Neuroscience and Biobehavioral Reviews 118 (2020) 440–450

Contents lists available at ScienceDirect

Neuroscience and Biobehavioral Reviews

journal homepage: www.elsevier.com/locate/neubiorev

Review article

The mental and physical health of older offenders: A systematic review and meta-analysis

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ARTICLE INFO

Keywords:
Aging
Older offenders
Criminal behavior
Mental health
Physical health

ABSTRACT

A systematic review with meta-analysis was performed to: 1) estimate the prevalence of both mental and physical health problems in older offenders; 2) calculate relative risks for the health conditions in relation to non-offender older adults and; 3) explore the potential confounding role of several variables. We searched five databases up to August 2019. Studies involving offenders older than 50 years old were included. Fifty-five publications met criteria. The pooled prevalence for 18 mental and 28 physical health problems was calculated. In comparison with non-offender older adults, older offenders showed significantly higher risk for Hypertension (RR = 1.16, CI = 1.1, 1.2), Cardiovascular Diseases (RR = 1.24, CI = 1.09, 1.41), Respiratory diseases (RR = 1.75, CI = 1.29, 2.35), and Arthritis (RR = 1.19, CI = 1.12, 1.25). Heterogeneity was significant for all meta-analyses and partially explained by the confounding effect of country, the diagnosis assessment method, and the sample characteristics. Future research should include comparison groups of non-offender older adults and use longitudinal study designs to identify risk factors that can be targeted in preventive programmes.

1. Introduction

The World Health Organization (WHO, 2017) projects that the world's population aged 60 years and older will raise to 2 billion by 2050, up from 900 million in 2015. Nowadays, this increasing ageing phenomenon is particularly concerning for specific contexts and population groups such as offenders and prisoners, where the proportion of prisoners over 50 years old represent between 10 and 19 % of the prison population in different western-countries (BRÅ, 2018; Di Lorito et al., 2018b; Ginn, 2012). This increasing number of offenders ageing inside prisons is challenging the social and physical environments of the prisons, because they may not be adapted to the particular cognitive, functional or motor disabilities and needs of older adults (Ginn, 2012). In addition, older offenders re-entering their communities face additional medical and psychosocial challenges. These additional challenges may be related to the fact that after being in prison, older offenders may increase their risk of becoming "Institutionalized" (Williams and Abraldes, 2007). Older offenders may lack some of the skills needed to deal with the challenges of daily life outside the prison context, which may increase their anxiety levels and reduce their problem-solving abilities to handle their health and psychosocial situation. Indeed, older offenders re-entering their communities seem to exhibit a number of medical conditions, functionality problems and low psychosocial adjustment, putting them in a vulnerable situation (Williams and Abraldes, 2007).

Previous research indicates that mental illness, specifically psychotic illnesses, substance abuse and severe depression, are common health problems among young adult prisoners worldwide (Fazel and Seewald, 2012). However, until recently, little has been known about the needs of older offenders (Fazel et al., 2016), their specific mental and physical health disorders, and/or how previous life-style and health conditions are associated with these outcomes. Although the body of

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https://doi.org/10.1016/j.neubiorev.2020.07.043
Received 13 January 2020; Received in revised form 31 May 2020; Accepted 31 July 2020
Available online 09 August 2020

literature is still not extensive, current studies indicate that around 80 % of older male prisoners may have at least one major illness (Fazel et al., 2001), where depression, schizophrenia/psychoses and anxiety would be the most common diagnoses (Di Lorito et al., 2018b). Importantly, several neurocognitive deficits seem to be associated with these psychiatric disorders such as executive dysfunctions or memory problems (Granacher, 2018b), that may have a negative impact during ageing. Moreover, the development of neurological disorders in ageing offenders, such as aphasias, apraxias, agnosias, or other neurocognitive syndromes like Alzheimer's disease or Vascular Dementia, may be related to previous life-span psychiatric problems (e.g., Substance abuse) or health conditions (e.g., Traumatic Brain Injury). These neurocognitive deficits and neurological disorders can affect the brain functioning and the behavior of older offenders, which impair older offenders' functionality, understanding, and autonomy in everyday activities (Granacher, 2018a). Despite of this, few studies have explored the prevalence of neurodegenerative disorders, such as primary or secondary dementias, in older offenders (Haesen et al., 2019). There is some evidence suggesting that older offenders, specifically forensic psychiatric offenders, have low prevalence rates for several neurocognitive disorders such as Alzheimer´s disease (Ekström et al., 2017), whereas other studies suggest that there is an elevated proportion of dementia diagnosis among older prisoners (Di Lorito et al., 2018b). Poor quality of life, functionality decline, and unmet social needs have also been reported previously (Di Lorito et al., 2018a; Fazel et al., 2004; Ginn, 2012; O'Hara et al., 2016). However, very few studies have used a comparison group of older adults in the general population to investigate whether older offenders show a higher burden of mental and physical health diseases.

Criminology researchers have highlighted several factors that increase the risk for persisting in a criminal career and developing adverse health and unadjusted social outcomes from childhood and adolescence up into adulthood (Corovic et al., 2017). These risk factors may refer to individual (e.g., biological and psychological traits), social (e.g. peer interactions, parenting styles and behaviors), demographic variables (e.g. socioeconomic status, geographical region, family structure, imprisonment history, education, employment situation), that offenders exhibit or are exposed to along their lifespan (Kretschmer et al., 2017). However, there is a lack of research exploring how these risk factors influence offenders in later-life stages. Furthermore, little is known about the potential effect on their ageing processes of lifespan medical conditions and mental health problems, the familiar structure, the income and employment situation, the geographical region where the offender grows older, the imprisonment status, the offender´s trajectory (e.g., persistent offender, first time offender) or the type of crime committed, among other factors.

We are aware of previous systematic reviews that have attempted to explore medical problems in older offenders or prisoners (Di Lorito et al., 2018; Di Lorito et al., 2018b; Haesen et al., 2019; Munday et al., 2019; Skarupski et al., 2018). However, these reviews can be expanded in a number of ways. Three of these systematic reviews were qualitative or scoping reviews (Di Lorito et al., 2018; Haesen et al., 2019; Skarupski et al., 2018) in which no meta-analyses were performed due to the lack of comparable estimates between the included studies. Several of these reviews (Di Lorito et al., 2018; Di Lorito et al., 2018b; Haesen et al., 2019) focused on substance abuse and mental health problems. Only one systematic review (Munday et al., 2019) reported a quantitative analysis of chronic physical diseases with long duration and slow progression, so the prevalence of other physical health problems has not yet been studied. The majority of these reviews were conducted on older prisoners (Di Lorito et al., 2018b; Haesen et al., 2019; Munday et al., 2019; Skarupski et al., 2018), but did not focus on the health of those older offenders who were under parole, ex-prisoners, in probation sentence, or in other types of institutions. To the best of our knowledge, no available review reported the prevalence of both mental and physical health problems and explored how the health estimates vary depending on potential confounders. In addition, to what extent older offenders present a higher risk for some of the mental and physical health problems in comparison with older adults without criminal history is unclear.

In this systematic review and meta-analysis, we sought to provide a comprehensive picture of the health profile of older offenders. We aim to address three main questions: 1) What is the pooled prevalence of mental and physical health problems in older offenders; 2) Whether and to what extent this population shows a higher risk for different mental and physical health problems in comparison to older adults without criminal history; 3) What are the effects of different potential confounding variables on the prevalence rates of the different mental and physical health problems. Given the exploratory nature of this review, no a priori hypotheses were formulated.

2. Method

A systematic review and meta-analysis were conducted following the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (Moher et al., 2009). The protocol of this systematic review was pre-registered with PROSPERO (CRD42019137464).

2.1. Search strategy

The strategy for the search in the electronic databases was developed with assistance of librarians from the Main Library of Örebro University. We searched PubMed, PsycINFO, Scopus, EMBASE and Web of Science databases with no restrictions regarding language, year of publication, and type of documents. The search strategy involved different combinations of terms related to three main concepts: Older Adults, Health, and Offenders. The following search terms and adequate adjustments for each database were used: aged, aging, older adults, elder; health, health status, disease, disorder, illness, somatic health, psychiatric health, mental health, physical health; criminal, criminal behavior, antisocial personality disorder, offenders, prisoners, inmates, perpetrators. For a complete description of the combinations of different terms and the different search strategies, please see Appendix F. In addition, we conducted a manual search where the reference lists of the included articles and previous narrative or systematic reviews on the topic were screened for any potential pertinent study not detected in the search of databases. The corresponding authors were contacted to request additional useful information to establish if their study met the inclusion criteria. The searches were carried out between December 2018 and January 2019. In order to identify any possible new evidence and to ensure we included all relevant publications, an update of the search was carried out between the first and the fifteenth of August 2019.

2.2. Selection criteria

We included observational studies, cohort studies (prospective, retrospective and population-based registry) and cross-sectional studies that met the following criteria:

1) The studied population were female and/or male offenders aged 50 years old or above. There is a lack of agreement about the chronological age at which an offender become an older adult (Williams et al., 2012). However, the selection of 50 years as the age cut-off is in accordance with previous research showing that offenders can experience an accelerated ageing onset in comparison with adults without criminal history who usually are considered older adults when above 65 years old (Bedard et al., 2016; Combalbert et al., 2018; Ginn, 2012; Loeb and AbuDagga, 2006). In fact, ageing-related health and functionality problems in offenders tend to occur 10–15 years earlier than in the general population (Wangmo et al.,

2016; Williams et al., 2012). Therefore, we decided to select this age cut-off for being considered an older offender because it reflects the accumulation of unhealthy and negative life experiences (e.g., life-span substance abuse problems, poor family interactions, poor socioeconomic levels) that may accelerate the onset of age-related medical and psychosocial problems in adults with a criminal history (Kakoullis et al., 2010).

2) Quantitative information that allowed the estimation of the prevalence of different mental or physical health problems (outcomes). As we aimed to be comprehensive and exploratory, we did not restrict to any health conditions.
3) In the included studies, the presence of any health problem was established via a clinical diagnosis, a research diagnosis or a sum score of mental and physical symptoms based on validated rating scales and questionnaires. The scales and questionnaires had to be rated by the clinician/researcher, a health professional, or self-reported. In addition, the mental and physical health problems had to be diagnosed according to definitions of disorders and diseases in the Diagnostic and Statistical Manual of Mental Disorders (DSM III; III-R; IV; IV-TR or 5) or the International Classification of Diseases (ICD 9 or10) criteria.

2.3. Data extraction (selection and coding)

Endnote X9 was used to manage all references identified by the electronic and manual searches. After removing duplicates one author (CS) selected potentially relevant studies based in their title and abstract. In case of any uncertainty while screening the titles and abstract two senior authors (HA and HL) were consulted and they assessed the potential inclusion/exclusion of the paper. The full-text version of the articles selected were downloaded and two authors (CS and MD) independently assessed the relevant papers based on their full text. Discrepancies were solved by consensus between the two authors. In case consensus was not achieved, a third senior author (HA) acted as an arbitrator. Papers meeting the predetermined inclusion criteria were selected, and the reasons for excluding non-selected studies were recorded.

After the full-text selection, two authors (CS and MD) extracted the following data: first author; year of publication; year of data collection; country where the study was conducted; study design; method to establish the diagnosis (i.e., medical/jail records, research diagnosis, combination of records + research diagnosis, self-reported); number of cases for each health outcome reported in the studies; sample size; mean age and standard deviation; gender; percentage of males in the sample; type of sample (i.e., prisoners; offenders who were under parole, probation sentence, ex-prisoners or the imprisonment status was not mentioned, forensic psychiatric offenders). In case of doubt or disagreement between the two authors, a third senior author (HA) was consulted. If there were important data not reported in the full text articles, the corresponding authors were contacted to request additional information.

2.4. Risk of bias appraisal

Two authors (CS and MD) independently assessed the quality and risk of bias of the included studies using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Studies Reporting Prevalence Data (Munn et al., 2014). This tool includes a checklist of 10 items to assess the methodological quality of studies reporting prevalence data. Studies with high risk of bias and/or low quality were not excluded from the meta-analysis.

2.5. Statistical analysis

Descriptive information of each health outcome was synthetized in order to explore the variety of mental and physical health outcomes reported for the included studies.

When prevalence estimates were found in two or more studies, we conducted meta-analyses to calculate the pooled prevalence and its 95 % confidence intervals. The prevalence estimate for each study was obtained by dividing the number of cases for each health outcome by the number of older offenders included in the study. Then, in order to explore the potential impact of confounders, we carried out meta-regression analyses using categorical variables. In accordance to the recommendations of the Cochrane Group (Higgins and Green, 2011), meta-regression was only conducted for those outcomes including ten or more studies. The regressors that were analyzed as categorical variables were: country or geographical region (i.e., Europe, North-America, Other country); method to establish the diagnosis (i.e., medical/jail records, research diagnosis, combination of records + research diagnosis, self-reported); mean age (i.e., mean age between 50–60, mean age between 60–70); gender (i.e., only males, only females, both males and females); and sample type (i.e., prisoners, offenders that were under parole, probation sentence, ex-prisoners or the imprisonment status was not mentioned, forensic psychiatric offenders). We were not able to include other individual, social or demographic risk factors as confounders in our analysis because information was not consistently reported among the included studies. If a meta-regression showed a significant impact of one confounder, follow-up sub-group analyses were conducted in order to explore how the prevalence estimates varied controlling for that confounding variable.

In addition, we ran a second meta-analysis for those mental and physical health problems reported in two or more studies and including a comparison group of non-offender older adults. When data were available, we calculated the individual Risk Ratios (RRs) for the studies and then the pooled RRs were estimated.

All the meta-analyses were conducted using Comprehensive Meta Analysis V3 (https://www.meta-analysis.com). Heterogeneity of results was assessed using the Cochran Q test and I^2 statistics. Due to the methodological differences between the included studies, we applied a random-effects model for all the analyses, as random-effects models are recommended when high between-study heterogeneity is expected (Fazel and Seewald, 2012; Higgins and Green, 2011).

3. Results

3.1. Description of included articles

The study selection process is shown in the Prisma Flow Chart (Fig. 1). The literature search yielded 3962 articles: 2169 from PubMed, 1125 from Scopus, 334 from Psychinfo, 296 from Embase, 32 from Web of Science; 6 additional articles were retrieved through manual searches (e.g., screening reference lists). After removing duplicates, 3389 were identified. Finally, after title-abstract and full-text revision, 55 publications were selected. The characteristics of the included papers can be found in Appendix A. Appendix H shows the complete reference list for the 55 included papers. Among the included 55 studies, 43 were on older prisoners, six on older forensic psychiatric offenders and six on older offenders who were under parole, probation sentence, ex-prisoners or with no specified imprisonment status. Most of the samples had a low proportion of females and just three of the included studies were carried out only on females (Handtke et al., 2015; Leigey and Johnston, 2015; Williams et al., 2006). The majority (n = 51) of the studies were carried out in European countries, United States of America, and Canada, except two studies conducted in Australia (D'Souza et al., 2005; Rodriguez et al., 2017), one in Nigeria (Majekodunmi et al., 2017), and one in Israel (Heinik et al., 1994). Only seven studies (Binswanger et al., 2009; Combalbert et al., 2016; Fazel et al., 2001; Greene et al., 2018; Koenig et al., 1995; Meyer, 2016; Williams et al., 2010b) included a comparison group of non-offender older adults. The methods for establishing the diagnosis of the outcomes were based mainly on the use of medical/jail records or a combination of the medical/jail records,

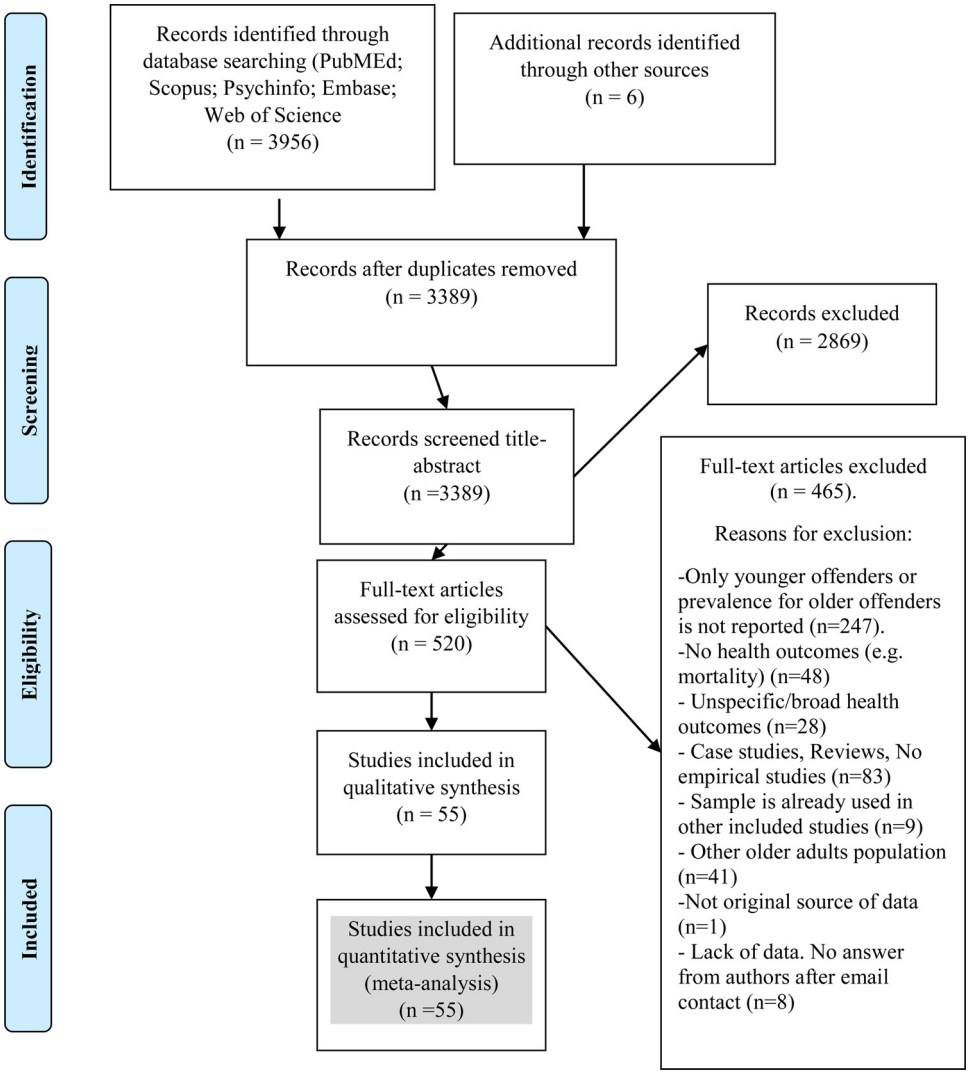

Fig. 1. PRISMA flow diagram that shows the selection process for the inclusion of the papers.

and a research diagnosis. Five studies (Maschi et al., 2017; Merten et al., 2012; Meyer, 2016; Williams et al., 2006, 2010a) based the diagnosis only on self-reports of health conditions.

We identified 25 different mental health problems from 40 publications and 34 different physical health problems from 36 publications. We found prevalence estimates in two or more studies for 72 % (18 outcomes) of the identified mental health problems and for 28 of the physical health outcomes (82 % of all the identified physical health problems). Only 32 % (eight outcomes) of the mental health outcomes and 29 % (ten outcomes) of the physical health problems were reported in more than ten publications. Table 1 highlights eight specific mental health problems and ten specific physical health problems that were the most frequently reported health outcomes, i.e., outcomes that were reported in ten or more publications. A complete list with the frequency (number of studies that provided prevalence rates) and the pooled prevalence of all the other mental and physical health outcomes that were meta-analyzed is reported in Appendix B.

Below, we present and discuss the results of the most frequently reported mental and physical health problems. This decision was taken after performing the systematic search and due to the large amount of different mental and physical health that were found in the included papers. Therefore, this decision was not pre-established in the PROSPERO protocol (see Appendix G for further clarifications).

3.2. Mental health problems

For older offenders, the pooled prevalence of the most frequently reported mental health problems (identified in ten or more publications) are shown in Fig. 2. The prevalence for these health problems ranged from 36.5 % for Alcohol abuse (95 % CI: 27.3, 46.8) to 5.3 % for Schizophrenia (95 % CI: 2.9, 9.6). Heterogeneity was significant for all the meta-analyses with I^2 values higher than 90 % (see Table 1 for all the Q and I^2 values). The forest-plots with the random-effects pooled prevalence and the papers included in the meta-analysis of each of these eight mental health problems are reported in Appendix C, Tables C.1–C.8.

In order to explain possible sources of heterogeneity, and to explore how different confounders affected the random-effects pooled prevalence of the different outcomes, we ran meta-regression and follow-up subgroup analyses. Our analyses revealed a significant effect of country, the method to establish the diagnosis, the gender and the sample type for Substance abuse, Alcohol Abuse, Personality Disorders, Depression, Schizophrenia, and Psychotic Disorders (see Table 2). The detailed results of the meta-regression and the forest-plots showing follow-up subgroup analyses are reported in Appendix E, Table E.1, Fig. E.1.

Finally, only two of the studies included a comparison group that allowed conducting a meta-analysis to explore the relative risk of depression among older adults with and without criminal history.

Table 1
Most frequently reported Health Outcomes. MH = Mental Health; PH = Physical Health. Cardiovascular diseases included Heart attack, Coronary disease in general or angina. Respiratory diseases included lung problems and respiratory disorders in general except asthma. Diabetes included any type of diabetes disorder.

Category	Health Problem	N of publications	Pooled Prevalence (95 % CI)	Heterogeneity		
				Q	P	I^2
MH	Depression	24 (Al-Rousan et al., 2017; Baillargeon et al., 2009; Brown and Brozowski, 2003; Caverley, 2006; Coid et al., 2002; Combalbert et al., 2016; Fazel et al., 2001a; Fitton et al., 2018; Gates et al., 2018; Greene et al., 2018; Hayes et al., 2012; Humphreys et al., 2018; Kingston et al., 2011; Koenig et al., 1995; Lewis et al., 2006; Majekodunmi et al., 2017; Murdoch et al., 2008; O'Hara et al., 2016; O'Sullivan and Chesterman, 2007; Regan et al., 2002; Rodriguez et al., 2017; Stoliker and Varanese, 2017; Williams et al., 2006, 2010a)	19.2 % (13.2, 26.9)	2268.54	< .001	98.98
MH	Alcohol Abuse	19 (Ahalt et al., 2018; Arndt et al., 2002; Bolano et al., 2016; Coid et al., 2002; Davoren et al., 2015; De Smet et al., 2016; Fazel and Grann, 2002; Fitton et al., 2018; Flatt et al., 2017; Gates et al., 2018; Greene et al., 2018; Hayes et al., 2012; Humphreys et al., 2018; Lewis et al., 2006; Moschetti et al., 2015; Putkonen et al., 2010; Rodriguez et al., 2017; Williams et al., 2014, 2010a)	36.5 % (27.3,46.8)	671.80	< .001	97.32
MH	Dementia	17 (Al-Rousan et al., 2017; Chodos et al., 2014; Combalbert et al., 2016; De Smet et al., 2016; Fazel and Grann, 2002; Fazel et al., 2001a; Hayes et al., 2012; Heinik et al., 1994; Kingston et al., 2011; Koenig et al., 1995; Lewis et al., 2006; McKinnon et al., 2017; O'Sullivan and Chesterman, 2007; Putkonen et al., 2010; Regan et al., 2002; Williams et al., 2010b, 2009)	6.9 % (3.3, 14)	961.77	< .001	98.33
MH	Schizophrenia	15 (Al-Rousan et al., 2017; Baillargeon et al., 2000, 2009; Caverley, 2006; Coid et al., 2002; Fazel and Grann, 2002; Kingston et al., 2011; Koenig et al., 1995; Lewis et al., 2006; Moschetti et al., 2015; O'Sullivan and Chesterman, 2007; Putkonen et al., 2010; Regan et al., 2002; Stoliker and Varanese, 2017; Williams et al., 2010a)	5.3 % (2.9,9.6)	1127.58	< .001	98.75
MH	Substance Abuse	14 (Ahalt et al., 2018; Al-Rousan et al., 2017; Bolano et al., 2016; Combalbert et al., 2016; Davoren et al., 2015; Fazel et al., 2001a; Fitton et al., 2018; Flatt et al., 2017; Hayes et al., 2012; Humphreys et al., 2018; Lewis et al., 2006; Moschetti et al., 2015; Williams et al., 2014, 2010a)	26.4 % (18.4, 36.5)	416.95	< .001	96.88
MH	Psychotic Disorders	12 (Al-Rousan et al., 2017; Baillargeon et al., 2009; Coid et al., 2002; Combalbert et al., 2016; Davoren et al., 2015; De Smet et al., 2016; Fazel and Grann, 2002; Fazel et al., 2001a; Fitton et al., 2018; Hayes et al., 2012; Heinik et al., 1994; Putkonen et al., 2010)	7.2 % (3, 15.9)	873.22	< .001	98.74
MH	Anxiety	11(Al-Rousan et al., 2017; Coid et al., 2002; Combalbert et al., 2016; Fitton et al., 2018; Gates et al., 2018; Hayes et al., 2012; Humphreys et al., 2018; Kingston et al., 2011; Koenig et al., 1995; Regan et al., 2002; Stoliker and Varanese, 2017)	10.2 % (2.7, 14.6)	157.47	< .001	93.65
MH	Personality Disorders	10 (Al-Rousan et al., 2017; De Smet et al., 2016; Fazel and Grann, 2002; Fazel et al., 2001a; Hayes et al., 2012; Heinik et al., 1994; Moschetti et al., 2015; O'Sullivan and Chesterman, 2007; Putkonen et al., 2010; Stoliker and Varanese, 2017)	17.8 % (11.3, 26.7)	241.58	< .001	96.27
PH	Hypertension	28 (Ahalt et al., 2018; Baillargeon et al., 2000; Beaufrère et al., 2014; Beaufrère and Chariot, 2015; Binswanger et al., 2009; Bolano et al., 2016; Chodos et al., 2014; D'Souza et al., 2005; De Smet et al., 2016; Gates et al., 2018; Greene et al., 2018; Harzke et al., 2010; Hayes et al., 2012; Humphreys et al., 2018; Lewis et al., 2006; Loeb and Steffensmeier, 2006; Majekodunmi et al., 2017; Maschi et al., 2017; McKinnon et al., 2017; Merten et al., 2012; Meyer, 2016; Moschetti et al., 2015; Rodriguez et al., 2017; Williams et al., 2006, 2014; Williams et al., 2010b, 2009; Williams et al., 2010a)	42 % (37, 48)	3153.35	< .001	99
PH	Cardiovascular Diseases	26 (Ahalt et al., 2018; Baillargeon et al., 2000; Beaufrère et al., 2014; Beaufrère and Chariot, 2015; Binswanger et al., 2009; Bolano et al., 2016; Chodos et al., 2014; Davoren et al., 2015; Fazel et al., 2001; Gates et al., 2018; Greene et al., 2018; Handtke et al., 2015; Hayes et al., 2012; Humphreys et al., 2018; Lewis et al., 2006; Loeb and Steffensmeier, 2006; Maschi et al., 2017; McKinnon et al., 2017; Merten et al., 2012; Meyer, 2016; Moschetti et al., 2015; Williams et al., 2006, 2014; Williams et al., 2010b, 2009; Williams et al., 2010a)	18.5 % (15, 25)	979.48	< .001	97.44
PH	Diabetes	26 (Ahalt et al., 2018; Baillargeon et al., 2000; Beaufrère et al., 2014; Beaufrère and Chariot, 2015; Binswanger et al., 2009; Bolano et al., 2016; Chodos et al., 2014; De Smet et al., 2016; Gates et al., 2018; Greene et al., 2018; Harzke et al., 2010; Hayes et al., 2012; Humphreys et al., 2018; Lewis et al., 2006; Majekodunmi et al., 2017; Maschi et al., 2017; McKinnon et al., 2017; Merten et al., 2012; Meyer, 2016; Moschetti et al., 2015; Rodriguez et al., 2017; Williams et al., 2006, 2014; Williams et al., 2010b, 2009; Williams et al., 2010a)	16 % (14,17.8)	371.99	< .001	93.27
PH	Arthritis, Rheumatism or Osteoporosis (ARO)	16 (Ahalt et al., 2018; Baillargeon et al., 2000; Beaufrère et al., 2014; Binswanger et al., 2009; Bolano et al., 2016; Chodos et al., 2014; Greene et al., 2018; Hayes et al., 2012; Humphreys et al., 2018; Loeb and Steffensmeier, 2006; Maschi et al., 2017; Meyer, 2016; Williams et al., 2006, 2014; Williams et al., 2009, 2010a)	35 % (24, 48)	2015.72	< .001	99.25
PH	Cancer	14 (Ahalt et al., 2018; Beaufrère et al., 2014; Binswanger et al., 2009; Bolano et al., 2016; Greene et al., 2018; Humphreys et al., 2018; Lewis et al., 2006; Maschi et al., 2017; Merten et al., 2012; Meyer, 2016; Williams et al., 2006, 2014; Williams et al., 2009, 2010a)	7% (5, 8)	43.15	< .001	69.87
PH	Hepatitis C	12 (Ahalt et al., 2018; Baillargeon et al., 2000, 2008; Bolano et al., 2016; Chodos et al., 2014; Greene et al., 2018; Humphreys et al., 2018; Macalino et al., 2004; Merten et al., 2012; Moschetti et al., 2015; Williams et al., 2014, 2010b)	22 % (11, 39)	451,697	< .001	99.75
PH	Stroke	12 (Ahalt et al., 2018; Bolano et al., 2016; Chodos et al., 2014; De Smet et al., 2016; Greene et al., 2018; Humphreys et al., 2018; Lewis et al., 2006; Maschi et al., 2017; Williams et al., 2006, 2014; Williams et al., 2009, 2010a)	8% (6, 11)	67.72	< .001	83.75

(*continued on next page*)

Table 1 (*continued*)

Category	Health Problem	N of publications	Pooled Prevalence (95 % CI)	Heterogeneity		
				Q	P	I^2
PH	HIV	12 [c]Ahalt et al., 2018; Baillargeon et al., 2000, 2008; Bolano et al., 2016; Chodos et al., 2014; Greene et al., 2018; Humphreys et al., 2018; Macalino et al., 2004; Merten et al., 2012; Moschetti et al., 2015; Williams et al., 2014, 2010b[b]	3% (2, 5)	293.30	< .001	96.25
PH	Respiratory Diseases	11 [c]Bolano et al., 2016; De Smet et al., 2016; Fazel et al., 2001; Gates et al., 2018; Handtke et al., 2015; Harzke et al., 2010; Hayes et al., 2012; Lewis et al., 2006; Maschi et al., 2017; Moschetti et al., 2015; Williams et al., 2010b[b]	11 % (8, 15)	337.06	< .001	97.03
PH	Asthma	11 [c]Baillargeon et al., 2000; Beaufrère et al., 2014; Beaufrère and Chariot, 2015; Binswanger et al., 2009; Harzke et al., 2010; Hayes et al., 2012; McKinnon et al., 2017; Merten et al., 2012; Moschetti et al., 2015; Williams et al., 2006, 2010a[b]	9% (6, 14)	537.78	< .001	98.14

Although not statistically significant, older offenders showed a 2.2 higher relative risk (RR) (95 % CI: 0.87, 5.5) of depression than non-offender older adults.

3.3. Physical health problems

The pooled prevalence of the most frequently reported physical health problems (identified in ten or more publications) is shown in Fig. 3. Prevalence for these health problems ranged from 42 % for Hypertension (95 % CI: 37, 48) to 3 % for HIV (95 % CI: 2, 5). Heterogeneity was significant for all the meta-analyses with I^2 values higher than 80 % except for Cancer (I^2 = 69.87) (see Table 1 for all the Q and I^2 values). The forest-plots with the random-effects pooled prevalence and the papers included in the meta-analysis of each of these ten physical health problems are reported in Appendix C, Tables C.9–C.18.

Similarly to what was found for mental health problems, the meta-regression analyses showed a significant confounding effect of the country, the method to establish the diagnosis, the gender, and the sample type for Hypertension, Asthma, Hepatitis C, HIV and Arthritis, Rheumatism or Osteoporosis (ARO) (see Table 2). The detailed results of the meta-regression and the forest-plots showing follow-up subgroup analyses are reported in Appendix E, Table E.2, Fig. E.2.

Finally, we found that older offenders showed a significantly higher risk of having Hypertension (RR = 1.15, 95 % CI: 1.1, 1.2), Cardiovascular Diseases (RR = 1.24, 95 % CI: 1.09, 1.41), Diseases of the respiratory system (RR = 1.74, 95 % CI: 1.29, 2.35) and ARO (RR = 1.91, 95 % CI: 1.12, 1.25), in comparison to non-offender older adults. However, Cancer showed the opposite pattern of results (RR = .78, 95 % CI: .66, .91) (see Fig. 4). The forest-plots of each of these meta-analyses are reported in Appendix D.

4. Discussion

In this systematic review and meta-analysis, we aimed to qualitatively and quantitatively summarize the existing evidence around the mental and physical health conditions of older offenders. We found that the pooled prevalence of the eight mental and ten physical most common health problems ranged between 3 % and 42 % among this population group. We explored how the random-effect pooled prevalence of these outcomes was affected by the confounding effect of several variables. We provided evidence indicating that the prevalence of Hypertension, Cardiovascular diseases, Diseases of the respiratory system and Arthritis is higher in older offenders than in the general population.

The most frequently reported health problems for older offenders were Alcohol abuse, Substance Abuse, Depression, Personality Disorders, Anxiety, Psychotic Disorders, Dementia, Schizophrenia, Hypertension, ARO, Hepatitis C, Cardiovascular Diseases, Diabetes, Respiratory Diseases, Asthma, Stroke, Cancer and HIV, with prevalence rates ranging from 42 to 3 percent. These results are in line with previous studies showing an elevated burden of psychiatric disorders (Di Lorito et al., 2018b; Haesen et al., 2019; Skarupski et al., 2018) and non-communicable diseases (Munday et al., 2019; Skarupski et al., 2018) among older people in prisons.

In addition, we found that heterogeneity was significant for all the outcomes meta-analyzed. Heterogeneity has been a matter of debate for previous researchers in the area (Fazel et al., 2016; Munday et al., 2019). It has been suggested that the observed prevalence rates of each study might be determined by methodological factors such as the diagnostic assessment tool and diagnostic criteria, the definition or nomenclature of the health problems, or the selected age cut-off for being considered older. Inconsistencies in these methodological factors across studies made it difficult to compare and pool together the estimates from different studies, to interpret them, and therefore, to accurately inform the research community and policy makers about the health

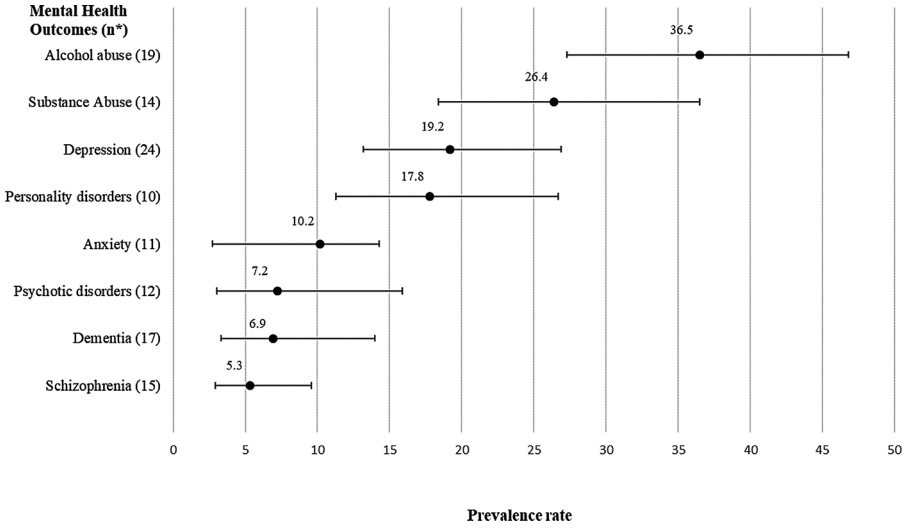

Fig. 2. Overall pooled prevalence for most frequently reported Mental Health Outcomes. Note: n* = number of studies included in the meta-analysis of the outcome. The forest plots with the prevalence rates for each study, the pooled prevalences for the meta-analysis of each mental health outcome and the heterogeneity measure (I^2) are reported in Appendix C, Tables C1–C8.

problems of this population. Thus, in an attempt to explain possible sources of the heterogeneity and reporting more adjusted pooled prevalence, we employed meta-regression and sub-groups analyses to investigate the potential confounding effect of country, diagnostic assessment method, sample type, gender, and age of the sample. Our findings suggest that European in comparison with North-American countries showed significantly higher rates of depression, schizophrenia and personality disorders, whereas we found the opposite pattern of results for substance abuse and hypertension. Furthermore, for those outcomes where there was a confounding effect of the diagnostic assessment method, significantly lower prevalence rates were found for substance abuse, depression, hypertension, asthma, hepatitis C and ARO, when the diagnosis of the health problem was based only on medical or jail records in comparison with other assessment methods. These differences are consistent with previous research showing that the prevalence rates of chronic disorders in older adults varied depending on whether they were based on medical records or other assessment methods such as self-report, which tend to overestimate the prevalence (Galenkamp et al., 2014). In addition, the results of our analyses also indicate that forensic psychiatric offenders showed a higher prevalence of psychotic disorders and schizophrenia than non-forensic prisoners, and it seems that the prevalence of hypertension was higher in prisoners than in older offenders under parole, probation sentence, ex-prisoners or when the imprisonment status was not mentioned.

Nevertheless, we are aware that other variables may also affect the prevalence of the health problems studied. In fact, we also aimed to identify and explore other sources of variability across the included studies that may influence the reported prevalence rates, but, unfortunately, there were not enough data in existing studies to include them as confounders. For instance, we lacked information about the types of crimes committed by the individuals included in the studies, the previous medical history, the length of the sentence, the socio-economic and educational level, among other risk factors that were not always reported or analyzed by the included studies. In addition, it may be possible that some interaction effects among confounders exist. Therefore, even though our findings provided different prevalence rates for the mental and physical health problems depending on the country,

Table 2
Meta-regression analyses for mental health and physical health outcomes. Separate meta-regression analyses were ran for each confounder and outcome. MH = Mental health.PH = Physical health. a. Test of the model: Simultaneous test that all coefficients (excluding intercept) are zero. b. Goodness of fit: test that unexplained variance is zero. c. Total between-study variance (intercept only). *** $p < 0.001$; ** $p < 0.01$; *$p < 0.05$. Only variables where the meta-regression showed a significant effect are presented in the table.

Category	Outcome	Confounder	Model[a]		Goodness of fit[b]		Total[c]		R^2
			Q	Df	Q	Df	Q	Df	
MH	Substance abuse	Country	10.13***	1	407.21***	12	416.96***	13	0.43
		Diagnosis Method	51.13***	3	130.58***	10	416.96***	13	0.38
		Gender	8.58**	1	399.97***	12	416.96***	13	0.38
MH	Alcohol Abuse	Gender	5.56*	1	304.44***	17	671.81**	18	0.24
MH	Personality Disorders	Country	19.94***	2	67.14***	7	241.59***	9	0.73
MH	Depression	Country	13.59**	2	14.96***	21	2268.54***	23	0.38
		Diagnosis Method	22.37***	3	1094.05***	20	2268.54***	23	0.51
		Gender	19.89***	2	1263.37***	21	2268.54***	23	0.48
MH	Schizophrenia	Country	7.03***	1	267.78***	13	1127.58***	14	0.38
		Sample Type	27.42***	1	194.17***	13	1127.58***	14	0.70
MH	Psychotic Disorder	Sample Type	27.88***	2	101.40***	9	873.22***	11	0.79
PH	Hypertension	Country	16.51***	2	2975.34***	25	3153.35***	27	0.39
		Diagnosis Method	10.99*	3	3045.64***	25	3153.35***	27	0.3
PH	Asthma	Diagnosis Method	50.35***	3	33.84***	7	537.78***	10	0.9
		Gender	12.31**	2	91.42***	8	537.78***	10	0.62
PH	Hepatitis C	Diagnosis Method	35.75***	3	3631.59***	8	4516.98***	11	0.76
PH	HIV	Diagnosis Method	87.05***	2	57.89***	9	293.3	11	0.93
PH	Arthritis, Rheumatism or Osteoporosis (ARO)	Diagnosis Method	19.75***	2	329 − 53***	13	2015.72***	15	0.6
		Sample Type	15.11***	1	1994.09***	14	2015.72***	15	0.47

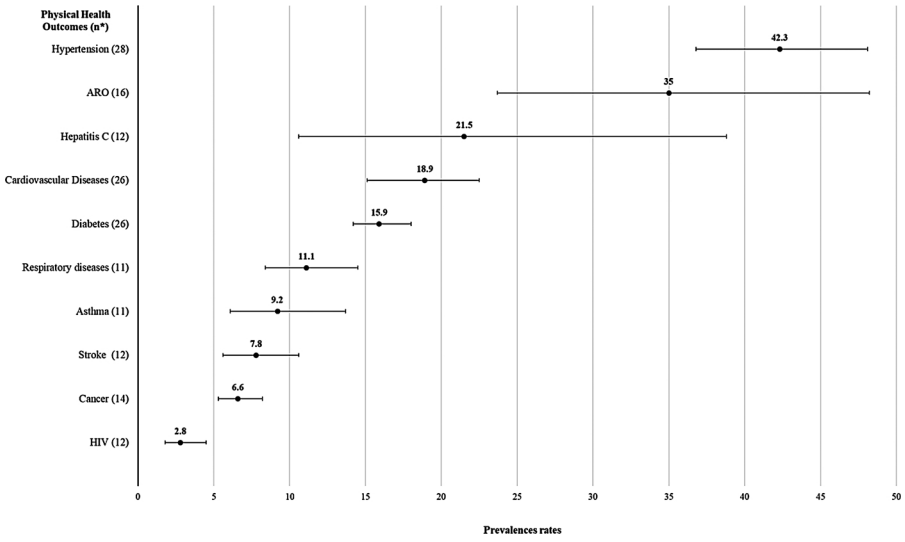

Fig. 3. Overall pooled prevalence for most frequently reported Physical Health Outcomes. Note: n* = number of studies included in the meta-analysis of the outcome. The forest plots with the prevalence rates for each study, the pooled prevalences for the meta-analysis of each physical health outcome and the heterogeneity measure (I^2) are reported in Appendix C, Tables C9–C18.

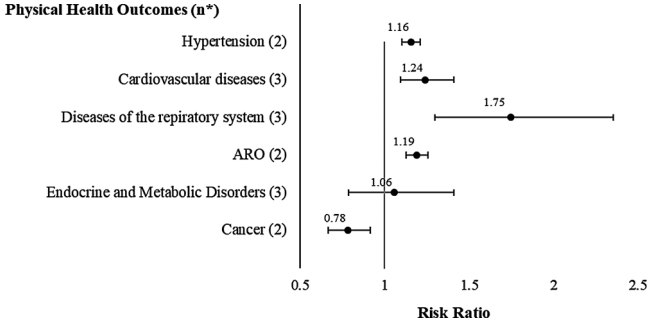

Fig. 4. Risk Ratios physical health outcomes. Note: n* = number of studies included in the meta-analysis of the outcome. ARO = Arthritis, Rheumatism or Osteoporosis. The forest plots, the risk ratio for each study, the overall risk ratio for each outcome and the measure of heterogeneity (I^2) for the meta-analysis of each physical health outcome are reported in Appendix D.

the assessment methods, the characteristics of the sample, and gender, these results should be interpreted carefully because methodological differences among the studies, interaction effects or other no controlled confounders might also affect the prevalence rates. Future studies should include more homogeneous samples and diagnostic assessment methods, but should also control for possible confounding effects of different individual, social and demographic risk factors.

One of our main goals with this systematic review was to understand if the most common health problems of older offenders differed from the health problems of older adults in the general population, and if they showed a special pattern of health needs. However, due to the limited number of studies reporting prevalence and including a comparison group of older adults without criminal history, risk ratios were only calculated for Depression, Hypertension, Cardiovascular Diseases, Endocrine and Metabolic disorders, Diseases of the respiratory system, ARO, and cancer. In comparison with non-offender older adults, older offenders showed a significantly higher risk of exhibiting Hypertension, Cardiovascular Diseases, Diseases of the respiratory system and ARO. Except for cancer, this pattern of results is consistent with previous research indicating a higher burden of diseases in prisoners in comparison with the general population (Fazel et al., 2001, 2016; Munday et al., 2019). Previous studies have also shown that mental health problems are overrepresented in prison populations (Fazel et al., 2016; Fazel and Seewald, 2012). Although not significant, our results showed a higher risk for depression among older offenders, but we were not able to calculate risk ratio estimates for the other reported mental health outcomes.

According to the World report on Ageing and Health (WHO, 2015) the most common health problems in older adults include cardiovascular diseases, osteoarthritis, pulmonary disease, diabetes, depression, and dementia. The prevalence rates of the most common mental health problems for adults older than 65 years old in the community fluctuate between 2–10 % for depression, between 6–10 % for anxiety and between 5–8 % for dementia (WHO, 2015, 2017a). The World Health Organization also estimates that approximately 1% of adults older than 65 years old present substance abuse problems. Based on the existing evidence, it seems that older offenders show a more complex combination of mental and physical health problems that lead to a higher burden of health conditions in comparison with older adults in the general population.

4.1. Limitations and future lines of research

Our systematic review highlighted several limitations to be addressed in future research. First, we assessed study quality and risk of bias using the JBI assessment tool where critical appraisal is evaluated for each individual publication. All the selected studies showed good study quality and low levels of risk of bias. However, methodological differences between studies are not appraised by this tool. These methodological differences across included studies might entail a main difficulty when pooling together the estimates of the respective health problems. For instance, studies differed in the diagnostic assessment method and diagnostic criteria to establish the health outcomes, the health problems nomenclature was not always well defined by the studies or it was inconsistent among studies, and the selected age cut-off for being consider older prisoner or offender varied between fifty, fifty-five, sixty and sixty-five years old. In addition, we lacked information about the type of prisoners included in some of the studies. Therefore, it is important to consider the possibility that some of the prisoners included in the publications might not have been older offenders convicted of a crime but older adults charged for crime and waiting for the sentence. Over the last years, there has been an increased interest in the study of older prisoners and offenders from different research disciplines (e.g., criminology, psychology, health science). Each discipline has approached the study of this population from its own theoretical and practical paradigms, which may explain the methodological inconsistencies found across studies. Hence, this area of research should face the challenge of developing a more common multidisciplinary methodological framework to support future studies on the health and needs of older offenders.

Secondly, little research has been conducted from a longitudinal perspective thus not exploring how lifespan risk factors may affect the

health of older adults with criminal history. Actually, due to the lack of consistent information among the reviewed studies, we could not include these factors as confounder variables in our analyses. Ageing is just possible to reach after living throughout childhood, adolescence, and adulthood life experiences. Thus, in order to understand ageing, studies should follow a life-course theoretical framework where ageing cannot just be described as a chronological age stage, but as a life process made up of biological, psychological and social experiences, which may affect health and the subjective perception of ageing (Settersten and Godlewski, 2016). In criminology, life-course theories have also tried to explain the stability of deviant and criminal behavior taking into account the importance of the sequences of transitions (life-events) and long-term patterns of ill-adjusted behavior (Sampson and Laub, 2001). In this line, theories of cumulative disadvantages, developed within sociological (see Settersten and Godlewski, 2016), psychological (Brown, 2010), and criminological (Sampson and Laub, 2001) research, claim that to understand later-life trajectories, we need to consider several different variables that may contribute to this cumulative disadvantage in ageing. In fact, a life of criminal behavior is associated with risk factors that interact with each other along the life of offenders, creating a loop of unhealthy and unadjusted psychosocial habits. This may influence not just the chances of perpetuating criminal behavior patterns but also of developing mental health, physical health and psychosocial problems in later life stages. For instance, poor-family structure, peer rejection, academic failure during childhood, or mid- to late-life low sociodemographic and mental health status, are some of the risk factors that offenders face along their life (Corovic et al., 2017), and therefore needs to be incorporated to the study of health, ageing, and criminal behavior.

Finally, few studies included a comparison group of non-offender older adults. Based on the existing literature we were able to report a tendency showing that the risk for several health problems in older offenders differed and was slightly higher than in the general older population. However, we lacked information to delve into the reasons that might explain this pattern of results. Additional studies including a comparison group of older adults without criminal history are needed. Understanding whether there are special health needs among older offenders may be a fundamental issue for policy makers and public health care services. This will allow to create accurate medical treatments, to adapt prison physical and social environments, and to develop adjusted intervention programs for this special ageing population.

5. Conclusions

To the best of our knowledge, this is the first systematic review and meta-analysis reporting both mental and physical health problems of older offenders. We found an elevated burden of health problems and a diverse profile of mental and physical health outcomes in older offenders and prisoners. In addition, and despite the limited number of available studies that compared health problems of older adults with and without criminal history, we provide some evidence showing that the prevalence of Hypertension, Cardiovascular diseases, Diseases of the respiratory system and Arthritis is higher in older prisoners and offenders in comparison with older adults in the general population. We also found that heterogeneity was significant across all the meta-analyzed health problems, which was partially explained by the confounding effect of the country where the study was conducted, the diagnosis assessment method that the studies used, and the type of older prisoners and offenders included in the sample. However, the effect of these variables should be interpreted with caution because interaction effects among these confounders or the confounding effect of uncontrolled variables (e.g., type of crime, length of sentence, previous health problems) could also explain part of our results.

More research is needed including a comparison group of non-offender older adults in order to explore whether older prisoners and offenders represent a special and vulnerable ageing group. This may help to develop accurate and adapted interventions for this population. Future research may also focus on developing more studies controlling for the influence that the offender´s trajectory, the type of crime or the accumulation of risk factors across the lifespan may have on the health, cognitive and psychosocial needs of older offenders.

Funding

This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 754285.

Declaration of Competing Interest

C. Solares does not declare any competing interest.

M. Dobrosavljevic does not declare any competing interest.

Professor H. Andershed does not declare any competing interest.

Professor H. Larsson has served as a speaker for Evolan Pharma and Shire and has received research grants from shire; all outside the submitted work.

Professor S. Cortese declares no competing interests in relation to this manuscript.

Acknowledgements

The authors acknowledge the librarians at the Main Library of Örebro University, Sweden, who helped to develop and design the search strategy for electronic search. The authors also thank Dr. Adrian Meehan, affiliated researcher at the School of Medical Sciences, Örebro University, who assisted with guidance on how to classify, group and organize the physical health problems reported in the included review.

Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.neubiorev.2020.07.043.

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