doi:10.3233/SHTI240394

Dementia and Alzheimer's Disease Prevalence in Bulgaria During 2018: Nationally Representative Study

Evgeniy KRASTEV [a], Ralitsa KRASTEVA [b], Mario FAZLI [a] and Dimitar TCHARAKTCHIEV [c,1]
[a] *Faculty of Mathematics and Informatics, Sofia University St. Kliment Ohridski, Bulgaria*
[b] *Specialized Hospital for Active Treatment of Children's Diseases, Sofia, Bulgaria*
[c] *Department of Medical Informatics, Medical University, Sofia, Bulgaria*
ORCiD ID: Evgeniy Krastev https://orcid.org/0000-0001-8740-5497,
Dimitar TCHARAKTCHIEV https://orcid.org/0000-0001-5765-840X

Abstract. This paper presents data analysis of a large dataset of outpatient records for the purpose of establishing accurate prevalence rates of dementia and Alzheimer's disease in Bulgaria. The research is motivated by the lack of accurate prevalence data as well as statistics about the actual number of people affected by dementia at national level. Health data from pseudonymized outpatient records (1,378,355) of 642,013 unique patients (Male 39.88%, Female 61.67%) with visits to neurologists and psychiatrists in 2018 was mapped to an OMOP CDM relational database. The size of this dataset is one of largest in the EU context. Prevalence of dementia for all age groups [30,100+] years is 1.61% (Male 0.62%, Female 0.99%) and Alzheimer' disease prevalence is 0.39% (Male 0.15%, Female 0.24%), where 24.34% of all the patients with dementia suffer Alzheimer's disease. The mean prevalence rates of dementia and Alzheimer's disease for ages above 64 are 9.52% (CI 95%, [6.98%, 12.04%]) and 1.04 % (CI 95%, [0.84%, 1.27%,]). A comparison with EU statistics yields 0.07% difference for dementia prevalence, while data visualization confirms the known patterns of prevalence with aging and gender specifics These results stimulate further research and support the development of a national strategy for dementia and Alzheimer's disease.

Keywords. dementia, Alzheimer's disease, prevalence, outpatient records, nationally representative study, OMOP CDM

1. Introduction

The increased longevity of life in Europe is challenged with the profound societal implications caused by the spread of dementia and the Alzheimer's disease among elderly people [1]. Dementia and its most common form, the Alzheimer's disease, are associated with loss of cognition abilities in multiple cognitive domains that severely impacts the social or occupational function of the individual. Prevalence of dementia and

[1] Corresponding Author: Dimitar Tcharaktchiev, Department of Medical Informatics, Medical University-Sofia, University Hospital of Endocrinology, 2 Zdrave street, Sofia 1431, Bulgaria; E-mail: dimitardt@gmail.com.

Alzheimer's disease in EU countries remains poorly explored and disputable [2] for more than 10 years after the end of the last one of the three EU projects aiming to estimate it [3]. It is the interoperability problems that appear in the process of health data retrieval from usually heterogenous data sources that don't allow to obtain accurate prevalence data through data analysis of large amounts of clinical documents [4]. At the same time the accuracy of such data is essential for achieving sustainability in modern healthcare systems due to the significant social burden of dementia and the Alzheimer's disease [5]. In this paper we explore the use of an OMOP CDM database for resolving these problems in a nationally representative study [6].

Here we present the results of the first nationally representative study on dementia and the Alzheimer' disease prevalence in Bulgaria and one of the few studies of that scale using observational health data for this purpose [7]. These data are provided by the National Health Insurance Fund (NHIF [8]) in Bulgaria for the research purposes of the National Scientific Program eHealth [9] and comprise all the outpatient records issued by neurologists and psychiatrists recording health data from patient's visits in 2018. The data analysis of this large amount of pseudonymized outpatient records for the purpose of obtaining accurate values for the prevalence of dementia and Alzheimer' disease in Bulgaria is the main objective of this study. This it also aims to contribute to the development of a sustainable national strategy for dementia and Alzheimer's disease care and support.

2. Methods

The outpatient records (1,378,355) were provided in XML format, following a proprietary XML schema introduced by the NHIF for its own purposes. In order to resolve potential interoperability problems during health data retrieval and analysis this dataset was mapped to the OMOP CDM [6]. It entailed the execution of the Extract, Transform, Load (ETL) process for transforming the data from the outpatient records into a MS SQL server database reproducing the OMOP CDM standard. At the end of the ETL process, table PERSON of the CDM was loaded with data for 642,013 unique patients (Male 39.88%, Female 61.67%) of mean age 57 years (CI (95%) [57.43, 57,52]) completed in 2018 by 1,413 physicians (1,003 neurologists and 410 psychiatrists) (loaded in table PROVIDER) from all the 22 regions of Bulgaria, where 87% of the given outpatient records were issued by neurologists.

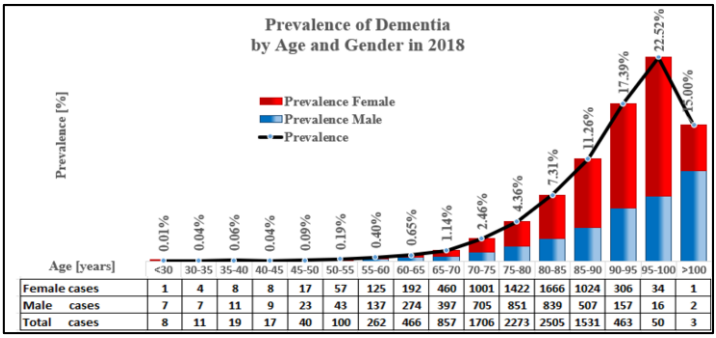
F00 Dementia in Alzheimer disease	
	F00.0 Dementia in Alzheimer disease with early onset
	F00.1 Dementia in Alzheimer disease with late onset
	F00.2 Dementia in Alzheimer disease, atypical or mixed type
	F00.9 Dementia in Alzheimer disease, unspecified
F01 Vascular dementia	
	F01.0 Vascular dementia of acute onset
	F01.1 Multi-infarct dementia
	F01.2 Subcortical vascular dementia
	F01.3 Mixed cortical and subcortical vascular dementia
	F01.8 Other vascular dementia
	F01.9 Vascular dementia, unspecified
F02 Dementia in other diseases classified elsewhere	
	F02.0 Dementia in Pick disease
	F02.1 Dementia in Creutzfeldt-Jakob disease
	F02.2 Dementia in Huntington disease
	F02.3 Dementia in Parkinson disease
	F02.4 Dementia in human immunodeficiency virus [HIV] disease
	F02.8 Dementia in other specified diseases classified elsewhere
F03 Unspecified dementia	
F05.1 Delirium superimposed on dementia	
G30.0 Alzheimer's disease with early onset	
G30.1 Alzheimer's disease with late onset	
G30.8 Other Alzheimer's disease	
G30.9 Alzheimer's disease, unspecified	

Figure 1. ICD-10 codes (Version: 2016) for Dementia and Alzheimer's disease.

The '*patient-centric*' architecture of the CDM proved to be very useful for the retrieval of prevalence data by means of SQL queries for calculating age and gender specific prevalence rates for dementia and Alzheimer' disease using the relevant ICD-10 codes (Figure 1) from table CONDITION_OCCURRENCE of the CDM. The prevalence datasets for dementia and Alzheimer's disease get identified, correspondingly, by all the codes and the subset of codes starting with G30. and F00 from Table 1 (the Alzheimer's cases are a subset of the dementia cases [10]). Prevalence rates are computed by following the same formula [11] and approach for applying it as it is exactly done in the existing literature. It makes the obtained results comparable to those obtained in other studies [2] [12]. Besides, this methodology allows to obtain the prevalence rates for dementia and Alzheimer's disease together with the actual number of patients distributed by age groups and gender.

3. Results

This section presents statistical summary of prevalence data extracted from the OMOP CDM database. The total number of unique patients with dementia is 10,311 (Male 38.65%, Female 61.35%), while the patients with Alzheimer' disease are 2,510 (Male 39.28%, Female 60.72%). Prevalence of dementia for all age groups is 1.61% (Male 0.62%, 3,985 cases; Female 0.99%, 6,326 cases) and Alzheimer' disease prevalence is 0.39% (Male 0.15%, 986 cases; Female 0.24%, 1,524 cases), where 24.34% of all patients with dementia suffer of Alzheimer's disease. The mean age of patients with dementia and Alzheimer' disease is, respectively, 78.06 (CI 95%, [77.89, 7.24]) years and 75.52 (CI 95%, [75.19, 75.86]) years. These values are obtained by excluding outpatient records with multiple codes from Figure 1.

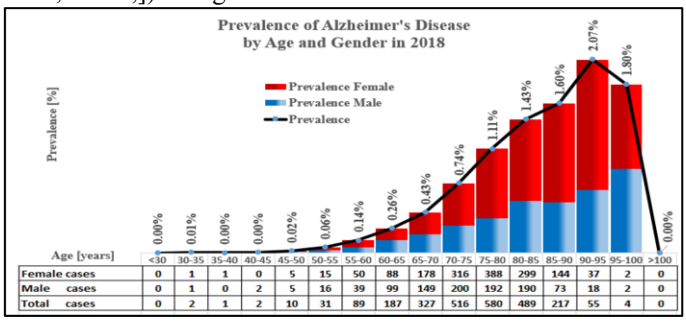


Age [years]	<30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100	>100
Female cases	1	4	8	8	17	57	125	192	460	1001	1422	1666	1024	306	34	1
Male cases	7	7	11	9	23	43	137	274	397	705	851	839	507	157	16	2
Total cases	8	11	19	17	40	100	262	466	857	1706	2273	2505	1531	463	50	3

Figure 2. Distribution of Dementia prevalence by age and gender in Bulgaria during 2018.

Figure 2 and Figure 3 display the prevalence rates of dementia and Alzheimer' disease among all age groups distributed by gender. The lower part of the figures shows the actual number of cases. We find also that, compared to male patients, the dementia prevalence rates of female patients begin to increase fast between 65-70, while in the case of Alzheimer' disease this happens at the age of 55-60. The mean prevalence rate of dementia among ages above 64 years is 9.52 % computed with CI (95%) [6.98%, 12.04%], compared to 12.4% CI (95%) [7.6%,17.2%] from meta-analysis summarizing data for the European population [2] and prevalence of 7.2% CI (95%) [5.0%, 9.4%] for Bulgaria in 2012 from a neurological examination of 540 patients [10]. Thus, our results confirm the hypothesis in [10] that dementia prevalence in Bulgaria in 2012 at ages above

64 years may be higher than 7.2%. For reference, the mean Alzheimer's prevalence among ages above 54 is 0.67% (CI 95%, [0.50%, 0.90%]) and increases up to 1.04 % (CI 95%, [0.84%,1.27%,]) for ages above 64.



Age [years]	<30	30-35	35-40	40-45	45-50	50-55	55-60	60-65	65-70	70-75	75-80	80-85	85-90	90-95	95-100	>100
Female cases	0	1	1	0	5	15	50	88	178	316	388	299	144	37	2	0
Male cases	0	1	0	2	5	16	39	99	149	200	192	190	73	18	2	0
Total cases	0	2	1	2	10	31	89	187	327	516	580	489	217	55	4	0

Figure 3. Distribution of Alzheimer's disease prevalence by age and gender in Bulgaria during 2018.

4. Discussion

The large number of outpatient records prepared by neurologists and psychiatrists from all the regions of the country ensures equal probability for including a patient with dementia or Alzheimer's disease in the population of individuals with similar health disorders. The diagnoses in the outpatient records are made by physicians (neurologists and psychiatrists) with the necessary medical qualification similarly to other research on dementia prevalence [2] [10]. Additionally, the computation of the prevalence rates is done using the same formula and approach to apply it to source data [2] [11]. It allows to discover quantitative and qualitative similarities of our results with findings in the public space. First, we find that the obtained prevalence rate (1.61%) for dementia is by 0.07% different of the estimated value (1.54%) for 2018 in the EU statistics [12]. In Figure 2 we establish a peak in the dementia cases in the age group 80-85 identically as it is observed in the same statistic report. Moreover, in Figure 2 and Figure 3 we note that compared to male patients, the prevalence rates of female patients begin to increase fast between 65-70, while in the case of Alzheimer' disease this happens at the age of 55-60. The same pattern in the case of dementia is established in many other studies [1] [2] [12]. Besides, the peak prevalence values in Figure 2 and Figure 3 are reached in age groups (90+) and it also agrees with findings in existing research (Table 3 [2]). The interpretation of these findings must take in consideration the following limitations of the study such as the absence of other nationally representative studies of dementia and Alzheimer's cases prevalence in Bulgaria for comparison. Existing prevalence reports like [12] deal with statistically estimated values, while our findings are presented in terms of the actual numbers of dementia cases registered only in outpatient care.

5. Conclusion

This paper presents analysis of data from the first nationally representative study in Bulgaria about prevalence of dementia and Alzheimer's disease that are known to impose a significant burden on the society. It is motivated by the lack of accurate prevalence data that are essential for strategy and policy development as well as for allocating resources needed for maintaining sustainability of the healthcare system. Health data from the

pseudonymized outpatient records (1,378,355) of 642,013 unique patients from their visits to neurologists and psychiatrists in 2018 was mapped to an OMOP CDM relational database [6]. The size of this dataset is one of largest in the EU context [2]. This mapping resolves interoperability problems as well as offers a relational model that simplifies extraction and computation of prevalence rates of dementia in terms of SQL queries. Key findings of the study include prevalence for dementia (1.61%) and Alzheimer's disease (0.39%) across all age groups between 30 and 100 years together with the actual number of subjects in each age group with gender details. A comparison with EU statistical estimates yields 0.07% difference for dementia prevalence, while Figure 2 and Figure 3 confirm the known trends of prevalence with aging and gender specifics [12]. These results stimulate further research work and aim to support the development of a national strategy for dementia and Alzheimer's disease.

Acknowledgement

This research is supported by the Fund for Scientific Research of Sofia University, Bulgaria by Grant 4. 80-10-59/09.04.2024.

References

[1] GBD 2019 Dementia Forecasting Collaborators. Estimation of the global prevalence of dementia in 2019 and forecasted prevalence in 2050: an analysis for the Global Burden of Disease Study 2019. Lancet Public Health. 2022; 7(2), doi: 10.1016/S2468-2667(21)00249-8.

[2] Bacigalupo I, et al. A Systematic Review and Meta-Analysis on the Prevalence of Dementia in Europe: Estimates from the Highest-Quality Studies Adopting the DSM IV Diagnostic Criteria. Journal of Alzheimer's Disease. 2018; 66(4): 1471-1481.

[3] Galeotti F, Giusti A, Meduri F, Raschetti R, Scardetti P. Epidemiological data on dementia. WP4. ALCOVE Deliverable n.4 Synthesis Report 2013; 2013.

[4] World Health Organization. Dementia. [Online]. WHO; 2024 [cited 2024 March 22. Available from: https://www.who.int/news-room/fact-sheets/detail/dementia.

[5] Blobel B. Interoperable EHR Systems–Challenges, Standards and Solutions. European Journal for Biomedical Informatics. 2018; 14(2): 10-19, doi: 10.24105/ejbi.2018.14.2.3.

[6] Observational Health Data Sciences and Informatics. OMOP Common Data Model v5.3. [Online].; 2021 [cited 2024 March 22. Available from: https://ohdsi.github.io/CommonDataModel/cdm53.html

[7] European Commission. EUROCODE:Final Report of WP 7 2006. Prevalence of Dementia in Europe. ; 2009.

[8] National Health Insurance Fund. About NHIF. [Online].; 2024 [cited 2024 April 2. Available from: https://www.nhif.bg/en/about.

[9] National Scientific Program eHealth. National Scientific Program "Electronic Healthcare in Bulgaria" (eHealth). [Online].; 2024 [cited 2024 April 2. Available from: https://ehealth.fmi.uni-sofia.bg/.

[10] Dimitrov I, Tzourio C, Milanov I, Deleva N, Traykov L. Prevalence of dementia and mild cognitive impairment in a Bulgarian urban population. American Journal of Alzheimer's Disease & Other Dementias. 2012; 27(2): 131-135, doi: 10.1177/1533317512442371.

[11] Tenny S, Hoffman MR. Prevalence. In: StatPearls [Internet]. [Online]. StatPearls Publishing; 2023 [cited 2024 March 22. Available from: https://www.ncbi.nlm.nih.gov/books/NBK430867/.

[12] Alzheimer Europe. Dementia in Europe Yearbook 2019: Estimating the prevalence of dementia in Europe. Luxembourg: Alzheimer Europe; 2019.