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*Systematic Review*

# Prevalence of Dementia in Older Adults in Central and Eastern Europe: A Systematic Review and Meta-Analysis

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**Abstract:** Data on dementia prevalence in Europe are primarily based on studies from Western Europe. Central and Eastern European countries differ from Western European countries in their average income and other socioeconomic and health factors that are relevant for dementia risk. We, therefore, conducted a systematic review of population-based studies on prevalence of dementia in Central and Eastern Europe. We searched in electronic databases from the date of inception up to July 2019, updated in October 2020. We hand-searched references of included articles and contacted experts in each country to identify further articles. We combined studies by meta-analysis where possible. Ten population-based studies (n = 30,268) met inclusion criteria. We meta-analysed seven studies (n = 11,994). The selected studies were conducted across 5 countries with no studies identified for the vast majority of countries in this region. Prevalence of all-cause dementia was 6.7% (95% CI 5.1–8.2) in those aged 60 or over, and 7.1% (95% CI 5.1–9.2) in those aged 65 and over. Prevalence rates were similar to those in Western Europe, but are increasing over time, compared with the patterns of reduction in age-specific prevalence in Western Europe.

**Keywords:** dementia; prevalence; epidemiology; Europe



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## 1. Introduction

The estimated number of people living with dementia worldwide was 46.8 million in 2015, while this number is expected to reach 74.7 million in 2030 and 131.5 million in 2050 [1]. A 2012 report on Dementia published by the World Health Organisation estimated that approximately 14 million people will suffer from some form of dementia in Europe by 2030, and the number is likely to reach 18 million by 2050 [2].

Cognitive impairment and dementia are the biggest contributors to needs for care compared to other chronic diseases and other types of impairment [3]. It is anticipated that by 2030, dementia cost in Europe will exceed €250 bn, a rise of 43% between 2008 and 2030 [4].

The prevalence of dementia varies considerably between countries and is influenced by socioeconomic and cultural factors [5]. Population based studies of prevalence are fundamental to understanding the societal burden of dementia. They provide essential information for the planning of healthcare services that are required to meet the needs of the people with the condition and their carers.

The EuroDem group has produced pooled estimates of dementia prevalence in Western Europe a decade apart, with the most recent report estimating a prevalence of 6.4% for all-cause dementia in people aged 65 and over [6,7]. The group did not include studies from Central and Eastern Europe.

The EuroCoDe group analysed 17 population-based dementia prevalence studies, including participants diagnosed with dementia according to the DSM III-R, DSM IV, CAMDEX, and ICD-10 clinical criteria. All studies were conducted in Western Europe,

except for two from Poland, and results were similar to the EuroDem findings (7.1% prevalence) [8]. The same prevalence was found in the most recent systematic review including only studies from Western Europe in which people were diagnosed with dementia according to DSM-IV criteria [9]. The Alcove project included 12 population-based studies performed in Western Europe between 2008 and 2011 [10], with a pooled prevalence of dementia of 8.2% in those over 65 and 6.5% in those 60 and over. A previous review of dementia prevalence in Central and Eastern Europe was carried out in 2006, but this was unable to meta-analyse any data [11].

Thus far, aggregate estimates of dementia prevalence have only been produced for Western Europe, and only one review included two studies from Poland. Central and Eastern Europe have been excluded from most reviews of this topic. Central and Eastern European countries have, on average, lower income [12], lower life expectancy [13], increased cardiovascular mortality and higher levels of smoking and alcohol use [14] than countries in Western Europe. These are all factors likely to increase risk of dementia, so it is important to have separate estimates for dementia prevalence for these regions rather than assuming homogeneity. The objective of this systematic review was, therefore, to address this gap in the literature by conducting a review of studies on the prevalence of dementia in Central and Eastern Europe.

## 2. Materials and Methods

This systematic review was performed using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method [15]. A protocol for this review was registered on Prospero before conducting the review (registration no: CRD42019136117).

### *2.1. Search Strategy and Selection Criteria*

Three authors (B.C., N.M. and P.R.) developed and refined the search strategy before conducting the final searches. We conducted searches from date of inception of each database until 30 July 2019 in the following electronic bibliographic databases: Medline, Embase, Psychinfo and CINAHL. We updated this search on 14 October 2020. No limits were placed based on language or date of publication. The primary search was conducted in English. The following keywords were used to perform multiple searches and to screen titles and abstracts: "Dementia" OR "Alzheimer" OR "Vascular dementia" OR "Mixed dementia" OR "Cognitive impairment" AND "prevalence" OR "frequency" OR "epidemiology." These were used in combination with the name of countries in Central and Eastern Europe according to The Institute for Health Metrics and Evaluation (IMHE) categorisation (Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Macedonia, Montenegro, Poland, Romania, Serbia, Slovakia, Slovenia, Belarus, Estonia, Latvia, Lithuania, Moldova, Ukraine and the Russian federation). Details of the search are in Appendix A. A further search on Google/Google Scholar was conducted in Albanian, Bulgarian, Romanian, Serbian and Polish using the same key words to identify any published data on dementia prevalence in the original languages.

Predefined inclusion and exclusion criteria were applied to select the final list of relevant articles to be included in the review:

### *2.2. Inclusion Criteria*

(1) Original research published in peer-reviewed journals or conference abstracts where full data are available.
(2) Population based (i.e., involved a defined "general population").
(3) Reported prevalence data from Central or Eastern European countries.
(4) Dementia diagnosed by standard criteria such as Diagnostic and Statistical Manual of Mental Disorders (DSM), International Classification of Diseases, Tenth Revision (ICD-10) or clinical interview by trained professionals.

### *2.3. Exclusion Criteria*

(1) Articles about dementia from reversible causes or external causes, or where dementia is a later secondary feature of the disorder, e.g., alcohol or traumatic brain injury, Parkinson's disease, Huntington's disease and Creutzfeldt Jakob disease, either sporadic or variant.
(2) Prevalence studies completed in specific populations such as nursing homes, residential care populations, hospital departments or specialist clinics.
(3) Non-original research.
(4) Dementia diagnosed only by cognitive screening instrument.

### *2.4. Study Selection*

Two reviewers (B.C. and E.O.) independently screened the titles and abstracts of retrieved studies in order to identify any potentially relevant papers that appeared to be reporting on prevalence of dementia. Any disagreement was resolved by discussion and consensus. Any potentially relevant articles not in English were included and translated by researchers fluent in the respective languages (Polish—E.O., Hungarian—J.S., Russian—A.S. and German—E.C.). Two reviewers (B.C. and E.O.) read each full text independently and extracted data using a standard proforma. Disagreements between authors about eligibility of the studies were resolved by consensus, through joint reassessment or the involvement of a third researcher when necessary. The references of included articles were hand searched to check if any additional articles could be found. We emailed/telephoned doctors working on dementia research or in specialist clinics from the following countries: Albania, Romania, Slovenia, Slovakia, Hungary, Poland and Serbia. These contacts were made to ensure that no study was missed and to clarify whether any important information using unpublished or ongoing surveys could be obtained. We contacted authors of publications that did not report full details of the data in order to obtain this data where needed.

### *2.5. Quality Assessment*

The methodological quality of the studies was evaluated and scored independently by two reviewers (B.C.) and (E.O.) using criteria from Munn's tool [16], which is described in Appendix B. This included evaluation of sample representativeness, sample size, recruitment, standard criteria used for measurement of condition and appropriate statistical analysis. A point was given for each item on the checklist to yield a total score for each study ranging from 0 to 10 (higher score indicating higher quality). Zero points were given to items that were unclear or had missing information. Disagreements about the quality assessment were resolved by discussion between researchers until a consensus was reached.

### *2.6. Meta-Analysis*

We pooled prevalence estimates for studies that studied the same age group ($\geq$60 or $\geq$65 years) with the metaprop command in Stata version 13.0 [17] using a random effects model.

## 3. Results

The PRISMA diagram with details of search results and exclusions is shown in Figure 1.

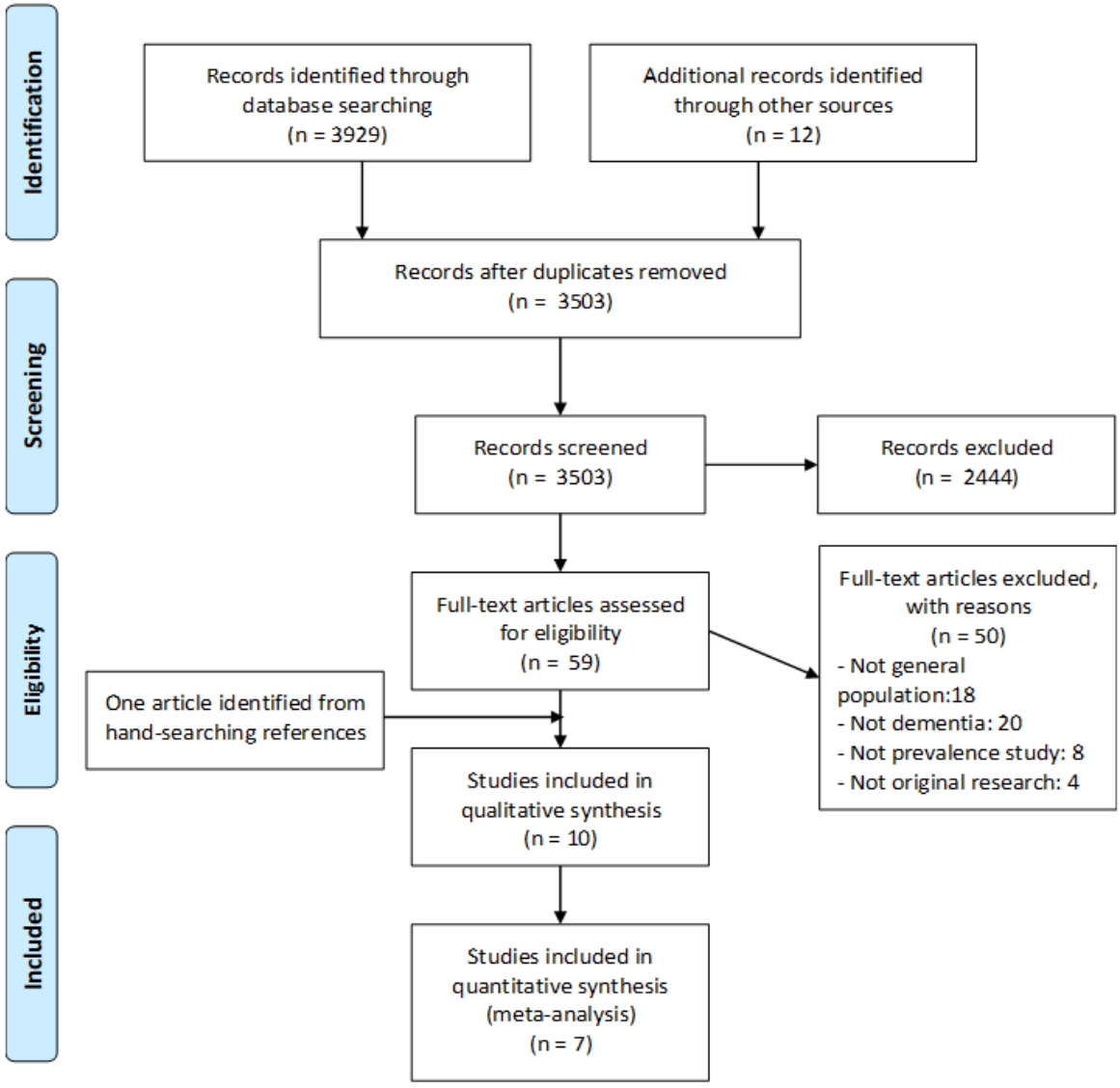


**Figure 1.** PRISMA flow diagram.

### *3.1. Included Studies*

The searches retrieved a total of 3929 papers and contacting experts yielded an additional 12 papers of potential interest. After screening of relevant titles and abstracts, 59 papers were included for full text review.

Ten papers met inclusion criteria and were included in the review. Four papers were originally in Polish and one in Russian. Most papers were excluded because:

(a) There was no reference to prevalence of dementia reported.
(b) They were not population-based studies.
(c) They were studies about other dementias (secondary or other neurodegenerative conditions).

A full list of excluded studies and reasons for exclusion is in Appendix C. The included studies are listed in Table 1 along with their quality scores. Two papers [18,19] reported on one prevalence study with two phases. Only the later one was eligible for inclusion [18].

**Table 1.** Characteristics of included studies.

| Author/Year of Publication | Country (Region) | Age Range | Sample Size | Sampling Frame/Design | Screening and Diagnostic Procedures | Dementia Prevalence (M-Males/F-Females) | Dementia Subtypes | Quality Score |
|---|---|---|---|---|---|---|---|---|
| Bdzan and Turczynski, 2005; Bdzan et al., 2007 [18] | POLAND (rural communities) | ≥60 | 1000 | Random selection from city registers Two-phase study | Screening: MMSE Diagnostic criteria: ICD-10 | All-cause dementia 6.7% (M: 3.0%/F: 8.8%) | AD 44.8% VaD: 44.8% | 9 |
| Gavrilova et al., 1987 [20] | RUSSIA | ≥60 | 2097 | Unclear sampling One-phase study | Clinical interview | All-cause dementia 5.5% | - | 1 |
| Wender et al., 1990 [21] | POLAND (Town and commune Steszew) | ≥45 | Total = 3741 <65: n = 2323 ≥65: n = 1418 | Patients from GP registers Two-phase study | Screening: MMSE, MSQ, SPMSQ Diagnostic criteria: DSM–III–R | Probable Alzheimer's Dementia: ≥65: 1.1% ≥65: 10.1% | - | 3 |
| Rossa, 1997 [22] | POLAND (District Swiebodzin) | ≥45 | 7417 <65: n = 4999 ≥65: n = 2418 | Municipal registers Two-phase study | Screening: CAMDEX Diagnostic criteria: DSM–III–R | All-cause dementia ≥45 3.6% (M: 2.3%/F: 4.5%) All-cause dementia ≥65 5.7% (M: 3.4%/F:7.0%) * | AD ≥65: 56.1% | 5 |
| Gabryelewicz, 1999 [23] | POLAND (Warsaw district Mokotow) | 65–84 | 1000 | Random selection from city registers Two-phase study | GDS ICD-10: for diagnosis of dementia and for differential diagnosis, DSM-IV: for mixed dementia MMSE | All-cause dementia 5.7% (M: 4.3%/F: 6.6%) 65–69: 1.9% 70–74: 5.8% 75–79: 8.6% 80–84: 16.5% | - | 8 |
| Kruja, 2002 [24] | ALBANIA (Tirana City) | ≥60 | 3521 | Random selection from city registers Two-phase study | Screening: MMSE Diagnostic criteria: ICD-10 | All-cause dementia 7.8% (M: 4.8%/F: 11.5%) 60–64: 2.1% 65–69: 6.3% 70–74: 7.2% 74–79: 12.5% 80–85: 36.4% >85: 45.2% | - | 7 |
| Stefanova et al., 2004 [25] | SERBIA (data from 16 public health centres) | - | 1000 | GP record survey One-phase study | ICD-10 | All-cause dementia 6.7% (M: 2.8%/F: 3.9%) | - | 4 |
| Pffefer et al., 2012 [26] | POLAND (Warsaw) | >100 | 83 | Municipal registers Two-phase study | Screening: MMSE, 6-CIT, GDS, BCRS Diagnostic criteria: DSM-IV | All-cause dementia 66.3% (M:50%, F:69%) | AD 74.5% VaD 18.1% | 6 |

**Table 1.** *Cont.*

| Author/Year of Publication | Country (Region) | Age Range | Sample Size | Sampling Frame/Design | Screening and Diagnostic Procedures | Dementia Prevalence (M-Males/F-Females) | Dementia Subtypes | Quality Score |
|---|---|---|---|---|---|---|---|---|
| Dimitrov et al., 2012 [27] | BULGARIA (Varna city) | ≥65 | 540 | Random sample of patients on GP registers Two-phase study | Screening: MMSE,MIS, IADL Diagnostic criteria: DSM-IV | All-cause dementia 7.2% (95% CI 5.0–9.4) | AD 43.1% VaD 27.8% Mixed 18.1% DLB 5.6% | 9 |
| Kruja et al., 2012 [28] | ALBANIA (Cities of Tirana and Saranda | 1–91 | 9869 | Random selection from city registers Two-phase study | Screening: MMSE Diagnostic criteria: DSM-IV | All-cause dementia 1.0% (95% CI 0.8–1.2) (M:0.8%, F: 1.1%) | - | 7 |

* Data obtained from authors by request. Key: AD—Alzheimer's Dementia; (6 CIT)—Six Item Cognitive Impairment Test (Jefferies); BCRS—Brief Cognitive Rating Scale; CAMDEX—Cambridge Mental Disorders of the Elderly Examination (Roth et al., 1986); DLB—Dementia with Lewy Bodies; DSM-IV—Diagnostic and Statistical Manual of Mental Disorders (Fourth Edition); DSM-III—Diagnostic and Statistical Manual of Mental Disorders (Third Edition); GDS—Global Deterioration Scale (Reisberg et al., 1988); ICD-10—10th revision of the International Statistical Classification of Diseases and Related Health Problems ; MMSE—Mini Mental State Examination (Folstein et al., 1975); MIS – Memory Impairment Scale (Bushke); MSQ—Mental State Questionnaire (Kahn et al., 1960); SPMSQ—Short Portable Mental State Questionnaire (Smyer); VaD—Vascular dementia.

### *3.2. Countries*

The included studies were conducted across 5 countries out of the 20 for which search terms were included: Albania (two studies), Russia (one study), Serbia (one study), Bulgaria (one study) and Poland (five studies). Out of the 10 selected studies, four studies were published prior to 2000 [20–23]. The most recent study was published in 2012 [28].

No population-based studies that met the inclusion criteria were identified from the 15 remaining countries of Central and Eastern Europe. There were no studies done on a national scale, as all the studies were conducted within a specific town or region of the specific country.

### *3.3. Sampling Frame*

All studies recruited individuals in urban populations, apart from one study [18] that recruited their study sample from rural areas of the Gdansk region. The sampling frame for each study came from different sources, where some studies selected a random proportion of the population from the region municipality register, others from General Practice records, or a combination of General Practice records and census data. Information about consent was recorded in 50% of the studies. Response rates were reported in just two studies, in which they were 89.3% [27] and 75.5% [26], respectively. Authors provided further data for one study, in which the response rate was 50% [21]. We were able to calculate response rate from data provided in three other studies, and these were 61.5% [26], 98.7% [28] and 99.2% [24], respectively.

The population sample tested varied significantly in size from 83 to 9869. The studies with the largest samples were conducted in Poland and Albania. The age range of people included in the studies also differed noticeably from the whole population [24] to $\geq$100 years of age [26].

### *3.4. Diagnostic Procedures*

Only two studies diagnosed dementia using clinical interview alone [20,25]. Of the remaining eight papers, six used the MMSE as one of or the only screening tool [18,21,24,26–28]. There was a range of training and skills in the investigators completing the screening phase across studies, from clinical specialist (neurologists, geriatricians) to psychologists, neurology residents, trained social workers and community nurses.

Only one study did not specify what diagnostic criteria were used to diagnose dementia [20]. The remaining studies were roughly evenly split between using the DSM (III-R or IV) and ICD-10 criteria.

### *3.5. Quality of Included Papers*

Quality assessment of all ten papers was done according to Munn's criteria as shown in the Appendix B. Each study received a quality score from 0 to 10. The range of quality scores for the included studies varied from 1 to 9. There was a tendency for the quality to improve over time, as shown in Table 2.

**Table 2.** Quality scores.

| Study Author and Year | Q1 Was the Sample Representative of Target Population? | Q2 Were Study Participants Recruited in an Appropriate Way? | Q3 Was the Sample Size Adequate? | Q4 Were the Study Subjects and Setting Described in Detail? | Q5 Is the Data Analysis Conducted with Sufficient Coverage of the Identified Sample? | Q6 Were Objective, Standard Criteria Used for Measurement of the Condition? | Q7 Was the Condition Measured Reliably? | Q8 Was There Appropriate Statistical Analysis? | Q9 Are All Important Confounding Factors/ Subgroups/ Differences Identified and Accounted for? | Q10 Were Subpopulations Identified Using Objective Criteria? | Scoring |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Bidzan (2007) [18] | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 9 |
| Gavrilova (1987) [20] | Yes | Not clear | No | No | No | Not clear | No | No | No | No | 1 |
| Wender (1990) [21] | No | No | No | Yes | No | Yes | Yes | Not clear | No | No | 3 |
| Rossa (1997) [22] | Yes | Yes | No | No | No | Yes | Yes | Yes | No | No | 5 |
| Gabryelewicz (1999) [23] | Yes | Yes | No | Yes | Not clear | Yes | Yes | Yes | Yes | Yes | 8 |
| Kruja (2002) [24] | Yes | Yes | Yes | No | Yes | Yes | Yes | No | Yes | No | 7 |
| Stefanova (2004) [25] | Yes | Yes | No | No | No | Yes | Yes | No | No | No | 4 |
| Pfeffer (2012) [26] | Yes | Yes | No | Yes | Yes | Yes | Yes | No | Yes | No | 6 |
| Dimitrov (2012) [27] | Yes | Yes | No | Yes | Yes | Yes | Yes | Yes | Yes | Yes | 9 |
| Kruja (2012) [28] | Yes | Yes | No | No | Yes | Yes | Yes | Yes | No | Yes | 7 |

Two studies scored lowest in quality [20,25]. One of these [20] was the earliest published and lacked detailed information about screening and diagnostic procedures. The other [25] had poor coverage of details regarding the population and lack of statistical analysis. Most of the studies did not report calculation on adequate sample size to ensure they were achieving a good precision of final estimate. There was no detailed description about response and non-response rates or comparison with people that were not included.

### *3.6. Prevalence of Dementia*

The reported prevalence rates varied across countries. Overall, dementia prevalence for those aged ≥60 years varied from 5.5% to 7.8%. Prevalence for those aged ≥65 ranged from 5.7 to 10.1%. The highest prevalence of 69% was found in those aged ≥100 [26]. In the studies where prevalence estimates were broken down by age groups, age stratified prevalence was reported. Prevalence of dementia increased proportionally with age in countries like Poland, Albania and Serbia. Prevalence in those ≥80 years old ranged from 16.5% in Poland to 23% in Serbia and 40.9% in Albania. Prevalence overall increased over time in both those over 60 and those over 65, except for one study [21], which found a much higher prevalence in 1990 than any subsequent study, even those in the same country.

All studies observed higher prevalence of dementia in females compared to males, apart from one conducted in 1990 [21], where dementia prevalence was higher in men.

All Polish studies reported prevalence data on dementia subtypes, particularly Alzheimer Disease and Vascular dementia [18,21–23,26]. The prevalence range of AD was higher than VaD. Furthermore, prevalence rates of AD were higher in females, while prevalence rates for VaD were higher in men.

On meta-analysis, the overall prevalence was 6.7% (95% CI 5.1–8.2) in those aged 60 or over and 7.1% (95% CI 5.1–9.2) in those aged 65 and over. Heterogeneity of studies was high ($I^2$ = 82.5% and 87.7% for over 60's and over 65's, respectively). This is shown in Figures 2 and 3, respectively.

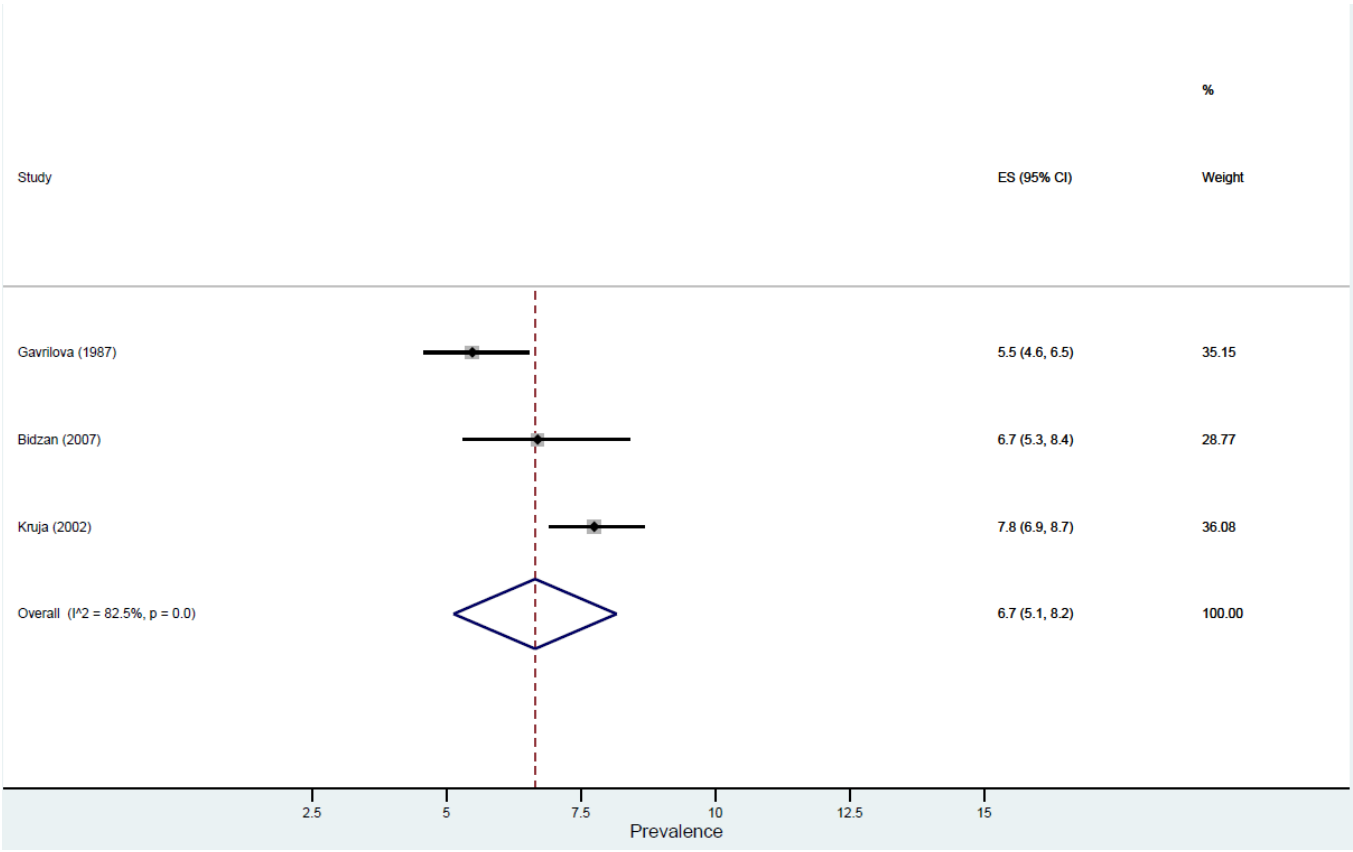


**Figure 2.** Dementia prevalence in over 60's.

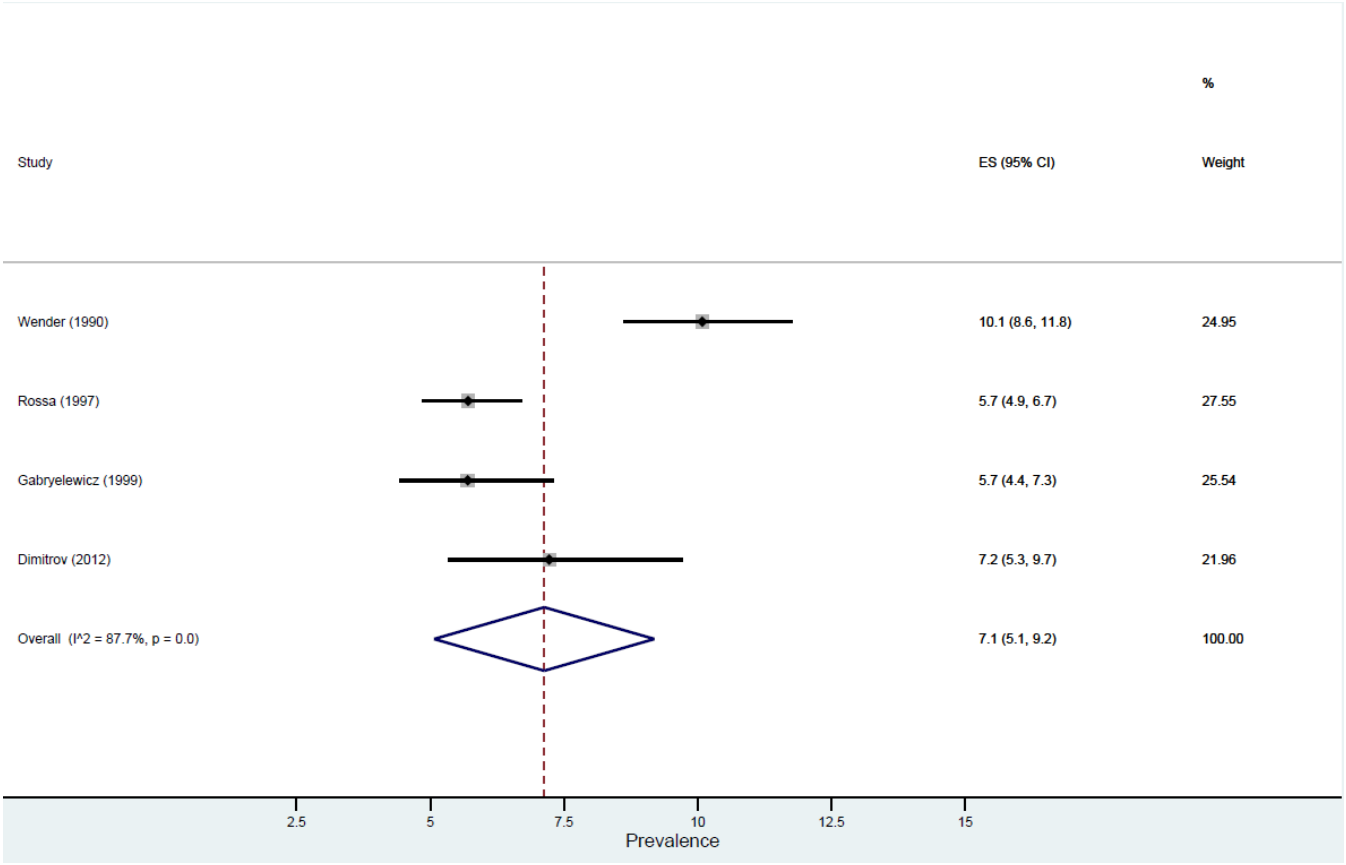


**Figure 3.** Dementia prevalence in over 65's.

## 4. Discussion

This is the first meta-analysis of dementia prevalence in Central and Eastern Europe and the first review of dementia prevalence in this region since 2006. We found a higher prevalence of dementia compared to previous Europe-wide [29] and world-wide [30] estimates.

Given the number of countries included in the search strategy and the inclusive nature of the review, there was a lack of studies reporting prevalence data for dementia in Central and Eastern Europe. There is, therefore, a relative lack of valid and robust sources of epidemiological data on dementia prevalence in Central and Eastern Europe compared to Western Europe. No epidemiological or population-based studies were identified during the search for most of the countries in the region. The vast majority of the studies included in the systematic review were conducted only in defined regions, such as rural or urban regions, while others were conducted at the municipal level. Half of the studies included in the review were conducted in Poland, and the other countries were represented with either one or two studies. No large scale or nationwide studies were found. The tradition of robust, large-scale studies characteristic for the US and Western Europe is not yet present in this part of Europe.

Prevalence rates of dementia varied considerably between countries and within the same country. This might be partly attributed to the lack of methodological uniformity, including the variety of diagnostic criteria used to diagnose dementia, although all studies used valid criteria for diagnosis. The age ranges of the population included varied considerably, which in itself can be a source of heterogeneity. Discrepancies in the prevalence of dementia in different regions can be explained not just by the use of unequal methodologies or differences in life expectancy, but possibly with diet, physical activities and different levels of educational attainment in each region.

In the collaborative populations-based study in Northwest and Southern Europe, the reported age standardised prevalence of dementia was 6.4% [7], and another paper [31] reported a 7.3% standardised prevalence rate in subjects >60 in Western Europe. A more recent systematic review and meta-analysis on highest quality studies in Western and Southern Europe using only the DSM-IV reported a prevalence rate of dementia of 7.1% [9]. Prevalence rates in Central and Eastern Europe are similar to those in Western Europe, ranging from 5.5% to 7.8% in those over the age of 60. However, the prevalence of dementia does seem to be increasing over time in this region compared to the declining age-specific prevalence in Western Europe [32]. This difference may be due to differences in education, socioeconomic status and other lifestyle factors that vary between the regions. The only studies in the same country that could be compared showed a higher prevalence of dementia in 1990 compared to 1997 [21,22]. It is likely that the study from 1990 is an overestimate, as it scores much lower on quality; the authors invited all those over the age of 65 to participate in cognitive tests and the response rate to this was 50%, so it is likely to have included people who were concerned about their memory and, therefore, it is not a robust estimate of dementia prevalence in the general population [21].

*Strengths and Limitations*

This systematic review had an inclusive search strategy and thorough approach to searching, which included contacting local experts. The standards followed are widely accepted, we followed PRISMA guidelines and the protocol was pre-registered on PROSPERO (CDR 42019136117).

Apart from the search in the English language in four databases (Medline, Embase, Psychinfo, CINAHL), other searches in Bulgarian, Polish, Hungarian, Romanian and Serbian were completed to retrieve articles that were not internationally published and/or translated. All the available literature on population-based studies is likely to have been identified in this review.

Another strength of the review is there was no restriction on the languages included in the review. Full text articles that were eligible were screened and translated from their original languages and additional data were obtained from authors where possible.

Several studies included in this review were the first and the only population-based study reporting on the prevalence of dementia for that specific country. They provided data on dementia prevalence that had not been available before. Most of the studies were two-phase studies, which used a range of trained and specialised investigators during the screening phase. This was followed by interviews and examination from a specialist (psychiatrist, neurologist or geriatrician), which increases the validity of cases. We were able to meta-analyse studies for the first time in this region, providing an aggregate estimate of prevalence, but unfortunately, we could not adjust the data for age or sex norms, and not all authors responded to our requests for additional data, so we could not meta-analyse all papers.

One of the main limitations of the literature is that it lacks coverage of the vast majority of the countries included in the search. The prevalence data presented by the countries in which studies were identified cannot be representative of the whole region. Moreover, despite the broad search in different languages, not all the languages of Central and Eastern European countries were used, thus papers published in those languages might have been missed. We did not assess for publication bias, as we were not assessing positive or negative trial results, but we acknowledge that this could mean we have missed unpublished studies that may have different estimates of prevalence.

Another limitation is the questionable quality of studies, particularly those conducted prior to 2000, which has significant implications for health care services. The lack of methodological uniformity and the use of different diagnostic criteria might have affected the true prevalence rates. Additionally, most studies did not report response rates and results may be biased.

Overall, this review is an important addition to the literature, providing an aggregate estimate of dementia prevalence in Central and Eastern Europe for the first time and showing an increase in prevalence over time. There is an urgent need for prevalence studies in the majority of countries in this region and evaluation of the reasons behind increasing prevalence as well as public health strategies to counterbalance these.

**Author Contributions:** B.C., N.M. and P.R. designed the study, interpreted the results and wrote the manuscript. B.C. conducted the literature searches and screened abstracts and extracted data independently from E.O., B.C. contacted authors for additional data from relevant papers. All authors have contributed to the work, agree with the presented findings, and the work has not been published before nor is being considered for publication in another journal. All authors have read and agreed to the published version of the manuscript.

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**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** Not applicable.

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**Conflicts of Interest:** The authors declare no conflict of interest.

## Appendix A. Search Terms

1. exp *Dementia/or exp *Dementia, Vascular/or exp *Dementia, Multi-Infarct/
2. exp *Cognition Disorders/or exp *Dementia/or exp *Alzheimer Disease/
3. exp *Cognition Disorders/or exp *Alzheimer Disease/or exp *Dementia/
4. exp *Cognition Disorders/or exp *Alzheimer Disease/or exp *Dementia/
5. exp *Alzheimer Disease/
6. exp *Dementia, Vascular/
7. exp *Cognitive Dysfunction/
8. 1 or 2 or 3 or 4 or 5 or 6 or 7
9. (frequenc* or prevalen* or epidemiolog*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
10. 8 and 9
11. limit 10 to (abstracts and humans)
12. Albania.mp.
13. Bosnia.mp. or "Bosnia and Herzegovina"/
14. exp *"Bosnia and Herzegovina"/or Herzegovina.mp.
15. Bulgaria.mp.
16. Croatia.mp.
17. Czech republic.mp.
18. Hungary.mp.
19. exp *"Macedonia (Republic)"/or Macedonia.mp.
20. Montenegro.mp.
21. Poland.mp.
22. Romania.mp.
23. Serbia.mp. or exp *Yugoslavia/
24. Slovakia.mp. or exp *Czechoslovakia/

25. Slovenia.mp.
26. Belarus.mp. or exp *"Republic of Belarus"/
27. estonia.mp.
28. Latvia.mp.
29. Lithuania.mp.
30. Moldova.mp.
31. Russia.mp.
32. Russian federation.mp.
33. Ukraine.mp.
34. 12 or 13 or 14 or 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33
35. 8 and 11 and 34
36. dementia.mp.
37. alzheimer.mp.
38. "Alzheimer's disease".mp.
39. "Alzheimer disease".mp.
40. "Alzheimer dementia".mp.
41. "Vascular Dementia".mp.
42. "Cognitive impairment".mp.
43. "Mixed Dementia".mp.
44. VaD.mp.
45. AD.mp.
46. 36 or 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45
47. 9 and 34 and 46
48. limit 47 to abstracts
49. exp *Dementia/or exp *Dementia, Vascular/or exp *Dementia, Multi-Infarct/
50. exp *Cognition Disorders/or exp *Dementia/or exp *Alzheimer Disease/
51. exp *Cognition Disorders/or exp *Alzheimer Disease/or exp *Dementia/
52. exp *Cognition Disorders/or exp *Alzheimer Disease/or exp *Dementia/
53. exp *Alzheimer Disease/
54. exp *Dementia, Vascular/
55. exp *Cognitive Dysfunction/
56. 49 or 50 or 51 or 52 or 53 or 54 or 55
57. (frequenc* or prevalen* or epidemiolog*).mp. [mp=title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]
58. 56 and 57
59. limit 58 to (abstracts and humans)

**Appendix B. Prevalence Critical Appraisal Instrument. (Munn at al., 2014)**

The 10 criteria used to assess the methodological quality of studies reporting prevalence data and an explanation are described below. These questions can be answered either with a yes, no, unclear, or not applicable.

Answers: Yes, No, Unclear or Not/Applicable

1. *Was the Sample Representative of the Target Population?*

This question relies upon knowledge of the broader characteristics of the population of interest. If the study is of women with breast cancer, knowledge of at least the characteristics, demographics, and medical history is needed. The term "target population" should not be taken to infer every individual from everywhere or with similar disease or exposure characteristics. Instead, give consideration to specific population characteristics in the study, including age range, gender, morbidities, medications, and other potentially influential factors. For example, a sample may not be representative of the target popula-

tion if a certain group has been used (such as those working for one organisation, or one profession) and the results then inferred to the target population (i.e. working adults).

2. *Were Study Participants Recruited in an Appropriate Way?*

Recruitment is the calling or advertising strategy for gaining interest in the study, and is not the same as sampling. Studies may report random sampling from a population, and the methods section should report how sampling was performed. What source of data were study participants recruited from? Was the sampling frame appropriate? For example, census data is a good example of appropriate recruitment as a good census will identify everybody. Was everybody included who should have been included? Were any groups of persons excluded? Was the whole population of interest surveyed? If not, was random sampling from a defined subset of the population employed? Was stratified random sampling with eligibility criteria used to ensure the sample was representative of the population that the researchers were generalizing to?

3. *Was the Sample Size Adequate?*

An adequate sample size is important to ensure good precision of the final estimate. Ideally we are looking for evidence that the authors conducted a sample size calculation o determine an adequate sample size. This will estimate how many subjects are needed to produce a reliable estimate of the measure(s) of interest. For conditions with a low prevalence, a larger sample size is needed. Also consider sample sizes for subgroup (or characteristics) analyses, and whether these are appropriate. Sometimes, the study will be large enough (as in large national surveys) whereby a sample size calculation is not required. In these cases, sample size can be considered adequate.

When there is no sample size calculation and it is not a large national survey, the reviewers may consider conducting their own sample size analysis using the following formula [33,34]:

$$n = \frac{Z^2 P(1-P)}{d^2}$$

where:

$n$ = sample size
$Z$ = Z statistic for a level of confidence
$p$ = Expected prevalence or proportion (in proportion of one; if 20%, $P = 0.2$)
$d$ = precision (in proportion of one; if 5%, $d = 0.05$)

4. *Were the Study Subjects and Setting Described in Detail?*

Certain diseases or conditions vary in prevalence across different geographic regions and populations (e.g. women vs. men, socio-demographic variables between countries). Has the study sample been described in sufficient detail so that other researchers can determine if it is comparable to the population of interest to them?

5. *Is the Data Analysis Conducted with Sufficient Coverage of the Identified Sample?*

A large number of dropouts, refusals or "not founds" amongst selected subjects may diminish a study's validity, as can low response rates for survey studies.

- Did the authors describe the reasons for non-response and compare persons in the study to those not in the study, particularly with regards to their socio-demographic characteristics?
- Could the not-responders have led to an underestimate of prevalence of the disease or condition under investigation?—If reasons for non-response appear to be unrelated to the outcome measured and the characteristics of non-responders are comparable to those in the study, the researchers may be able to justify a more modest response rate.
- Did the means of assessment or measurement negatively affect the response rate (measurement should be easily accessible, conveniently timed for participants, acceptable in length, and suitable in content).

6. *Were Objective, Standard Criteria Used for Measurement of the Condition?*

Here we are looking for measurement or classification bias. Many health problems are not easily diagnosed or defined and some measures may not be capable of including or excluding appropriate levels or stages of the health problem. If the outcomes were assessed based on existing definitions or diagnostic criteria, then the answer to this question is likely to be yes. If the outcomes were assessed using observer reported, or self-reported scales, the risk of over- or under-reporting is increased, and objectivity is compromised. Importantly, determine if the measurement tools used were validated instruments as this has a significant impact on outcome assessment validity.

7. *Was the Condition Measured Reliably?*

Considerable judgment is required to determine the presence of some health outcomes. Having established the objectivity of the outcome measurement instrument (see item 6 of this scale), it is important to establish how the measurement was conducted. Were those involved in collecting data trained or educated in the use of the instrument/s? If there was more than one data collector, were they similar in terms of level of education, clinical or research experience, or level of responsibility in the piece of research being appraised?

- Has the researcher justified the methods chosen?
- Has the researcher made the methods explicit? (For interview method, how were interviews conducted?)

8. *Was There Appropriate Statistical Analysis?*

As with any consideration of statistical analysis, consideration should be given to whether there was a more appropriate alternate statistical method that could have been used. The methods section should be detailed enough for reviewers to identify the analytical technique used and how specific variables were measured. Additionally, it is also important to assess the appropriateness of the analytical strategy in terms of the assumptions associated with the approach as differing methods of analysis are based on differing assumptions about the data and how it will respond. Prevalence rates found in studies only provide estimates of the true prevalence of a problem in the larger population. Since some subgroups are very small, 95% confidence intervals are usually given.

9. *Are All Important Confounding Factors/Subgroups/Differences Identified and Accounted for?*

Incidence and prevalence studies often draw or report findings regarding the differences between groups. It is important that authors of these studies identify all important confounding factors, subgroups and differences and account for these.

10. *Were Subpopulations Identified Using Objective Criteria?*

Objective criteria should also be used where possible to identify subgroups (refer to question 6).

## Appendix C. Table of Studies Excluded with Reason

| Author | Study | Reason for Exclusion |
| --- | --- | --- |
| Auer, S., Linsmayer, E., Berankova, A., Pascher, P., Firlinger, B., Prischl, D., ... Holmerova, I. (2017) | DEMDATA: The Austrian-Czech institutional long-term care project—design and protocol of a two-centre cross sectional study. | Not General Population |
| Auer, S. R., Hofler, M., Linsmayer, E., Berankova, A., Prieschl, D., Ratajczak, P., ... Holmerova, I. (2018) | Cross-sectional study of prevalence of dementia, behavioural symptoms, mobility, pain and other health parameters in nursing homes in Austria and the Czech Republic: results from the DEMDATA project. | Not General Population |

| Author | Study | Reason for Exclusion |
|---|---|---|
| Kijowska, V., & Szczerbinska, K. (2018) | Prevalence of cognitive impairment among long-term care residents: a comparison between nursing homes and residential homes in Poland. | Not General Population |
| Dobrzyn-Matusiak, D., Marcisz, C., Bak, E., Kulik, H., & Marcisz, E. (2014) | Physical and mental health aspects of elderly in social care in Poland | Not General Population |
| Sutovsky, S., Klobucnikova, K., Volarikova, V., & Turcani, P. (2012). | The ussian assisted living study: Prevalence, recognition and treatment of dementia, parkinsonism and depression in the assisted living population | Not General Population |
| Sutovsky, S., Kralova, M., Siarnik, P., & Turcani, P. (2018) | Prevalence, Recognition, and Treatment of Dementia in Assisted Living Facilities | Not General Population |
| Sutovsky, S., & Turcani, P. (2015) | Prevalence, recognition and treatment of parkinsonism, dementia and depression in the assisted living population of Slovakia. | Not General Population |
| Trifonov, E. G., & Ognev, A. E. (1997). | The geriatric psychiatric day hospital: an analysis of 5 years of activities. | Not General Population |
| Turcani, P., & Sutovsky, S. (2014). | The Slovakia assisted living study: Two cross-sectional studies of prevalence, recognition, and treatment of dementia and depression in the assisted living population of Slovakia. | Not General Population |
| Bidzan, L., & Turczynski, J. (2005). | Environment and cognitive functions in a population 60 years and older. | Studies on Cognitive Decline |
| Bidzan, L., Turczynski, J., & Szabert, K. (2009) | Prevalence of MCI in a population from area near Gdansk. | Studies on Cognitive Decline |
| Formanek, T., Kagstrom, A., Winkler, P., & Cermakova, P. (2019). | Differences in cognitive performance and cognitive decline across European regions: a population-based prospective cohort study. | Studies on Cognitive Decline |
| Gabryelewicz, T., Styczynska, M., Luczywek, E., Barczak, A., Pfeffer, A., Androsiuk, W., . . . Barcikowska, M. (2007). | The rate of conversion of mild cognitive impairment to dementia: predictive role of depression. | Studies on Cognitive Decline |
| Gurgu, M., Zamfirescu, A., Stroie, A. M., & Aurel, R. (2012). | Cognitive impairment prevalence and correlations with subjective memory impairment: Findings from Brasov, Romania. | Studies on Cognitive Decline |
| Gurina, N., Frolov, E., Isaeva, T., Korystina, E., Zelenukha, D., Tadjibaev, P., & Degryse, J. (2010). | Aging in Russia: The results of crystal project in the St-Petersburg district. | Studies on Cognitive Decline |
| Gurina, N. A., Frolova, E. V., & Degryse, J. M. (2011). | A roadmap of aging in Russia: the prevalence of frailty in community-dwelling older adults in the St. Petersburg district—the "Crystal" study. | Studies on Cognitive Decline |
| Knasiene, J., Legotaite, G., & Damuleviciene, G. (2016) | Characteristics of cognitive disorders of the older patients visiting the Memory clinic for the first time | Studies on Cognitive Decline |
| Klich-Rączka, A., Piotrowicz, K., Mossakowska, M., Skalska, A., Wizner, B., Broczek, K.,... & Grodzicki, T. (2014). | The assessment of cognitive impairment suspected of dementia in Polish elderly people: results of the population based PolSenior Study. | Studies on Cognitive Decline |

| Author | Study | Reason for Exclusion |
|---|---|---|
| Makeeva, O. A., Romero, H. R., Markova, V. V., Melikyan, Z. A., Zhukova, I. A., Minaycheva, L. I., ... Welsh-Bohmer, K. (2015). | Ascular risk factors confer domainspecific deficits in cognitive performance within an elderly ussian population. | Studies on Cognitive Decline |
| Motyl, R., Slowik, A., Turaj, W., Szczudlik, A., & Pajak, A. (1998). | Cognitive impairment and cardiovascular disease risk factors. Project CASCADE Krakow. VI. Magnetic resonance imaging of the aging brain in elderly persons (65−78 years old). | Studies on Cognitive Decline |
| Pomykalska, E., Pajak, A., & Szczudlik, A. (1998). | Cognitive impairment and cardiovascular disease risk factors. Project CASCADE Krakow. II. Agreement of Mini-Mental State Examination (MMSE) obtained by nurses and by psychologists from the same persons at age 67−78 years of age. | Studies on Cognitive Decline |
| Orlowiejska-Gillert, M., Pajak, A., Szczudlik, A., Kawalec, E., & Pomykalska, E. (1998). | Cognitive impairment and cardiovascular disease risk factors. Project CASCADE Krakow. III. Assessment of cognitive function in elderly women and men (65−78 years old). | Studies on Cognitive Decline |
| Pajak, A., Kawalec, E., Pomykalska, E., Topor-Madry, R., Orlowiejska-Gillert, M., & Szczudlik, A. (1998). | Cognitive impairment and cardiovascular disease risk factors. Project CASCADE Krakow. IV. Prevalence of cognitive impairment in relation to age, sex, education and history of myocardial infarction in men and women at age 65−78, residents of a rural province in Poland | Studies on Cognitive Decline |
| Parnowski T, Gabryelewicz T, Matuszewska E, Jarkiewicz J. 1993. | Prevalence of the dementia syndrome among elderly people in an urban area. A pilot study. | Study on Cognitive Decline |
| Sipos, K., Bodo, M., May, Z., Lendvai, B., Piros, A., Spitzer, N., ... Banyasz, A. (2008). | Risk of mental disorders, their changes and somatic consideration in rural Hungary. | Studies on Cognitive Decline |
| Szczudlik, A., Slowik, A., Turaj, W., Orlowiejska-Gillert, M., Motyl, R., Topor-Madry, R., & Pajak, A. (1998). | Cognitive impairment and cardiovascular disease risk factors. Project CASCADE Krakow. V. Disorders of higher cerebral functions in elderly people (65−78 years old). | Studies on Cognitive Decline |
| Tkacheva, O. N., Runikhina, N. K., Ostapenko, V. S., Sharashkina, N. V., Mkhitaryan, E. A., Onuchina, J. S., ... Press, Y. (2018). | Prevalence of geriatric syndromes among people aged 65 years and older at four community clinics in Moscow | Studies on Cognitive Decline |
| Tkacheva, O. N., Runikhina, N. K., Yakhno, N. N., Mkhitaryan, E. A., Ostapenko, V. S., Shrashkina, N. V., & Savushkina, I. Y. (2016). | High prevalence of cognitive impairment in elderly subjects in primary care. | Studies on Cognitive Decline |
| Gavrilov, S. I., & Kirzhanova, V. V. (1983) | Incidence of mental disorders among the late middle-aged and elderly population (according to the primary registration data of the psychoneurologic institutions of Moscow). | Incidence Study |
| Cornutiu, G. (2010). | The incidence and prevalence of Alzheimer's disease | Literature Review |

| Author | Study | Reason for Exclusion |
|---|---|---|
| Gavrilova, S. I., & Bratsun, A. L. (1999). | Epidemiology and risk factors of Alzheimer's disease. | Literature Review |
| Kiejna, A., Frydecka, D., Adamowski, T., Bickel, H., Reynish, E., Prince, M., ... Georges, J. (2011). | Epidemiological studies of cognitive impairment and dementia across Eastern and Middle European countries (Epidemiology of Dementia in Eastern and Middle European Countries). | Literature Rivew |
| Ersek, K., Karpati, K., Kovacs, T., Csillik, G., Gulacsi, A. L., & Gulacsi, L. (2010). | [Epidemiology of dementia in Hungary]. | Literature Review |
| Leel-Ossy, L. (1995). | Incidence of Alzheimer's dementia in homes for the elderly. | Incidence Study |
| Trascu, R. I., & Spiru, L. (2011). | Is Alzheimer's crisis adequately perceived in Romania? | No Prevalence Study |
| Sova, M. R., Dobrin, R. P., & Chirita, V. (2009) | Aspects regarding the incidence and prevalence of vascular dementia forms]. | No Prevalence Study |
| Iova, A., Mihancea, P., & Sabau, M. (2009). | General aspects of the morbidity in Alzheimer's dementia during 2003-2005 at the Neurology and Psychiatry Clinical Hospital Oradea. | Not General Population |
| Klich-Raczka, A., Dubiel, M., Sulicka, J., Zyczkowska, J., & Pitucha, M. (2006). | Comprehensive geriatric assessment in hospitalized patients aged 80 years and more. | Not General Population |
| Klimkowicz, A., Dziedzic, T., Slowik, A., & Szczudlik, A. (2002). | Incidence of pre- and poststroke dementia: cracow stroke registry. | Not General Population |
| Klimkowicz-Mrowiec, A., Dziedzic, T., Stowik, A., & Szczudlik, A. (2006). | Predictors of Poststroke Dementia: Results of a Hospital-Based Study in Poland. | Not General Population |
| Kovacs, G. G., Kovari, V., & Nagy, Z. (2008). | Frequency of different forms of dementia at the Department of Neuropathology of the Hungarian National Institute of Psychiatry and Neurology during a 3-year period. | Not General Population |
| Dumitru, M. M., Chirita, V., & Chirita, R. (2014). | Characteristics of early onset dementia in a hospital setting from Romania. | Not General Population |
| Dimitrov, I., Kaprelyan, A., Usheva, N., & Ivanov, B. (2015). | Alzheimer's disease outpatient referrals to a dementia centre: Diagnostic challenges. | Not General Population |
| Catipovic, V., Drobac, R., & Slijepcevic, M. K. (2004). | [Epidemiological study of psychiatric hospitalizations in Bjelovar General Hospital]. | Not General Population |
| Pecotic, Z., & Pandzic, M. (2000). | The age and sex of hospitalized demented patients. | Not General Population |
| Togoj, A. (2008). | Care for people with dementia in Slovenia | No Prevalence Study |
| Bartos, A., & Raisova, M. (2016) | The Mini-Mental State Examination: Czech Norms and Cutoffs for Mild Dementia and Mild Cognitive Impairment due to Alzheimer's Disease | No Prevalence Studies |
| Gabryelewicz, T., Kotapka-Minc, S., Maczka, M., Motyl, R., Sobow, T., Szczudlik, A., ... Barcikowska, M. (2006) | The characteristic of Polish population Alzheimer's disease patients and their caregivers: Results from observation EX-ON study | No Prevalence Studies |
| Macijauskiene, J., & Engedal, K. (2005) | Medico social care for persons suffering from Alzheimer's disease and related disorders | No Prevalence Studies |

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