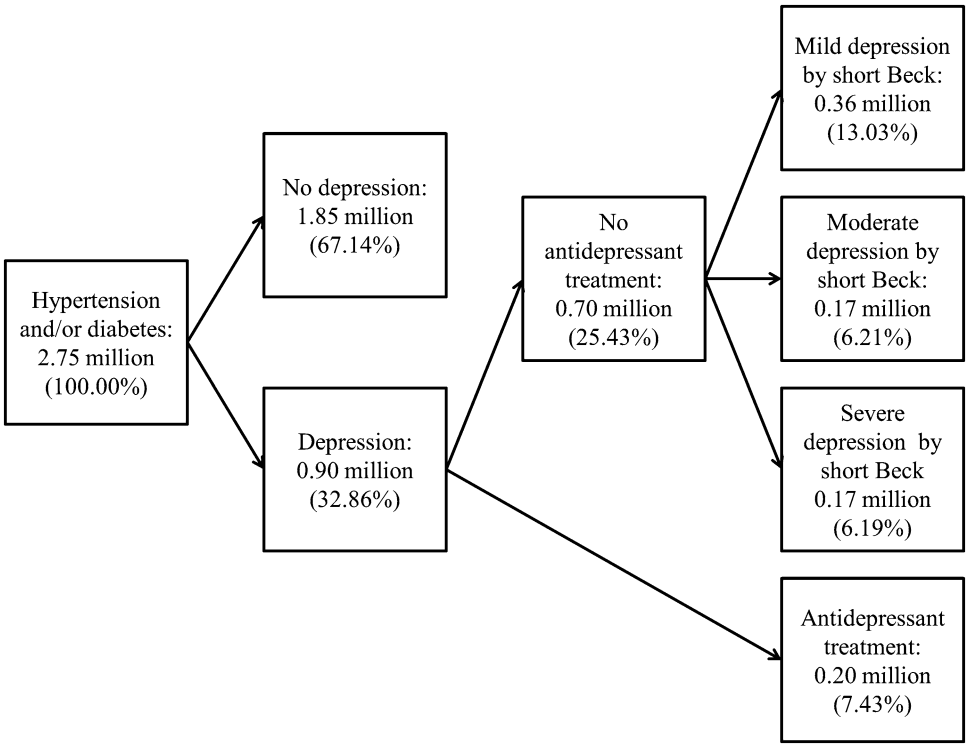

Fig. 4 Estimated numbers of patients with an abbreviated Beck Depression Inventory score and antidepressant-treated depression in Hungary in 2014 among adults with treated hypertension and/or diabetes

The estimated number of patients with mild, moderate, and severe untreated depressive symptoms among HT and/or DM patients is 0.36 million, 0.17 million, and 0.17 million, respectively (Fig. 4).

Since 5085 GMPs are operating in Hungary, the average number of untreated patients with at least moderate depressive symptoms (requiring psychiatric care) among hypertensive and/or diabetic patients is 67 per Hungarian GMP. These patients could benefit from the implementation of a once yearly depression screening in the primary care setting under care in an average GMP. The average number of new cases of HT and/or DM per year in a Hungarian GMP is 26 (based on GPMSSP data) and number of prevalent cases is 478 (based on our estimation: estimated number of HT and/or DM patients per GMP—estimated number of AD-treated HT and/or DM patients per GMP—number of incident HT and/or DM patients a year). Accordingly, in a typical Hungarian GMP, the extra workload per month required for the GPs would be 2.16 screenings for depression among patients with newly diagnosed and 39.83 screenings for depression among formerly diagnosed, prevalent hypertensive and/or diabetic patients. By this systematic screening, the GP could identify the 67 HT and/or DM patients with at least moderate depression, and could organize the psychiatric support for them.

Discussion

Main findings

According to our survey, two-thirds (63.20%) of the patients with HT and/or DM were free of depressive symptoms according to their BDI scores and antidepressant non-use. The 64.17% prevalence of the lack of depression among the hypertensive patients and 64.47% prevalence among the diabetic patients observed in our study were similar to the published reference data of a 70.20% prevalence among hypertensive patients [47] and a 67–71% prevalence among diabetic patients [48]. Our results are also in agreement with the findings of previous Hungarian studies (i.e. a 30.1% prevalence of depression among subjects with CVDs and a 29.3% prevalence of depression among patients with DM) [8, 30].

The use of outpatient services by patients with HT and/or DM was increased when comorbid untreated depression was present even after controlling for the socioeconomic status, lifestyle, compliance, and comorbidities. Moreover, this relationship was severity dependent; i.e. the associations between depression symptom severity and both the number of visits and reimbursement were more pronounced in patients with more severe depressive symptoms. The same conclusion was drawn by other investigations on health care utilization among subjects with ischaemic heart disease [24, 49] and among diabetic patients [8].

Socioeconomic status (i.e. education and Roma ethnicity) was not associated with the outpatients' service use-related expenses, but the education showed significant association with the additional use. According to the observations of published investigations, health care usage of patients with mental or psychiatric problems does not show a consistent association with race and socioeconomic status [50–52].

Taking into consideration both the prevalent and the incident cases of HT and/or DM, the needed number of depression screening would be 42 per month in a typical Hungarian GMP. Because the time required to fill out a short BDI is about 5 min, the corresponding working time is approximately 210 min a month [53].

Strengths and limitations

Our study investigated the depression occurrence and its impacts on HT and DM outpatient care among patients who represented a population living in the intervention area. Due to this sampling, the bias elicited by selecting patients by the health provider institutions was avoided. Moreover, we were able to control for several socioeconomic and lifestyle factors.

For the depression assessment, we used the abbreviated BDI, which was recommended by the AHA [54]. This tool has been used previously in several Hungarian epidemiological and clinical studies. Accordingly, physicians and nurses have a lot of working experience with this tool [28, 35].

The treatment of depression was approximated by AD purchases. Because psychotherapy without the administration of ADs is rarely available in the government-subsidized health care system in Hungary, this approximation did not introduce significant bias into the analysis of the association between depression and outpatient care use. However, ADs have indications other than depression (e.g. anxiety disorders, such as panic and obsessive–compulsive disorders, or eating disorders), and off-label prescriptions (e.g. for insomnia) are also not rare [55–58]. In line with the above, defining 'treated depression' by AD prescription may result in the misclassification of some non-depressed individuals as depressed (i.e. the AD-treated group may consist some subjects who are not depressed but receive AD). On the other hand, we can be sure that the AD-untreated group, from which our main conclusions on the positive association between untreated depressive symptoms and additional use of health care were drawn, was free of patients with treated depression. Accordingly, the additional use of secondary health care among them cannot be the result of the treatment of depression per se.

Since we included the number of visits (and their related costs) in any type of outpatient secondary health care into our analysis, our findings on the additional use of secondary outpatient care by depressed patients might only reflect their appearance in outpatient psychiatric care. However, because the episode numbers in outpatient institutions and/or the related expenses were higher in the groups of AD-untreated patients with a severe depressed state, this possibility was improbable.

Another limitation of the study was that our data collection did not cover the whole spectrum of secondary services. Therefore, the extension of this analysis to hospital care is a future task for our group. Details of the care provided for patients and the interventions responsible for the additional use of outpatient care also require further investigation.

The comorbidity of patients with HT and/or DM as a source of extra outpatient care was controlled directly for diseases targeted by the Primary Health Care Model Programme's health check (e.g. chronic kidney diseases, chronic musculoskeletal disorders, osteoporosis, visual acuity impairment, and hearing loss) and was indirectly controlled for smoking-, alcohol- and obesity-associated diseases by inserting these risk factors into the multivariate statistical models. Furthermore, patients with cancer were excluded from the study. Of course, not all possible comorbidities were covered directly by our data collection. We cannot exclude that a certain percentage of the extra use of outpatient services can be attributed to diseases not controlled directly by or not associated with smoking, alcohol consumption and obesity, and these diseases may have contributed to the development of depressive mood disorder.

In our analysis, the compliance with antihypertensive and/or antidiabetic medications was controlled because several studies have confirmed that comorbid depression is associated with poor compliance and prognosis [7, 9–11]; furthermore, this kind of noncompliance may also lead to increased health care utilization and expenditures [7, 9–11, 59–61]. In our study, the medicine consumption database of NIHIFM was used to ascertain compliance. The limitation of our method was the lack of information on the adequacy of doses prescribed. Moreover, the main disadvantage of using the medicine consumption database is that the purchase of a medicine does not ensure its use; therefore, the overestimation of compliance is a possible shortcoming of our investigation [61–63]. Notwithstanding, taking into consideration that the proportion of compliant patients in our sample (79.53%) was similar to those found by others in regard to oral hypoglycaemic agents (70–80%) and antihypertensive medications (50–70%) [63, 64], the extent of the possible overestimation is supposedly not remarkable in this study.

Conclusions

Our study showed that untreated depression was a frequent condition among Hungarian patients with HT and/or DM, and many untreated depression cases could be detected by

systematic screening at the level of primary health care. Furthermore, the presence of depressive symptoms without treatment was associated with the additional use of secondary care in a severity-dependent and socioeconomic status-independent manner in our sample. These findings may suggest that the identification of depressed Hungarian patients with HT and/or DM with a regular and systematic screening in the primary care could contribute to the detection of untreated cases and to the initiation of their adequate treatment. Further examinations could shed light on the extent to which the identified additional secondary care visits and costs are related to untreated depression and could possibly be reduced by treating the depression. Since long-term care for HT and DM is mainly managed by GPs, they are in an ideal position to conduct depression screening. Moreover, considering that this activity would not induce a remarkable workload increase, depression screening in the primary health care seems to be feasible, as well. Altogether, our results suggest that GPs should consider depressive symptoms in patients with HT and/or DM like the classic major cardiovascular and diabetic prognostic factors (such as smoking, obesity or physical inactivity). GPs should check for and initiate required intervention against moderate and severe depressive symptoms.

Acknowledgements The authors thank all the participants who took the time to complete the questionnaires and the members of general practitioners' cluster who participated in data collection. Furthermore, the authors thank Alexandra Balázs for support in managing the legal issues related to data access. The reported study was carried out in the framework of the "Public Health Focused Model Programme for Organising Primary Care Services Backed by a Virtual Care Service Centre" (SH/8/1). The Model Programme is funded by the Swiss Government via the Swiss Contribution Programme (SH/8/1) in agreement with the Government of Hungary. Additional source of funding was from GINOP-2.3.2-15-2016-00005 project which was co-financed by the European Union and the European Regional Development Fund.

Author contributions Concept/design: AP, JS, MP; data collection: AP, JS, MP, LK, ZSF, LP; data analysis/interpretation: AP, JS, ZSB, PD, ZR; drafting manuscript: AP, JS, PD, ZR. All authors contributed to the writing of the final version of the paper.

Compliance with ethical standards

Ethical approval The study protocol was approved by the Ethics Committee of the Hungarian National Scientific Council on Health (TUKEB 16676-3/2016/EKU, 0361/16). All enrolled patients signed an informed consent form contributing to the storage and analysis of their data before the data collection of health check started. Furthermore, the legal staff of the National Institute of Health Insurance Fund Management checked each signed informed consent before issuing the permission for record linkage. The health insurance numbers of the patients were handled exclusively on computers of and within the National Institute of Health Insurance Fund Management by this institution's own staff members dedicated to handling these sensitive data as their usual job. Nobody else from the study personnel obtained permission to handle these data.

Conflict of interest ZR has in the past received speakers' bureau honoraria, advisory board funding or travel support from AstraZeneca, Janssen, Lundbeck, Lilly, Servier-EGIS, Richter and TEVA-Biogal. The other authors report no biomedical financial interests or potential conflicts of interest. The authors declare that the presented epidemiological research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Appendix 1

Association between any indicator of depression among patients with hypertension and/or diabetes and a higher-than-median episode number per year in outpatient institutions according to the multivariate logistic regression analysis (significant results are in bold)

	Risk for above-median episode numbers[a]	
	Complete case analysis ($N=1772$)	Multiple imputation ($N=2027$)
Gender		
Female	1.05 [0.84–1.32]	1.03 [0.83–1.27]
Male	1 (reference)	1 (reference)
Age		
Year	**1.01 [1.00–1.02]**	**1.01 [1.00–1.02]**
Education		
Primary	1.05 [0.74–1.50]	1.26 [0.91–1.74]
Vocational	1.28 [0.87–1.90]	1.39 [0.97–1.99]
High school	1.17 [0.80–1.73]	1.38 [0.96–1.97]
Tertiary	1.21 [0.74–1.95]	1.33 [0.84–2.10]
Less than primary	1 (reference)	1 (reference)
Ethnicity		
Roma	1.07 [0.69–1.67]	1.11 [0.74–1.68]
Non-Roma	1 (reference)	1 (reference)
Alcohol consumption by AUDIT		
Problem drinker	0.66 [0.24–1.84]	0.71 [0.29–1.75]
Non-problem drinker	1 (reference)	1 (reference)
Smoking		
Occasional	1.61 [0.84–3.08]	**1.86 [1.01–3.42]**
Regular	0.92 [0.69–1.22]	0.89 [0.67–1.17]
Former	**1.40 [1.07–1.81]**	**1.35 [1.03–1.77]**
Never	1 (reference)	1 (reference)
BMI		
Obese	1.07 [0.87–1.32]	1.10 [0.90–1.34]
Normal	1 (reference)	1 (reference)
Central obesity		
Central obesity	1.24 [0.82–1.86]	1.14 [0.77–1.68]
Normal	1 (reference)	1 (reference)

	Risk for above-median episode numbers[a]	
	Complete case analysis ($N=1772$)	Multiple imputation ($N=2027$)
Accompanying disease		
Chronic musculoskeletal disorders	**1.54 [1.23–1.93]**	**1.58 [1.27–1.95]**
Visual acuity impairment or hearing loss	1.28 [0.94–1.73]	1.24 [0.92–1.66]
Osteoporosis	1.30 [0.89–1.89]	1.27 [0.88–1.83]
Chronic kidney disorder	1.01 [0.68–1.50]	1.04 [0.71–1.52]
No accompanying disorder	1 (reference)	1 (reference)
Compliance		
Purchased medicine[b] less than four times a year	0.98 [0.76–1.26]	1.00 [0.79–1.27]
Purchased medicine[b] at least four times a year	1 (reference)	1 (reference)
Generel practitioner (GP)		
GP 1	0.80 [0.53–1.21]	0.82 [0.55–1.23]
GP 2	**0.52 [0.33–0.82]**	**0.55 [0.35–0.85]**
GP 3	0.79 [0.42–1.50]	0.93 [0.53–1.61]
GP 4	0.93 [0.41–2.12]	0.93 [0.51–1.71]
GP 5	0.84 [0.54–1.29]	0.88 [0.58–1.33]
GP 6	1.57 [0.83–2.97]	1.59 [0.99–2.55]
GP 7	0.76 [0.50–1.16]	0.81 [0.53–1.22]
GP 8	0.91 [0.49–1.67]	1.14 [0.67–1.92]
GP 9	0.58 [0.23–1.48]	1.02 [0.51–2.05]
GP 10	**0.26 [0.15–0.45]**	**0.27 [0.16–0.46]**
GP 11	**0.31 [0.18–0.52]**	**0.32 [0.19–0.54]**
GP 12	**0.49 [0.29–0.84]**	**0.53 [0.31–0.89]**
GP 13	**0.34 [0.20–0.58]**	**0.36 [0.22–0.60]**
GP 14	**0.37 [0.23–0.61]**	**0.40 [0.25–0.66]**
GP 15	1 (reference)	1 (reference)
Depression		
Depression (BDI > 9 and did not purchase antidepressant in 12 months)	1.21 [0.96–1.53]	1.25 [1.00–1.56]
Purchased antidepressant in 12 months	**3.42 [2.29–5.12]**	**3.24 [2.21–4.75]**
No depression (BDI ≤ 9 and did not purchase antidepressant in 12 months)	1 (reference)	1 (reference)

[a]Odds ratio [95% confidence interval]

[b]Antihypertensive and/or antidiabetic medicine

Appendix 2

Association between any indicator of depression among patients with hypertension and/or diabetes and a higher-than-median reimbursement per year in outpatient institutions according to the multivariate logistic regression analysis (significant results are in bold)

	Risk for above-median expenses[a]	
	Complete case analysis ($N=1772$)	Multiple imputation ($N=2027$)
Gender		
Female	1.22 [0.97–1.53]	1.10 [0.89–1.36]
Male	1 (reference)	1 (reference)
Age		
Year	1.01 [1.00–1.02]	1.01 [1.00–1.02]
Education		
Primary	1.11 [0.78–1.59]	1.25 [0.90–1.73]
Vocational	1.35 [0.91–2.00]	1.34 [0.93–1.93]
High school	1.18 [0.80–1.74]	1.27 [0.88–1.82]
Tertiary	1.31 [0.81–2.13]	1.27 [0.80–2.02]
Less than primary	1 (reference)	1 (reference)
Ethnicity		
Roma	0.92 [0.59–1.44]	1.00 [0.66–1.52]
Non-Roma	1 (reference)	1 (reference)
Alcohol consumption by AUDIT		
Problem drinker	0.60 [0.21–1.69]	0.63 [0.25–1.57]
Non-problem drinker	1 (reference)	1 (reference)
Smoking		
Occasional	1.33 [0.69–2.56]	1.64 [0.86–3.14]
Regular	0.95 [0.72–1.26]	0.94 [0.72–1.23]
Former	**1.44 [1.11–1.88]**	**1.41 [1.08–1.86]**
Never	1 (reference)	1 (reference)
BMI		
Obese	1.03 [0.83–1.27]	1.07 [0.87–1.30]
Normal	1 (reference)	1 (reference)
Central obesity		
Central obesity	1.07 [0.72–1.61]	1.05 [0.71–1.54]
Normal	1 (reference)	1 (reference)
Accompanying disease		
Chronic musculoskeletal disorders	**1.52 [1.21–1.91]**	**1.56 [1.26–1.94]**
Visual acuity impairment or hearing loss	**1.39 [1.02–1.90]**	1.30 [0.96–1.75]
Osteoporosis	**1.56 [1.06–2.29]**	**1.50 [1.03–2.18]**
Chronic kidney disorder	1.05 [0.70–1.56]	1.06 [0.72–1.56]
No accompanying disorder	1 (reference)	1 (reference)
Compliance		
Purchased medicine[b] less than four times a year	0.98 [0.76–1.26]	1.00 [0.79–1.26]

	Risk for above-median expenses[a]	
	Complete case analysis ($N=1772$)	Multiple imputation ($N=2027$)
Purchased medicine[b] at least four times a year	1 (reference)	1 (reference)
Generel practitioner (GP)		
GP 1	0.86 [0.57–1.31]	0.87 [0.58–1.31]
GP 2	**0.58 [0.37–0.90]**	**0.57 [0.36–0.88]**
GP 3	1.11 [0.58–2.10]	1.22 [0.70–2.13]
GP 4	1.21 [0.52–2.83]	1.08 [0.58–1.99]
GP 5	0.90 [0.58–1.39]	0.92 [0.61–1.41]
GP 6	**2.07 [1.07–4.03]**	**2.00 [1.23–3.25]**
GP 7	1.06 [0.69–1.63]	1.10 [0.73–1.67]
GP 8	0.99 [0.54–1.84]	1.11 [0.65–1.88]
GP 9	1.09 [0.43–2.78]	1.69 [0.81–3.50]
GP 10	**0.22 [0.12–0.38]**	**0.23 [0.13–0.39]**
GP 11	**0.33 [0.20–0.56]**	**0.35 [0.21–0.58]**
GP 12	**0.56 [0.33–0.97]**	**0.58 [0.34–0.99]**
GP 13	**0.28 [0.17–0.48]**	**0.30 [0.18–0.50]**
GP 14	**0.35 [0.21–0.58]**	**0.39 [0.24–0.63]**
GP 15	1 (reference)	1 (reference)
Depression		
Depression (BDI > 9 and did not purchase antidepressant in 12 months)	**1.44 [1.14–1.81]**	**1.52 [1.21–1.90]**
Purchased antidepressant in 12 months	**4.41 [2.87–6.79]**	**4.17 [2.78–6.25]**
No depression (BDI ≤ 9 and did not purchase antidepressant in 12 months)	1 (reference)	1 (reference)

[a]Odds ratio [95% confidence interval]

[b]Antihypertensive and/or antidiabetic medicine

Appendix 3

Association between different categories of depression among patients with hypertension and/or diabetes and a higher-than-median episode number per year in outpatient institutions according to the multivariate logistic regression analysis (significant results are in bold)

	Risk for above-median episode numbers[a]	
	Complete case analysis ($N=1772$)	Multiple imputation ($N=2027$)
Gender		
Female	1.05 [0.83–1.31]	1.03 [0.83–1.27]
Male	1 (reference)	1 (reference)
Age		
Year	**1.01 [1.00–1.02]**	**1.01 [1.00–1.02]**
Education		
Primary	1.08 [0.76–1.55]	1.30 [0.94–1.80]
Vocational	1.36 [0.91–2.02]	**1.46 [1.01–2.10]**
High school	1.25 [0.84–1.85]	**1.45 [1.01–2.09]**
Tertiary	1.30 [0.80–2.11]	1.41 [0.89–2.24]
Less than primary	1 (reference)	1 (reference)
Ethnicity		
Roma	1.00 [0.64–1.57]	1.05 [0.69–1.59]
Non-Roma	1 (reference)	1 (reference)
Alcohol consumption by AUDIT		
Problem drinker	0.61 [0.22–1.72]	0.66 [0.26–1.65]
Non-problem drinker	1 (reference)	1 (reference)
Smoking		
Occasional	1.56 [0.81–3.00]	1.84 [0.99–3.39]
Regular	0.90 [0.68–1.20]	0.88 [0.66–1.16]
Former	**1.38 [1.06–1.80]**	**1.35 [1.03–1.77]**
Never	1 (reference)	1 (reference)
BMI		
Obese	1.06 [0.86–1.31]	1.08 [0.89–1.32]
Normal	1 (reference)	1 (reference)
Central obesity		
Central obesity	1.23 [0.82–1.85]	1.12 [0.76–1.65]
Normal	1 (reference)	1 (reference)
Accompanying disease		
Chronic musculoskeletal disorders	**1.55 [1.23–1.94]**	**1.58 [1.28–1.96]**
Visual acuity impairment or hearing loss	1.26 [0.92–1.71]	1.22 [0.91–1.64]
Osteoporosis	1.30 [0.89–1.90]	1.28 [0.89–1.86]
Chronic kidney disorder	1.00 [0.67–1.48]	1.02 [0.70–1.50]
No accompanying disorder	1 (reference)	1 (reference)
Compliance		
Purchased medicine[b] less than four times a year	0.99 [0.77–1.27]	1.02 [0.81–1.29]
Purchased medicine[b] at least four times a year	1 (reference)	1 (reference)
Generel practitioner (GP)		
GP 1	0.80 [0.53–1.22]	0.82 [0.55–1.23]
GP 2	**0.54 [0.34–0.84]**	**0.56 [0.36–0.87]**
GP 3	0.80 [0.42–1.51]	0.92 [0.53–1.60]
GP 4	0.88 [0.38–2.04]	0.88 [0.48–1.64]
GP 5	0.84 [0.54–1.29]	0.87 [0.57–1.32]
GP 6	1.53 [0.81–2.91]	1.56 [0.97–2.50]
GP 7	0.76 [0.50–1.17]	0.80 [0.53–1.21]
GP 8	0.90 [0.49–1.66]	1.14 [0.67–1.92]

	Risk for above-median episode numbers[a]	
	Complete case analysis ($N=1772$)	Multiple imputation ($N=2027$)
GP 9	0.57 [0.22–1.46]	1.02 [0.51–2.05]
GP 10	**0.26 [0.15–0.44]**	**0.26 [0.15–0.45]**
GP 11	**0.31 [0.19–0.53]**	**0.32 [0.19–0.54]**
GP 12	**0.50 [0.29–0.85]**	**0.52 [0.31–0.89]**
GP 13	**0.34 [0.20–0.58]**	**0.35 [0.21–0.59]**
GP 14	**0.36 [0.22–0.60]**	**0.39 [0.24–0.64]**
GP 15	1 (reference)	1 (reference)
Depression		
No depression by BDI, purchased antidepressant in 12 months	**2.24 [1.24–4.03]**	**2.39 [1.36–4.19]**
Mild depression by BDI, did not purchase antidepressant in 12 months	0.98 [0.73–1.33]	1.04 [0.79–1.38]
Mild depression by BDI, purchased antidepressant in 12 months	**3.45 [1.44–8.28]**	**3.53 [1.45–8.58]**
Moderate depression by BDI, did not purchase antidepressant in 12 months	1.42 [0.96–2.11]	1.41 [0.96–2.06]
Moderate depression by BDI, purchased antidepressant in 12 months	**3.45 [1.31–9.11]**	**2.72 [1.14–6.50]**
Severe depression by BDI, did not purchase antidepressant in 12 months	**1.60 [1.07–2.38]**	**1.60 [1.11–2.31]**
Severe depression by BDI, purchased antidepressant in 12 months	**7.85 [3.14–19.58]**	**6.80 [2.85–16.21]**
No depression by BDI, did not purchase antidepressant in 12 months	1 (reference)	1 (reference)

[a]Odds ratio [95% confidence interval]

[b]Antihypertensive and/or antidiabetic medicine

Appendix 4

Association between different categories of depression among patients with hypertension and/or diabetes and a higher-than-median reimbursement per year in outpatient institutions according to the multivariate logistic regression analysis (significant results are in bold)

	Risk for above-median expenses[a]	
	Complete case analysis ($N=1772$)	Multiple imputation ($N=2027$)
Gender		
Female	1.21 [0.96–1.52]	1.10 [0.88–1.36]
Male	1 (reference)	1 (reference)
Age		
Year	1.01 [1.00–1.02]	**1.01 [1.00–1.02]**
Education		
Primary	1.15 [0.80–1.64]	1.30 [0.93–1.81]
Vocational	1.44 [0.97–2.16]	1.44 [0.99–2.08]
High school	1.26 [0.85–1.87]	1.36 [0.94–1.97]
Tertiary	1.43 [0.87–2.33]	1.38 [0.87–2.19]
Less than primary	1 (reference)	1 (reference)
Ethnicity		
Roma	0.87 [0.55–1.36]	0.95 [0.62–1.44]
Non-Roma	1 (reference)	1 (reference)
Alcohol consumption by AUDIT		
Problem drinker	0.58 [0.20–1.65]	0.59 [0.23–1.50]
Non-problem drinker	1 (reference)	1 (reference)
Smoking		
Occasional	1.25 [0.64–2.42]	1.59 [0.84–3.00]
Regular	0.93 [0.70–1.23]	0.92 [0.71–1.21]
Former	**1.42 [1.09–1.85]**	**1.40 [1.06–1.83]**
Never	1 (reference)	1 (reference)
BMI		
Obese	1.02 [0.82–1.25]	1.05 [0.86–1.28]
Normal	1 (reference)	1 (reference)
Central obesity		
Central obesity	1.07 [0.71–1.62]	1.04 [0.71–1.53]
Normal	1 (reference)	1 (reference)
Accompanying disease		
Chronic musculoskeletal disorders	**1.52 [1.20–1.91]**	**1.57 [1.26–1.95]**
Visual acuity impairment or hearing loss	1.35 [0.99–1.85]	1.26 [0.94–1.70]
Osteoporosis	**1.53 [1.04–2.25]**	**1.49 [1.02–2.17]**

	Risk for above-median expenses[a]	
	Complete case analysis ($N=1772$)	Multiple imputation ($N=2027$)
Chronic kidney disorder	1.03 [0.69–1.53]	1.04 [0.70–1.53]
No accompanying disorder	1 (reference)	1 (reference)
Compliance		
Purchased medicine[b] less than four times a year	0.99 [0.76–1.27]	1.02 [0.80–1.29]
Purchased medicine[b] at least four times a year	1 (reference)	1 (reference)
Generel practitioner (GP)		
GP 1	0.88 [0.58–1.34]	0.88 [0.58–1.32]
GP 2	**0.60 [0.38–0.94]**	**0.59 [0.38–0.91]**
GP 3	1.12 [0.59–2.13]	1.23 [0.70–2.15]
GP 4	1.21 [0.51–2.84]	1.04 [0.56–1.95]
GP 5	0.92 [0.60–1.42]	0.93 [0.61–1.42]
GP 6	**2.08 [1.07–4.04]**	**1.99 [1.22–3.23]**
GP 7	1.09 [0.71–1.67]	1.11 [0.73–1.69]
GP 8	1.00 [0.54–1.85]	1.12 [0.66–1.90]
GP 9	1.10 [0.43–2.81]	1.71 [0.83–3.55]
GP 10	**0.22 [0.12–0.38]**	**0.22 [0.13–0.38]**
GP 11	**0.34 [0.20–0.58]**	**0.35 [0.21–0.59]**
GP 12	0.58 [0.34–1.00]	0.59 [0.34–1.00]
GP 13	**0.29 [0.17–0.49]**	**0.30 [0.18–0.51]**
GP 14	**0.35 [0.21–0.58]**	**0.38 [0.23–0.62]**
GP 15	1 (reference)	1 (reference)
Depression		
No depression by BDI, purchased antidepressant in 12 months	**2.30 [1.27–4.18]**	**2.37 [1.35–4.19]**
Mild depression by BDI, did not purchase antidepressant in 12 months	1.22 [0.90–1.65]	1.28 [0.97–1.69]
Mild depression by BDI, purchased antidepressant in 12 months	**4.97 [1.90–12.99]**	**4.78 [1.67–13.71]**
Moderate depression by BDI, did not purchase antidepressant in 12 months	1.40 [0.94–2.08]	**1.52 [1.04–2.23]**
Moderate depression by BDI, purchased antidepressant in 12 months	**12.23 [2.79–53.66]**	**8.76 [1.62–47.47]**
Severe depression by BDI, did not purchase antidepressant in 12 months	**2.16 [1.44–3.25]**	**2.20 [1.50–3.22]**
Severe depression by BDI, purchased antidepressant in 12 months	**9.29 [3.46–24.92]**	**9.62 [3.55–26.08]**
No depression by BDI, did not purchase antidepressant in 12 months	1 (reference)	1 (reference)

[a]Odds ratio [95% confidence interval]

[b]Antihypertensive and/or antidiabetic medicine

Appendix 5

Sociodemographic, lifestyle and clinical characteristics of the patients by depression classifications

	BDI (normal) AD(−)[b]	BDI (mild) AD(−)[b]	BDI (moderate) AD(-)[b]	BDI (severe) AD(−)[b]	AD(+)[b]	Missing[b]	Total[b]
Gender							
Male	503 (39.27%) [36.58–42.00%]	85 (32.44%) [26.81–38.48%]	49 (36.03%) [27.98–44.70%]	42 (27.81%) [20.84–35.68%]	35 (23.65%) [17.06–31.32%]	16 (32.65%) [19.95–47.54%]	**730 (36.01%) [33.92–38.15%]**
Female	778 (60.73%) [58.00–63.42%]	177 (67.56%) [61.52–73.19%]	87 (63.97%) [55.30–72.02%]	109 (72.19%) [64.32–79.16%]	113 (76.35%) [68.68–82.94%]	33 (67.35%) [52.46–80.05%]	**1297 (63.99%) [61.85–66.08%]**
Age							
Year (mean ± SD)	61.41 (± 13.07)	59.60 (± 13.18)	60.42 (± 12.61)	56.89 (± 11.27)	58.51 (± 12.41)	56.18 (± 13.34)	**60.43 (± 12.96)**
Education							
Less than primary	117 (9.13%) [7.61–10.85%]	29 (11.07%) [7.54–15.51%]	21 (15.44%) [9.82–22.63%]	38 (25.17%) [18.47–32.87%]	19 (12.84%) [7.91–19.32%]	8 (16.33%) [7.32–29.66%]	**232 (11.45%) [10.09–12.91%]**
Primary	414 (32.32%) [29.76–34.96%]	79 (30.15%) [24.66–36.10%]	51 (37.50%) [29.35–46.21%]	64 (42.38%) [34.39–50.68%]	55 (37.16%) [29.37–45.48%]	18 (36.73%) [23.42–51.71%]	**681 (33.60%) [31.54–35.70%]**
Vocational	297 (23.19%) [20.90–25.60%]	75 (28.63%) [23.23–34.51%]	36 (26.47%) [19.28–34.72%]	26 (17.22%) [11.57–24.20%]	27 (18.24%) [12.38–25.42%]	12 (24.49%) [13.34–38.87%]	**473 (23.33%) [21.51–25.24%]**
High school	340 (26.54%) [24.14–29.05%]	61 (23.28%) [18.30–28.88%]	22 (16.18%) [10.42–23.46%]	20 (13.25%) [8.28–19.71%]	37 (25.00%) [18.25–32.78%]	9 (18.37%) [8.76–32.02%]	**489 (24.12%) [22.28–26.05%]**
Tertiary	113 (8.82%) [7.33–10.51%]	18 (6.87%) [4.12–10.64%]	6 (4.41%) [1.64–9.36%]	3 (1.99%) [0.41–5.70%]	10 (6.76%) [3.29–12.07%]	2 (4.08%) [0.50–13.98%]	**152 (7.50%) [6.39–8.73%]**
Ethnicity							
Roma	55 (4.29%) [3.25–5.55%]	17 (6.49%) [3.82–10.19%]	18 (13.24%) [8.04–20.11%]	29 (19.21%) [13.26–26.40%]	11 (7.43%) [3.77–12.91%]	1 (2.04%) [0.05–10.85%]	**131 (6.46%) [5.43–7.62%]**
Non-Roma	1223 (95.47%) [94.19–96.54%]	245 (93.51%) [89.81–96.18%]	117 (86.03%) [79.05–91.37%]	122 (80.79%) [73.60–86.74%]	137 (92.57%) [87.09–96.23%]	48 (97.96%) [89.15–99.95%]	**1892 (93.34%) [92.17–94.39%]**
Missing	3 (0.23%) [0.05–0.68%]	0 (0.00%) [0.00–1.40%]	1 (0.74%) [0.02–4.03%]	0 (0.00%) [0.00–2.41%]	0 (0.00%) [0.00–2.46%]	0 (0.00%) [0.00–7.25%]	**4 (0.20%) [0.05–0.50%]**
Alcohol consumption by AUDIT							
Problem drinker	15 (1.17%) [0.66–1.92%]	1 (0.38%) [0.01–2.11%]	3 (2.21%) [0.46–6.31%]	0 (0.00%) [0.00–2.41%]	1 (0.68%) [0.02–3.71%]	1 (2.04%) [0.05–10.85%]	**21 (1.04%) [0.64–1.58%]**
Non-problem drinker	1263 (98.59%) [97.79–99.17%]	259 (98.85%) [96.69–99.76%]	133 (97.79%) [93.69–99.54%]	151 (100.00%) [97.59–100.00%]	147 (99.32%) [96.29–99.98%]	48 (97.96%) [89.15–99.95%]	**2001 (98.72%) [98.13–99.16%]**
Missing	3 (0.23%) [0.05–0.68%]	2 (0.76%) [0.09–2.73%]	0 (0.00%) [0.00–2.68%]	0 (0.00%) [0.00–2.41%]	0 (0.00%) [0.00–2.46%]	0 (0.00%) [0.00–7.25%]	**5 (0.25%) [0.08–0.57%]**
Smoking							
Occasional	25 (1.95%) [1.27–2.87%]	6 (2.29%) [0.84–4.92%]	4 (2.94%) [0.81–7.36%]	7 (4.64%) [1.88–9.32%]	2 (1.35%) [0.16–4.80%]	0 (0.00%) [0.00–7.25%]	**44 (2.17%) [1.58–2.90%]**

	BDI (normal) AD(−)[b]	BDI (mild) AD(−)[b]	BDI (moderate) AD(-)[b]	BDI (severe) AD(−)[b]	AD(+)[b]	Missing[b]	Total[b]
Regular	231 (18.03%) [15.96–20.25%]	59 (22.52%) [17.61–28.06%]	40 (29.41%) [21.91–37.83%]	56 (37.09%) [29.37–45.31%]	45 (30.41%) [23.12–38.50%]	12 (24.49%) [13.34–38.87%]	**443 (21.85%) [20.07–23.72%]**
Former	266 (20.77%) [18.57–23.09%]	51 (19.47%) [14.85–24.79%]	31 (22.79%) [16.04–30.77%]	25 (16.56%) [11.01–23.46%]	26 (17.57%) [11.81–24.67%]	11 (22.45%) [11.77–36.62%]	**410 (20.23%) [18.50–22.04%]**
Never	653 (50.98%) [48.20–53.75%]	114 (43.51%) [37.42–49.75%]	50 (36.76%) [28.67–45.45%]	45 (29.80%) [22.64–37.78%]	64 (43.24%) [35.13–51.63%]	22 (44.90%) [30.67–59.77%]	**948 (46.77%) [44.58–48.97%]**
Missing	106 (8.27%) [6.82–9.92%]	32 (12.21%) [8.51–16.80%]	11 (8.09%) [4.11–14.01%]	18 (11.92%) [7.22–18.18%]	11 (7.43%) [3.77–12.91%]	4 (8.16%) [2.27–19.60%]	**182 (8.98%) [7.77–10.31%]**
BMI							
Obese	660 (51.52%) [48.75–54.29%]	121 (46.18%) [40.03–52.42%]	67 (49.26%) [40.59–57.97%]	71 (47.02%) [38.86–55.30%]	73 (49.32%) [41.02–57.66%]	18 (36.73%) [23.42–51.71%]	**1010 (49.83%) [47.63–52.03%]**
Normal	611 (47.70%) [44.93–50.47%]	136 (51.91%) [45.68–58.10%]	68 (50.00%) [41.31–58.69%]	72 (47.68%) [39.50–55.96%]	72 (48.65%) [40.36–56.99%]	30 (61.22%) [46.24–74.80%]	**989 (48.79%) [46.59–50.99%]**
Missing	10 (0.78%) [0.37–1.43%]	5 (1.91%) [0.62–4.40%]	1 (0.74%) [0.02–4.03%]	8 (5.30%) [2.31–10.17%]	3 (2.03%) [0.42–5.81%]	1 (2.04%) [0.05–10.85%]	**28 (1.38%) [0.92–1.99%]**
Central obesity							
Central obesity	1181 (92.19%) [90.59–93.60%]	240 (91.60%) [87.56–94.66%]	125 (91.91%) [85.99–95.89%]	142 (94.04%) [88.99–97.24%]	139 (93.92%) [88.77–97.18%]	44 (89.80%) [77.77–96.60%]	**1871 (92.30%) [91.06–93.43%]**
Normal	97 (7.57%) [6.18–9.16%]	20 (7.63%) [4.72–11.54%]	11 (8.09%) [4.11–14.01%]	9 (5.96%) [2.76–11.01%]	9 (6.08%) [2.82–11.23%]	4 (8.16%) [2.27–19.60%]	**150 (7.40%) [6.30–8.63%]**
Missing	3 (0.23%) [0.05–0.68%]	2 (0.76%) [0.09–2.73%]	0 (0.00%) [0.00–2.68%]	0 (0.00%) [0.00–2.41%]	0 (0.00%) [0.00–2.46%]	1 (2.04%) [0.05–10.85%]	**6 (0.30%) [0.11–0.64%]**
Accompanying disease							
Chronic kidney disorder	75 (5.85%) [4.63–7.28%]	17 (6.49%) [3.82–10.19%]	10 (7.35%) [3.58–13.11%]	13 (8.61%) [4.66–14.27%]	8 (5.41%) [2.36–10.37%]	2 (4.08%) [0.50–13.98%]	**125 (6.17%) [5.16–7.30%]**
No accompanying chronic kidney disorder	1206 (94.15%) [92.72–95.37%]	245 (93.51%) [89.81–96.18%]	126 (92.65%) [86.89–96.42%]	138 (91.39%) [85.73–95.34%]	140 (94.59%) [89.63–97.64%]	47 (95.92%) [86.02–99.50%]	**1902 (93.83%) [92.70–94.84%]**
Osteoporosis	87 (6.79%) [5.48–8.31%]	26 (9.92%) [6.59–14.20%]	6 (4.41%) [1.64–9.36%]	13 (8.61%) [4.66–14.27%]	15 (10.14%) [5.78–16.17%]	6 (12.24%) [4.63–24.77%]	**153 (7.55%) [6.44–8.79%]**
No accompanying osteoporosis	1194 (93.21%) [91.69–94.52%]	236 (90.08%) [85.80–93.41%]	130 (95.59%) [90.64–98.36%]	138 (91.39%) [85.73–95.34%]	133 (89.86%) [83.83–94.22%]	43 (87.76%) [75.23–95.37%]	**1874 (92.45%) [91.21–93.56%]**
Loss of visual acuity or hearing	444 (34.66%) [32.05–37.34%]	114 (43.51%) [37.42–49.75%]	46 (33.82%) [25.94–42.43%]	70 (46.36%) [38.22–54.65%]	58 (39.19%) [31.28–47.54%]	11 (22.45%) [11.77–36.62%]	**743 (36.66%) [34.55–38.80%]**
No accompanying loss of visual acuity or hearing	837 (65.34%) [62.66–67.95%]	148 (56.49%) [50.25–62.58%]	90 (66.18%) [57.57–74.06%]	81 (53.64%) [45.35–61.78%]	90 (60.81%) [52.46–68.72%]	38 (77.55%) [63.38–88.23%]	**1284 (63.34%) [61.20–65.45%]**
Chronic musculoskeletal disorders	399 (31.15%) [28.62–33.76%]	114 (43.51%) [37.42–49.75%]	57 (41.91%) [33.51–50.67%]	71 (47.02%) [38.86–55.30%]	63 (42.57%) [34.49–50.95%]	20 (40.82%) [27.00–55.79%]	**724 (35.72%) [33.63–37.85%]**
No accompanying chronic musculoskeletal disorders	882 (68.85%) [66.24–71.38%]	148 (56.49%) [50.25–62.58%]	79 (58.09%) [49.33–66.49%]	80 (52.98%) [44.70–61.14%]	85 (57.43%) [49.05–65.51%]	29 (59.18%) [44.21–73.00%]	**1303 (64.28%) [62.15–66.37%]**

	BDI (normal) AD(−)[b]	BDI (mild) AD(−)[b]	BDI (moderate) AD(-)[b]	BDI (severe) AD(−)[b]	AD(+)[b]	Missing[b]	Total[b]
Compliance							
Purchased medicine[a] at least four times a year	1023 (79.86%) [77.56–82.02%]	204 (77.86%) [72.34–82.74%]	103 (75.74%) [67.64–82.67%]	122 (80.79%) [73.60–86.74%]	121 (81.76%) [74.58–87.62%]	39 (79.59%) [65.66–89.76%]	**1612 (79.53%) [77.70–81.26%]**
Purchased medicine[a] less than four times a year	258 (20.14%) [17.98–22.44%]	58 (22.14%) [17.26–27.66%]	33 (24.26%) [17.33–32.36%]	29 (19.21%) [13.26–26.40%]	27 (18.24%) [12.38–25.42%]	10 (20.41%) [10.24–34.34%]	**415 (20.47%) [18.74–22.30%]**
Total	**1281 (63.20%) [61.05–65.30%]**	**262 (12.93%) [11.49–14.46%]**	**136 (6.71%) [5.66–7.89%]**	**151 (7.45%) [6.34–8.68%]**	**148 (7.30%) [6.21–8.52%]**	**49 (2.42%) [1.79–3.18%]**	**2027 (100.00%) [99.82–100.00%]**

AD antidepressant drug purchase, *BDI* Beck Depression Inventory, *SD* standard deviation

[a]Antihypertensive and/or antidiabetic medicine

[b]Number of patients and prevalence (%) [95% confidence interval]

References

1. DALYs GBD2015, Collaborators HALE. (2016) Global, regional, and national disability-adjusted life-years (DALYs) for 315 diseases and injuries and healthy life expectancy (HALE), 1990–2015: a systematic analysis for the Global Burden of Disease Study 2015. Lancet 388:1603–1658. https://doi.org/10.1016/S0140-6736(16)31460-X
2. GBD Compare | IHME Viz Hub. http://vizhub.healthdata.org/gbd-compare. Accessed 9 May 2017
3. Soler EP, Ruiz VC (2010) Epidemiology and risk factors of cerebral ischemia and ischemic heart diseases: similarities and differences. Curr Cardiol Rev 6:138–149. https://doi.org/10.2174/157340310791658785
4. Vigo D, Thornicroft G, Atun R (2016) Estimating the true global burden of mental illness. Lancet Psychiatry 3:171–178. https://doi.org/10.1016/S2215-0366(15)00505-2
5. Cohen BE, Edmondson D, Kronish IM (2015) State of the art review: depression, stress, anxiety, and cardiovascular disease. Am J Hypertens 28:1295–1302. https://doi.org/10.1093/ajh/hpv047
6. Fiore V, Marci M, Poggi A et al (2015) The association between diabetes and depression: a very disabling condition. Endocrine 48:14–24. https://doi.org/10.1007/s12020-014-0323-x
7. Nemeroff CB, Goldschmidt-Clermont PJ (2012) Heartache and heartbreak–the link between depression and cardiovascular disease. Nat Rev Cardiol 9:526–539. https://doi.org/10.1038/nrcardio.2012.91
8. Vamos EP, Mucsi I, Keszei A et al (2009) Comorbid depression is associated with increased healthcare utilization and lost productivity in persons with diabetes: a large nationally representative Hungarian population survey. Psychosom Med 71:501–507. https://doi.org/10.1097/PSY.0b013e3181a5a7ad
9. Carney RM, Freedland KE (2017) Depression and coronary heart disease. Nat Rev Cardiol 14:145–155. https://doi.org/10.1038/nrcardio.2016.181
10. Gan Y, Gong Y, Tong X et al (2014) Depression and the risk of coronary heart disease: a meta-analysis of prospective cohort studies. BMC Psychiatry 14:371. https://doi.org/10.1186/s12888-014-0371-z
11. Hare DL, Toukhsati SR, Johansson P, Jaarsma T (2014) Depression and cardiovascular disease: a clinical review. Eur Heart J 35:1365–1372. https://doi.org/10.1093/eurheartj/eht462
12. Huffman JC, Celano CM, Beach SR et al (2013) Depression and cardiac disease: epidemiology, mechanisms, and diagnosis. Cardiovasc Psychiatry Neurol 2013:695925. https://doi.org/10.1155/2013/695925
13. Chang C-K, Hayes RD, Perera G et al (2011) Life expectancy at birth for people with serious mental illness and other major disorders from a secondary mental health care case register in London. PloS One 6:e19590. https://doi.org/10.1371/journal.pone.0019590
14. Walker ER, McGee RE, Druss BG (2015) Mortality in mental disorders and global disease burden implications: a systematic review and meta-analysis. JAMA Psychiatry 72:334–341. https://doi.org/10.1001/jamapsychiatry.2014.2502
15. Carney RM, Blumenthal JA, Freedland KE et al (2004) Depression and late mortality after myocardial infarction in the enhancing recovery in coronary heart disease (ENRICHD) study. Psychosom Med 66:466–474. https://doi.org/10.1097/01.psy.0000133362.75075.a6
16. Glassman AH, Bigger JT, Gaffney M (2009) Psychiatric characteristics associated with long-term mortality among 361 patients having an acute coronary syndrome and major depression: seven-year follow-up of SADHART participants. Arch Gen Psychiatry 66:1022–1029. https://doi.org/10.1001/archgenpsychiatry.2009.121
17. de Jonge P, Honig A, van Melle JP et al (2007) Nonresponse to treatment for depression following myocardial infarction: association with subsequent cardiac events. Am J Psychiatry 164:1371–1378. https://doi.org/10.1176/appi.ajp.2007.06091492
18. Lichtman JH, Bigger JTJ, Blumenthal JA et al (2008) Depression and coronary heart disease: recommendations for screening, referral, and treatment: a science advisory from the American Heart Association Prevention Committee of the Council on Cardiovascular Nursing, Council on Clinical Cardiology, Council on Epidemiology and Prevention, and Interdisciplinary Council on Quality of Care and Outcomes Research: endorsed by the American Psychiatric Association. Circulation 118:1768–1775. https://doi.org/10.1161/CIRCULATIONAHA.108.190769
19. Lichtman JH, Froelicher ES, Blumenthal JA et al (2014) Depression as a risk factor for poor prognosis among patients with acute coronary syndrome: systematic review and recommendations: a scientific statement from the American Heart Association. Circulation 129:1350–1369. https://doi.org/10.1161/CIR.0000000000000019

20. Garrofé BC, Björnberg A, Phang A, Trojcakova I (2016) Health Consumer Powerhouse Euro Heart Index 2016 Report. https://healthpowerhouse.com/files/EHI_2016/EHI_2016_report.pdf. Accessed 12 Apr 2017
21. Baumeister H, Haschke A, Munzinger M et al (2015) Inpatient and outpatient costs in patients with coronary artery disease and mental disorders: a systematic review. Biopsychosoc Med 9:11. https://doi.org/10.1186/s13030-015-0039-z
22. Egede LE (2007) Major depression in individuals with chronic medical disorders: prevalence, correlates and association with health resource utilization, lost productivity and functional disability. Gen Hosp Psychiatry 29:409–416. https://doi.org/10.1016/j.genhosppsych.2007.06.002
23. Hutter N, Schnurr A, Baumeister H (2010) Healthcare costs in patients with diabetes mellitus and comorbid mental disorders–a systematic review. Diabetologia 53:2470–2479. https://doi.org/10.1007/s00125-010-1873-y
24. Rutledge T, Vaccarino V, Johnson BD et al (2009) Depression and cardiovascular health care costs among women with suspected myocardial ischemia: prospective results from the WISE (Women's Ischemia Syndrome Evaluation) Study. J Am Coll Cardiol 53:176–183. https://doi.org/10.1016/j.jacc.2008.09.032
25. Townsend N, Wilson L, Bhatnagar P et al (2016) Cardiovascular disease in Europe: epidemiological update 2016. Eur Heart J 37:3232–3245. https://doi.org/10.1093/eurheartj/ehw334
26. World Health Organization (2006) Highlights on health in Hungary 2005. http://www.euro.who.int/__data/assets/pdf_file/0016/103219/E88736.pdf. Accessed 12 Apr 2017
27. Szadoczky E, Papp Z s, Vitrai J et al (1998) The prevalence of major depressive and bipolar disorders in Hungary. Results from a national epidemiologic survey. J Affect Disord 50:153–162
28. Torzsa P, Rihmer Z, Gonda X et al (2008) [Prevalence of major depression in primary care practices in Hungary]. Neuropsychopharmacol Hung Magy Pszichofarmakologiai Egyesulet Lapja Off J Hung Assoc Psychopharmacol 10:265–270
29. Van de Velde S, Bracke P, Levecque K (2010) Gender differences in depression in 23 European countries. Cross-national variation in the gender gap in depression. Soc Sci Med 1982 71:305–313. https://doi.org/10.1016/j.socscimed.2010.03.035
30. Purebl G, Birkas E, Csoboth C et al (2006) The relationship of biological and psychological risk factors of cardiovascular disorders in a large-scale national representative community survey. Behav Med Wash DC 31:133–139. https://doi.org/10.3200/BMED.31.4.133-139
31. Adany R, Kosa K, Sandor J et al (2013) General practitioners' cluster: a model to reorient primary health care to public health services. Eur J Public Health 23:529–530. https://doi.org/10.1093/eurpub/ckt095
32. Sandor J, Kosa K, Papp M et al (2016) Capitation-based financing hampers the provision of preventive services in primary health care. Front Public Health 4:200. https://doi.org/10.3389/fpubh.2016.00200
33. Ádány R (2013) Operations Manual for GPs Cluster on Public Health Services in Primary Health Care. Version 5. http://alapellatasimodell.hu/images/mukodesi_kezikonyv/SH.8.1_operations_manual_version5.pdf. Accessed 20 Feb 2018
34. Gaal P, Szigeti S, Csere M et al (2011) Hungary health system review. Health Syst Transit 13:1–266
35. Rihmer Z, Torzsa P (2016) A short method of screening for depression and suicide risk in general practitioners' practice. Háziorv Továbbk Szle 21:584–589
36. Rózsa S, Szádóczky E, Füredi J (2001) Usefulness of the Hungarian 9-item version of Beck Depression Inventory. Psychiat Hung 16:384–402
37. Beck AT, Ward CH, Mendelson M et al (1961) An inventory for measuring depression. Arch Gen Psychiatry 4:561–571
38. Rethelyi JM, Berghammer R, Kopp MS (2001) Comorbidity of pain-associated disability and depressive symptoms in connection with sociodemographic variables: results from a cross-sectional epidemiological survey in Hungary. Pain 93:115–121
39. Kopp MS, Skrabski A, Szedmak S (1995) Socioeconomic factors, severity of depressive symptomatology, and sickness absence rate in the Hungarian population. J Psychosom Res 39:1019–1029
40. Paulik E, Nagymajtenyi L, Easterling D, Rogers T (2011) Smoking behaviour and attitudes of Hungarian Roma and non-Roma population towards tobacco control policies. Int J Public Health 56:485–491. https://doi.org/10.1007/s00038-011-0252-x
41. Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro MG (2001) AUDIT The Alcohol Use Disorders Identification Test Guidelines for Use in Primary Care. http://www.talkingalcohol.com/files/pdfs/WHO_audit.pdf. Accessed 20 Mar 2017
42. Eurostat (2013) European Health Interview Survey (EHIS wave 2) Methodological manual. http://ec.europa.eu/eurostat/documents/3859598/5926729/KS-RA-13-018-EN.PDF/26c7ea80-01d8-420e-bdc6-e9d5f6578e7c. Accessed 20 Mar 2017
43. Nedo E, Paulik E (2012) Association of smoking, physical activity, and dietary habits with socioeconomic variables: a cross-sectional study in adults on both sides of the Hungarian-Romanian border. BMC Public Health 12:60. https://doi.org/10.1186/1471-2458-12-60
44. International Diabetes Federation (2006) The IDF consensus worldwide definition of the metabolic syndrome. https://www.idf.org/e-library/consensus-statements/60-idfconsensus-worldwide-definitionof-the-metabolic-syndrome. Accessed 20 Mar 2017
45. WHO Consultation on Obesity (2000) Obesity: preventing and managing the global epidemic: report of a WHO consultation. http://apps.who.int/iris/handle/10665/42330. Accessed 20 Mar 2017
46. Széles G, Vokó Z, Jenei T et al (2003) Establishment and preliminary evaluation of the General Practitioners' Morbidity Sentinel Stations Program in Hungary. Prevalence of hypertension, diabetes mellitus and liver cirrhosis. Orv Hetil 144:1521–1529
47. Li Z, Li Y, Chen L et al (2015) Prevalence of depression in patients with hypertension: a systematic review and meta-analysis. Medicine (Baltimore) 94:e1317. https://doi.org/10.1097/MD.0000000000001317
48. Anderson RJ, Freedland KE, Clouse RE, Lustman PJ (2001) The prevalence of comorbid depression in adults with diabetes: a meta-analysis. Diabetes Care 24:1069–1078
49. Palacios JE, Khondoker M, Achilla E et al (2016) A single, one-off measure of depression and anxiety predicts future symptoms, higher healthcare costs, and lower quality of life in coronary heart disease patients: analysis from a multi-wave, Primary Care Cohort Study. PLoS One 11:e0158163. https://doi.org/10.1371/journal.pone.0158163
50. Neighbors HW, Caldwell C, Williams DR et al (2007) Race, ethnicity, and the use of services for mental disorders: results from the National Survey of American Life. Arch Gen Psychiatry 64:485–494. https://doi.org/10.1001/archpsyc.64.4.485
51. Roy-Byrne PP, Joesch JM, Wang PS, Kessler RC (2009) Low socioeconomic status and mental health care use among respondents with anxiety and depression in the NCS-R. Psychiatr Serv Wash DC 60:1190–1197. https://doi.org/10.1176/ps.2009.60.9.1190
52. Sripada RK, Richards SKH, Rauch SAM et al (2015) Socioeconomic Status and Mental Health Service Use Among National Guard Soldiers. Psychiatr Serv Wash DC 66:992–995. https://doi.org/10.1176/appi.ps.201400346
53. Edelstein B, Drozdick L, Ciliberti C (2010) Assessment of depression and bereavement in older adults. Handbook of assessment in clinical gerontology. 2nd edn. Wiley, Hoboken
54. Davidson KW, Kupfer DJ, Bigger JT et al (2006) Assessment and treatment of depression in patients with cardiovascular disease:

National Heart, Lung, and Blood Institute Working Group Report. Psychosom Med 68:645–650. https://doi.org/10.1097/01.psy.0000233233.48738.22
55. Hirschfeld RMA (2001) The comorbidity of major depression and anxiety disorders: recognition and management in primary care. Prim Care Companion J Clin Psychiatry 3:244–254
56. Keski-Rahkonen A, Mustelin L (2016) Epidemiology of eating disorders in Europe: prevalence, incidence, comorbidity, course, consequences, and risk factors. Curr Opin Psychiatry 29:340–345. https://doi.org/10.1097/YCO.0000000000000278
57. Wong J, Motulsky A, Eguale T et al (2016) Treatment indications for antidepressants prescribed in primary care in Quebec, Canada, 2006–2015. JAMA 315:2230–2232. https://doi.org/10.1001/jama.2016.3445
58. Zonda T, Bozsonyi K, Kmetty Z (2016) Ecological investigation on suicide and antidepressive medication. J Ment Health Psychosom 17:97–116
59. Jimmy B, Jose J (2011) Patient medication adherence: measures in daily practice. Oman Med J 26:155–159. https://doi.org/10.5001/omj.2011.38
60. Goldstein CM, Gathright EC, Garcia S (2017) Relationship between depression and medication adherence in cardiovascular disease: the perfect challenge for the integrated care team. Patient Prefer Adherence 11:547–559. https://doi.org/10.2147/PPA.S127277
61. Brown MT, Bussell J, Dutta S et al (2016) Medication Adherence: Truth and Consequences. Am J Med Sci 351:387–399. https://doi.org/10.1016/j.amjms.2016.01.010
62. Farmer KC (1999) Methods for measuring and monitoring medication regimen adherence in clinical trials and clinical practice. Clin Ther 21:1074–1090. https://doi.org/10.1016/S0149-2918(99)80026-5 discussion 1073.
63. World Health Organization (2003) Adherence to long-term therapies: evidence for action. http://www.who.int/chp/knowledge/publications/adherence_full_report.pdf. Accessed 15 May 2018
64. Cramer JA, Benedict A, Muszbek N et al (2008) The significance of compliance and persistence in the treatment of diabetes, hypertension and dyslipidaemia: a review. Int J Clin Pract 62:76–87. https://doi.org/10.1111/j.1742-1241.2007.01630.x