Review Article

Cardiovascular Risk Factors Among Prisoners

An Integrative Review

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ABSTRACT

Background and Aim: Incarceration is characterized by inequalities in disease burden and an increased risk for cardiovascular disease (CVD). The aim of this review was to critique published empirical research studies on cardiovascular risk factors among prisoners and to summarize and synthesize current knowledge and findings across these studies.

Design and review method: An integrative review of the studies was conducted. Cooper's five stage method was used as a framework to guide data collection, analysis, and synthesis. Quality appraisal of retrieved studies was done using a combined evaluation tool for quantitative research studies and a checklist. The following databases were searched: CINAHL, MEDLINE, PubMed, Cochrane, Indigenous Studies Portal (iPortal), Native Health Database, Criminal Justice Abstracts, and PsychInfo using keywords. Inclusion criteria were used to select published papers.

Results and Conclusion: A total of 12 studies that met the inclusion criteria were identified and analyzed. Hypertension, among other CVD risk factors such as smoking, physical inactivity and obesity, was one of the three most common CVD risk factors found in prisoners. Women and young offenders had a higher prevalence of hypercholesterolemia. Identifying prevalent risks factors among prisoners might influence the development of CVD prevention strategies that are specifically directed to at risk prisoners.

KEY WORDS:

cardiovascular disease; cardiovascular risk factors; incarceration; integrative review hypertension; prisoners

Introduction

Globally, cardiovascular disease (CVD) is increasing and among the leading causes of death and disability. In 2008, an estimated 17.3 million people died from CVD worldwide, attributing to almost 30% of all deaths. Approximately 80% of deaths from CVD occur in lower- and middle-income countries. Although a decline has been observed in the incidence rates of CVD in developed countries, evidence shows that CVD is on the increase in developing countries. It is estimated that in 2030, almost 23.6 million people will die from CVD (Mendis, Puska, & Norrving, 2011). Lifestyle, behavioral risk factors (Cottrell, 2007), as well as knowledge about CVD (McDermott et al., 2003) does impact on the incidence and mortality rates of CVD among people. Risk factors for CVD are broadly classified as traditional and emerging risk factors for CVD. The traditional risk factors further distinguished as modifiable risk factors (e.g., hypercholesterolemia, hypertension, smoking, physical inactivity; Anand et al., 2003), and nonmodifiable risk factors (e.g., gender, heredity, and age). Some of these risk factors for CVD, such as metabolic syndrome (Malik et al., 2004) have been associated with an increased mortality risk.

Evidence of additional CVD risk factors beyond traditional risk factors is mounting in the literature. In recent years, a number of emerging risk factors and in particular biochemical markers, have been proposed to be either associated with CVD or is a significant predictor of atherosclerosis, the primary pathogenic mechanism for CVD. Included among these emerging risk factors that are linked to CVD include C-reactive protein (CRP), lipoprotein, fibrinogen, homocystine (Gleeson & Crabbe, 2009; McDonald,

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Maguire, Duarte, Wang, & Hoy, 2005), vitamin D deficiency (Wang et al., 2008), periodontal disease and dental hygiene (Frisbee, Chambers, Frisbee, Goodwill, & Crout, 2010; Helfand et al., 2009). In addition, the link between psychosocial and socioeconomic factors with CVD (Anand et al., 2001) has also been explored. These preceding findings have implications for preventive health service in correctional environments, known for their high incidence of stress, mental health challenges, and serious oral diseases among prisoners (McGrath, 2002; World Health Organization, 2007). Population subgroups, such as ethnic minorities (Chiu, Austin, Manual, & Tu, 2010), women (Gleeson & Crabbe, 2009) and prisoners (Binswanger, Krueger, & Steiner, 2009) all seem to carry a disproportionate burden of CVD.

A history of incarceration has been independently associated with disparities in access to health care and chronic diseases (Agozino & Volpe, 2009). The prison environment contributes to stress, which in turn leads to a variety of physical and psychological reactions such as depression, hopelessness, anxiety, nervousness, and hypertension, all factors associated with the pathogenesis of CVD (Sethness, Rauschhuber, Gilliland, Lowry, & Jones, 2005). Studies in the U.S. (Loeb & Steffensmeier, 2006), the UK (Payne-James et al., 2010), and Australia (Kariminia, Butler, & Levy, 2007) addressing the health of incarcerated people have demonstrated that CVD is a common health problem among prisoners and that they are disproportionately affected by it compared with the general population. In an integrative review, Loeb and AbbuDagga (2006) found that CVD was among the most commonly reported health conditions in older prisoners. CVD among prisoners is also associated with a high mortality rate (Kulkarni, Baldwin, Lightstone, Gelberg, & Diamant, 2010), which in some instances exceeds national averages in some parts of the world, such as North America (Wobeser, Datema, Bechard, & Ford, 2002). In the U.S., between 2001 and 2009 CVD accounted for 26% of all deaths and together with cancer (23%) is regarded as the single cause of illness-related deaths in prisons (Noonan & Carson, 2011; Binswanger et al., 2007). CVD among prisoners accounts for almost 34% of deaths and is one of the most common causes of death among prisoners (Grant et al., 2007) in places such as Canada (Wobeser, Datema, Bechard, & Ford, 2002); Europe (Verger, Rotily, Prudhomme, & Bird, 2003); Russia (Bobrik, Danishevski, Eroshina, & McKee, 2005); Australia (Hobbs et al., 2006; Kariminia, Butler, Jones, & Law, 2012); and New Zealand (Tobias & Turley, 2005).

In addition, a number of studies that have investigated the prevalence of lifestyle behaviors among prisoners such as smoking or tobacco use (Belcher, Butler, Richmond, Wodak, & Wilhelm, 2006), exercise or the lack thereof (Cashin, Potter, & Butler, 2008), obesity (Leddy, Schulkin, & Power, 2009), and psychological factors (Kang, Bullman, & Taylor, 2006) demonstrated alarming high incidence rates of these behavioral factors. These studies are predominantly from North-American countries and Australia and very few have specifically investigated the link between these behavioral and lifestyle factors and CVD risk. Prisoners, by virtue of particular characteristics and conditions in prisons, seem to be at a significantly higher risk for CVD risk factors. Thus, in response to the noticeable gap in the knowledge about cardiovascular risk factors among prisoners, this literature review has been undertaken to establish the current state of CVD risk factors among prisoners.

Cardiovascular Risk Factors

Cardiovascular risk factors were defined broadly, as inclusive of bio-psychosocial and economical risk factors, which contribute to or are associated with CVD.

Prisoners

The definition of prisoners included inmates, offenders, and/or people incarcerated or held in community jails, facilities, and or prisons.

The Review

Aim

The aim of this review was to critique published empirical research studies on cardiovascular risk factors among prisoners, and to summarize and synthesize current knowledge and findings across these studies.

Design

An integrative review was carried out. An integrative review according to Whittemore and Knafl (2005) can be seen as "a specific method that summarizes past empirical or theoretical literature to provide a more comprehensive understanding of a particular phenomenon or health problem" (p. 546). This approach was appropriate and relevant as it allowed the inclusion of studies with diverse methodologies in the same review (Cooper, 1989). Accordingly, Cooper's five-stage method for integrative reviews provided a framework for data collection, analysis, and synthesis. The following steps were used in this integrative review: identification of the research problem, literature search, data evaluation, data analysis, and presentation of results. Given the requirement for methodological rigor that research reviews should meet, strategies to enhance the rigor of integrative reviews by Whittemore and Knafl (2005) were adhered to.

Sample and Inclusion Criteria

Inclusion criteria included: (1) CVD risk factors among prisoners; (2) empirical research studies; (3) published in English language; (4) in peer-reviewed journals; (5) during

the period 2000–2011. Due to the multidisciplinary interest in the health of prisoners, peer-reviewed literature from the disciplines of nursing, medical, social, epidemiological, corrections, and forensic sciences were included.

Databases Searched

The multidisciplinary interest in the health of inmates necessitated an exploration of a variety of databases, such as CINAHL, MEDLINE, PubMed, Google Scholar, Cochrane, Indigenous Studies Portal (iPortal), Native Health Data base, Criminal Justice Abstracts, and PsychInfo. The search used key terms, such as cardiovascular risk factors, prisoners, offenders, inmates, prison, incarceration, jail, or correctional facility.

Search Outcome

The original search resulted in 1088 hits that had the key words reflected either in the title and/or abstract (see Figure 1). These located studies spanning the period 2000–2011 included 751 hits in CINAHL, 11 in MEDLINE, 22 in PubMed, 206 in PsychInfo, 86 in Criminal Justice Abstracts, 4 in Native Health Data base, 8 in Google Scholar, and none for Cochrane and iPortal: Indigenous Studies Portal, respectively. After duplicates were excluded, the titles and abstracts of 702 studies were screened to determine relevance, 543 studies were discarded as not being directly relevant to the review as they were not concerned with incarcerated subjects, leaving 159 studies for more detailed examination. The 159 studies were further examined to determine whether they met the inclusion criteria. After this review and with the exclusion of duplicate studies, a further 147 studies were excluded as they did not meet the inclusion criteria in terms of empirical nature, context or population and subject focus. One study (Mauri, Victòria Pardo, Solé, & Morgan, 2005) written in Spanish was also excluded. The authors acknowledge that this study may have provided some findings on the association between CVD risk and infectious disease among prisoners. A total of 12 studies were identified for appraisal and inclusion in this review. The second author confirmed that the chosen papers met the inclusion criteria and that those excluded did not.

Data Abstraction and Synthesis

Studies were synthesized under the following headings: author/country, design, aim/objectives/hypotheses/questions, key concepts, sample size, population, data collection and analysis, main findings, limitation/rigor and comments (see Supplemental Digital Content 1, http://links.lww.com/JFN/A0)

Quality Appraisal

Assessing the quality of sources in an integrative review is a complex and challenging process due to the diversity of studies, and the fact that there isn't a gold standard for evaluating and interpreting quality in research reviews (Whittemore & Knafl, 2005). In this vein, Cooper (1989) suggests that extraction of particular methodological characteristics of primary studies should be used to evaluate overall quality of the studies. To facilitate critical examination and evaluation, each paper in this review was appraised using an evaluation tool that is a combination of an evaluation tool for quantitative research studies (Health Care Practice Development Unit, 2005) and a checklist (Bowling, 2002). Along with other indicators, Bowling's tool involves identifying clear aims and objectives, checking that the study design was adequately described, that the results were clear, and that the discussion did not draw conclusions beyond the limits of the study. The combined tool contained the following indicators: study evaluation overview; study setting and sample; ethics; group comparability and outcome measurement; policy and practice implications; and other comments. Each study was summarized according to authors, year of publication, and location. The research process was critically appraised to determine whether the rigor of the study justified its inclusion.

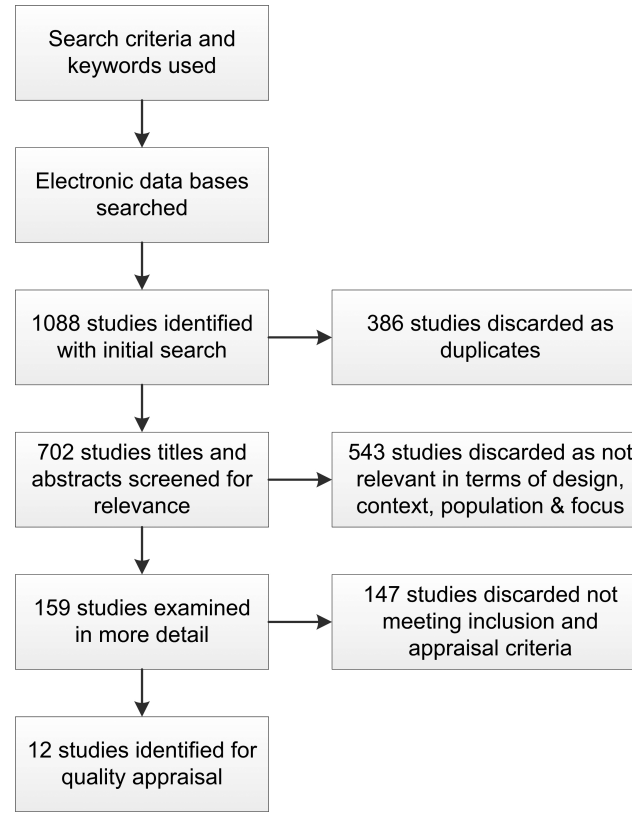

FIGURE 1. Flow chart of literature review.

Results

The results of the integrative review reported here include a summary of the methodology of the studies reviewed as

well as the findings related to the CVD risk factors among prisoners. Using the inclusion criteria as discussed previously, 12 (n = 12) studies were eligible for review. Two of the 12 studies were reported in the form of a short correspondence or research letter but contain sufficient information about study design to be included in this review.

Geographical Distribution

CVD risk factors have been studied in different countries, geographical locations, physical settings, and populations. However, the majority of these studies looked at CVD risk factors in either hospitalized or nonhospitalized settings. Very few studies have been published on incarcerated populations. Hence, the 12 studies included in this review-incorporated research into cardiovascular risk factors among prisoners. Out of the 12 studies, most were from Australia (n = 4), followed by the U.S. (n = 3), Pakistan (n = 2), and then one each from the UK, Belgium, and Japan.

Study Designs

Studies were predominantly of an epidemiological nature. Of these, cross sectional survey designs were among the most common type of research design used to study CVD risk factors among prisoners. One prospective longitudinal design, two randomized controlled trials were also used.

Sampling

The sample included both male and female prisoners across a range of prison environments, including jails, prisons, and community custody facilities. Two studies had a male group only (Sazhin & Reznik, 2008; Richmond et al., 2011); two studies had female groups only (Khavjou et al., 2007; Plugge, Foster, Yudkin, & Douglas, 2009). The rest of the studies had representation of both genders however; the majority of study participants were male. Three of the Australian studies (D'Souza, Butler, & Petrovsky, 2005; Denney-Wilson, Kenny, Hardy, & Nelson, 2007; Richmond et al., 2011) compared data between Aboriginal and non-Aboriginal groups.

Measurement Instruments Used

The majority of studies made use of questionnaires to obtain biographical information, followed by bio-physical and anthropometric measures, and blood tests for serum nonrandom blood glucose and cholesterol panel to assess CVD risk factors. The CVD risk factors that were studied include hypertension (systolic and diastolic pressures), diabetes (serum nonfasting blood sugar) obesity (BMI), total cholesterol (cholesterol, low-density lipoproteins (LDL's), high-density lipoproteins (HDL's), and triglycerides), smoking and exercise.

Data Collection Methods and Data Analysis

The majority of studies used both descriptive and inferential statistics to analyze the data. Multiple regression analysis was the most common inferential statistical method used.

CVD Risk Factors and Incarceration

This review demonstrates that incarceration impacts the cardiovascular health of prisoners in significant ways and sometimes or often predisposes prisoners to particular health risks. CVD at 35% is one of three most prevalent health conditions found in prisoners, along with psychiatric (45%), musculoskeletal (24%), and respiratory diseases (15%) (Binswanger et al., 2007; Fazel & Baillargeon, 2011; Noonan & Carson, 2011). Evidence from a review of incarceration literature (Karaminia Butler, Jones & Law, 2012; Richmond et al., 2011; Wang et al., 2009), shows that prisoners are significantly affected by CVD risk factors and that some prisoner cohorts, such as women (SMR: 14.8, 95% CI: 8.0 to 27.7), older prisoners (Loeb & AbuDagga, 2006), young offenders (prevalence rates of 30% to 40%; Denney-Wilson et al., 2007) and some ethnic minorities, particularly Aboriginal and Black prisoners (Fazel & Baillargeon, 2011; Karaminia et al., 2012) are disproportionately affected. Furthermore, some literature demonstrates a significant association between an incarceration history and some CVD risk factors, such as incident hypertension among groups with a high prevalence of prior incarceration. Risk factors for CVD most prevalent among prisoners include: hypertension, smoking, physical inactivity and obesity, blood glucose and diabetes, hypercholesterolemia and diet, psychological stress and the role of inflammatory markers.

Hypertension

Hypertension was the most common CVD risk factor found among prisoners. Wang et al. (2009), using a multivariate logistical regression model to explore covariates of the associations of various CVD risk factors found that incarceration was significantly associated with incident hypertension (Hafizullah, Fawad, Saqib, Gul, & Jan, 2010). Even after adjusting for factors such as smoking, alcohol, illicit drug use, and family income the latter association remained significant (AOR 1.6 [CI, 1.0–2.6]; Wang et al., 2009). Relying on similar data using comparisons of prevalence estimates in two separate prisoner samples from 1996 and 2001, D'Souza et al. (2005) also found a statistically significant difference of a 3% higher prevalence for hypertension among prisoners in the 2001 group with a standardized morbidity ratio (SMR) of 1.7 (95% CI 1.39–2.18). Compared with the general population, prisoners were found to have a higher odds of hypertension (OR_{jail} 1.19, (95%

CI 1.08–1.31; OR_{prison} 1.17, (CI 95% 1.09–1.27). Furthermore, the data suggests that particular subgroups within prison samples are also at a significantly higher risk for incident hypertension, such as young offenders (AOR, 1.6 [95% CI, 1.0–2.6; Wang et al., 2009), African American men (AOR, 1.9 [95% CI, 1.1–3.5]); less educated people (Binswanger et al., 2009), Indigenous people (D'Souza et al., 2005), young women (OR 9.5 (95% CI, 3.3–27.1; AOR, 9.1 [95% CI, 3.1–26.3; $p \leq 0.001$) (Plugge et al., 2009). Thus, hypertension is an appropriate target for primary prevention efforts among at-risk prisoners, such as young offenders, and women prisoners, because such efforts have the potential of influencing the incidence and prevalence rates of several CVDs among them.

Smoking

Public health strategies and medical treatment have led to improved cardiovascular health among some populations of developed countries, like the U.S., Canada, and Australia resulting in lower mortality rates. One such strategy focusing on tobacco use in the general population as in Australia have lowered daily tobacco use to 17% (Richmond et al., 2010; Richmond et al., 2011). However, this trend is not reflected in some marginalized populations such as prisoners. Smoking was identified as the second most common cardiovascular risk factor among prisoners. Prisoner populations have a smoking prevalence that is up to three times that of the general populations with estimates ranging between 84 and 88% (Belcher et al., 2006; Hafizullah et al., 2010) and with 96% smoking rolled cigarettes (Richmond et al., 2011). A study by D'Souza et al. (2005) pointed out a SMR of 0.89 (95% CI, 0.83–0.96) in one prison sample. An Australian study (Belcher et al., 2006) found that the rate of smoking among prisoners was 1.5–2.5 times higher than the equivalent groups within the community. The mean age that the majority of prisoners had their first cigarette, was before the age of 15 years (Belcher et al., 2006) for men, and before 14.4 years for women (Plugge et al., 2009). The average tobacco use was 23.5 g/day, which amounts to an equivalent of just over 20 cigarettes.

Some studies (D'Souza et al., 2005; Plugge et al., 2009) demonstrated that smoking among certain prison subgroups such as women (mean 85.3% [95% CI, 81.9–88.1]) and Indigenous people (mean 82.3% [95% CI, 76.8–87.0]) also indicated a higher smoking prevalence. In a UK based study with a female sample, Plugge et al. (2009) indicated that Caucasian women younger than 30 years, those who left school aged 16 years or less, and those who were unemployed prior to imprisonment were all more likely to smoke. Belcher et al. (2006) using univariate analysis demonstrated that older inmates, those employed prior to incarceration and those with higher levels of education were all less likely to smoke, which is consistent with community data. In fact, Belcher et al. (2006) pointed out that "increased time in prison was associated with a reduced likelihood of being a smoker" (p. 347). Looking at the time of imprisonment and smoking, Plugge's et al. (2009) study demonstrated that the proportion of women smoking during their time of incarceration did not change much from the pre-imprisonment period (81.2%) compared to those still smoking 1 month after imprisonment (80.3%). In contrast, similar data from the U.S. (CASA, 2010) on tobacco use in inmates in the month of their arrest shows a reduced incidence of 37.8% for state inmates and 38.6% for federal inmates. Furthermore, tobacco use among state inmates and federal inmates who met clinical criteria for substance abuse disorders had even higher rates of 66.5% and 51.5%, respectively in the month of their arrest. Despite meaningful efforts to reduce the incidence of smoking among prisoners, smoking among particular prisoner subgroups such as women and young prisoners remains unacceptably high and poses not only a threat to their health, but also that of all other individuals among the correctional population. Efforts to reduce cigarette smoking in prisons need to take into consideration the specific factors influencing smoking habits in prisons. Thus, a more integrated and whole approach to the prevention and reduction of smoking in prisons among young offenders and women are of paramount importance.

Physical Inactivity and Obesity

International literature has provided indisputable evidence of the relationship between physical exercise and people's physiological health (Warburton, Nicol, & Bredin, 2006). Particularly with older people or those who are currently inactive, increasing the amount of regular physical exercise has been shown to have a positive relationship to decreased risk of developing a chronic illness, such as CVD (Mernitz & McDermott, 2004). The evidence in the literature on the levels of physical activity or inactivity among prisoners varied considerably. In their study, Cashin et al. (2008) found that 87% of men (n = 620) and 73% of women (n = 107) reported that they had exercised in a 4-week period. The mean (±SD, range) exercise time per week was found to be 73.2 (85.5, 0–621.4) minutes. Furthermore, only 66% of men (n = 471) and 51% of women (n = 75) in the same study re- ported daily exercises. Similar, low levels of physical activity in a cohort of a women only study (Plugge et al., 2009) were found. Hafizullah et al. (2010) also reported that in their study 71% of prisoners did not have a regular exercise schedule, which they hypothesized partly contributed to obesity among them.

The link between obesity, type 2 diabetes and CVD has been extensively studied in the landmark longitudinal,

multigenerational cohort study of CVD risk factors known as the Framingham Heart Study (FHS). This study demonstrated that the prevalence of obesity (BMI > 30 kg/m^2) has risen in the past 30–40 years from just a few percent to between 25 and 30% among men in the general population (Meigs, 2010). Findings in the reviewed literature on obesity among prisoners demonstrate that prison inmates compared to jail inmates had a significantly ($p < 0.001$) higher odds of obesity (AOR 1.14, 95% CI 1.04–1.25) or being overweight (AOR 1.19, 95% CI 1.09–1.29) (Binswanger et al., 2009). D'Souza et al. (2005) found that if a prisoner was classified as "obese," they had an eight times higher odds of having diabetes (OR 8.2, 95% CI 1.9–34.5). On the contrary, a UK study by Plugge et al. (2009) found that only 189 (44%) out of a sample of 430 women with data on BMI had a healthy BMI. In fact, this study points out that women tended to gain weight following imprisonment. Among those women ($n = 220$) still in prison after 1 month of imprisonment, they found a mean weight increase from 65.3 kg to 66.8 kg (mean change 1.5 kg, 95% CI 1.0–2.0; $p < 0.001$). At the start of their incarceration, 37.6% women in Plugge et al.'s study sample were overweight or obese and this percentage increased to 39.5% after 1 month of incarceration. Given mixed findings in the literature on the link between incarceration and obesity, highlights the need for further research in this area. However, that does not negate the possible benefits of structured exercise programs for cardiovascular health among prisoners. Anecdotal evidence in the literature has shown that short periods of exercise can be beneficial, however the lack of any large scale studies that examine the effect thereof on the incidence and extent of CVD risks among prisoners remains a matter for further investigation.

Blood Glucose and Diabetes

Metabolic syndrome, also known as insulin resistance is a cluster of abnormalities such as Type-2 diabetes and CVD risk factors that act synergistically to greatly increase the risk for CVD (Meigs, 2010). Insulin resistance has been linked to a number of cardiovascular risk factors, such as high very low density lipoprotein (VLDL), low HDL-C, and a shift in LDL particle size from large buoyant to small dense LDL (Lebovitz, 2005). The latter are powerful indicators of coronary heart disease. Although a causal relationship has not been established between hyperglycemia, diabetes and CVD, some evidence has shown an association between them. In the FHS metabolic syndrome has been shown to increase the 7–11 year risk for CVD in men by about threefold relative to those without metabolic syndrome, and for type 2 diabetes, the increase is about sevenfold (Meigs, 2010). Although CVD is not specific to diabetes, it is more prevalent among patients with type 1 or type 2 diabetes, than among those without diabetes. Over 80% of individuals with type 2 diabetes are overweight or obese and a similar percentage are insulin resistant (Lebovitz, 2005; Nathan et al., 2005).

A study by Binswanger et al. (2009), demonstrated after adjustment for age and sex, that jail and prison inmates had a higher odds of diabetes than non- institutionalized adults (OR 1.06, 95% CI; 0.92–1.23). In a study by D'Souza et al. (2005), Indigenous status among prisoners was associated with six times higher odds of having diabetes (OR 6.2; 95% CI 2.1–18.0) and two times higher odds for elevated random glucose (OR 2.4; 95% CI 1.2–4.8). If a prisoner was classified as "obese," they had an eight times higher odds of having diabetes (OR 8.2; 95% CI 1.9–34.5) and three times higher odds for elevated random glucose (OR 3.4; 95% CI 1.5–8.0). As age increased, there was a steep increase in the odds of diabetes and elevated random glucose. However, although this review of the literature demonstrates that prisoners have higher odds of hyperglycemia and diabetes, the link between incarceration, hyperglycemia, diabetes, and CVD among prisoners, remains unclear.

Although a pronounced and statistically significant relationship between incarceration and hypertension among African American men and less educated individuals, subgroups of the CARDIA study sample (Wang et al., 2009) was found, the results for diabetes (2% vs. 3%; $p = 0.81$) did not differ between participants with and without a history of incarceration, respectively. A limitation in the latter study pointed out a lack of information on the duration of incarceration, hence it cannot be stated with certainty that such observed differences are associated with incarceration or not. Furthermore, comparisons of the characteristics among incarcerated women were relative to other low-income and underinsured/uninsured women. Thus, further research, inclusive of multiethnic minorities and age groups are required to investigate the link between incarceration, diabetes, and CVD among prisoners.

Hypercholesterolemia and Diet

Evidence indicates that hypercholesterolemia, other lipids abnormalities and vitamin D deficiencies are associated and increasingly are regarded as an important risk factor for CVD (Stoney, 2003; Wang et al., 2008). Hypercholesterolemia is regarded as an independent CVD risk factor for both men and women. Although a causal relationship between hypercholesterolemia and incarceration are not evident in the literature, the WISEWOMEN study (Khavjou et al., 2007) found some significant differences (standard error, 2.95; $p < 0.01$) in the average total cholesterol levels among incarcerated and nonincarcerated participants. In addition, a study by Sazhin & Reznik (2008) also observed elevated serum cholesterol ≥5.1 mmol/L-1 (20%) and serum triglycerides ≥1.7 mmol/L-1 (18%) levels among forensic patients. Elevated mean blood cholesterol levels of

more than 180 mg/dL was also found among 37.9% of prisoners in a similar study by Hafizullah et al. (2010). Also, a study by D'Souza et al. (2005) found that participants in their study sample had high odds of hypercholesterolemia (OR, 1.5, 95% CI 0.8–2.9). A retrospective chart review by La Forest and Algozzine (2003) showed that 97% of individuals in their sample (n = 79) were being treated with a statin, a form of antihyperlipidemia therapy. In a study among young offenders, Denney-Wilson et al. (2007) concluded that risk factor prevalence for hypercholesterolemia among young offenders was extremely high compared with other published studies. In this study sample, over 40% of boys and over 20% of girls had low levels of HDL cholesterol ("good" cholesterol), with over 10% of boys and girls having elevated LDL cholesterol ("bad" cholesterol). In this vein, a contributing risk factor for the latter observations is found in the high prevalence rate for fatty liver disease among young offenders in this study. Almost 15% of boys and 30% of girls presented with raised alanine aminotransferase (ALT) levels, suggesting hepatic cellular injury.

In so far as diet is concerned, Plugge et al. (2009) found that women who were unemployed prior to imprisonment were significantly less likely to meet recommendations both before and after adjustment for all other factors. After 1 month in prison, fewer women were eating the recommended portions of fruit or vegetables per day (13.4% vs. 8.3%). In the WISEWOMEN study (Khavjou et al., 2007) it was found that a significantly higher percentage of incarcerated women (84.6%) than nonincarcerated women (53.6%) with high cholesterol were unaware of having hypercholesterolemia (AOR = 3.57; [95% CI, 1.14–11.23, $p < 0.05$]). Medication use for high cholesterol was 2.1% among incarcerated women and 18.6% among nonincarcerated women. Some research studies (Sioen et al, 2009; Deckelbaum & Akabas, 2006) have demonstrated that through simple adjustments in terms of diet, such as providing alpha-linolenic acid (ALA) through fortified food, and without many changes in the dietary habits of subjects, can have beneficial effects on some CVD risk factors such as lowering blood pressure and increasing good HDL cholesterol among a group of elderly prisoners. A study by Sioen et al. (2009), investigating the effect of an ALA enriched diet (n-3 fatty acids) among prisoners, that provided the opportunity to increase the intake of n-3 fatty acid and decrease the n-6/n-3 ratio, resulted in a decrease in diastolic blood pressure and an increase in the good HDL-cholesterol among nonsmoking individuals. Previous studies in the area of cardiovascular risk prevention demonstrated that serum lipid levels are reduced by physical training. More research is needed to identify the link between vitamin D deficiency and CVD risk among prisoners, as well as the effectiveness of novel dietary strategies and interventions on CVD risk factors and the health of at-risk incarcerated populations, such as young offenders, women, and elderly prisoners.

CVD Risk, Stress and Mental Health Disorders

Hummasti & Hotamisligil (2010) pointed out that prolonged elevated cortisol activation associated with stress can lead to blood sugar abnormalities, weight gain, higher blood pressure, hyperinsulinemia, hypercholesterolemia, and a plethora of other metabolic imbalances, the release of inflammatory neuropeptides, and other proinflammatory cytokines and mediators, all of which are associated with the pathogenesis of many health problems. Stress is implicated in the pathogenesis and development of both CVD and most mental health disorders, such as anxiety, depression and post-traumatic stress disorder (PTSD). The prison environment is associated with stressful situations that cause prisoners to experience a state of sympathetic stimulation, resulting in chronically increased cortisol amounts. A qualitative study (Nurse, Woodcock, & Ormsby, 2003) on the influence of environmental factors on the mental health of prisoners summarized the following key factors: isolation and lack of mental stimulation, drug misuse, negative relationships with prison staff, bullying, lack of family contact, and staff shortages as key factors. A study by Maschi, Morgen, Zgoba, Courtney, & Ristow (2011a) examining the relationship between age, objective, and subjective measures of trauma and stressful life events and post-traumatic stress symptoms among older prisoners, has shown that subjective impressions of traumatic and stressful life events over the past year, had a positive and significant relationship to current post-traumatic stress symptoms among prisoners. Age was found to have a significant and inverse relationship to subjective traumatic and stressful life events with younger prisoner participants reporting higher levels of cumulative traumatic and stressful life events and past year subjective ratings of being bothered by these events. Research evidence demonstrates that incarcerated populations have substantially higher prevalence rates of mental health and substance use problems often associated with the stress of incarceration, compared with the general population (Livingstone, 2009). Prevalence rates for mental illnesses such as mood and personality disorders among prisoners are estimated to be as high as 75% and are on the rise in many parts of the world (Fazel & Baillargeon, 2011; James & Glaze, 2006; WHO, 2007). Some evidence also demonstrates a link between CVD risk factors and mental health problems such as PTSD, which has been linked to hypertension, hyperlipidemia, and obesity (Coughlin, 2011). PTSD can be viewed as a prolonged stress reaction accompanied by neuroendocrine alterations and activation of inflammatory markers that could lead to the initiation and development of atherosclerosis and CVD. In so far as prison

populations are concerned, Goff, Rose, Rose, & Purves (2007) in a systematic review on PTSD show that PTSD rates among prisoners ranges from 4 to 21% and that women are disproportionately affected. A recent study (Reichert & Bostwick, 2010) on PTSD and victimization among female prisoners show that 83% of the sample reported being bothered by a PTSD symptom. A study by Maschi, Gibson, Zgoba, & Morgan (2011b) examining lifetime trauma and life events stressors among young and older prisoners demonstrated that approximately 40% of young and older adult prisoners reported exposure to violent victimizations. Sazhin and Reznik (2008) also found some evidence of CVD risk factors among forensic patients with major mental health disorders such as schizophrenia, delusional, and manic psychosis treated with antipsychotic medication such as olanzapine and clozapine. These drugs are known to be frequently associated with weight gain. The study showed that on admission 50% of 30 patients had weight gain of more than 90kg and seven (23%) of them weighed more than 100kg. The prevalence of hypercholesterolemia was as high as 53%; 84% of the patients smoked. These findings support previous studies (Mackin, Bishop, Watkinson, Gallagher, & Ferrier, 2007; Osborne, Nazareth, & King, 2006) that link cardiovascular risk factors among individuals with mental illnesses treated with antipsychotic medications. In so far as behavioral interventions for certain mental health disorders among prisoners is concerned, a study by Cashin et al. (2008) demonstrated a statistically significant correlation ($r = 0.079$, $n = 838$, $p < 0.02$) between total exercise time in minutes and hopelessness. An increase in self-reported exercise was demonstrated to be correlated with a decrease in feelings of hopelessness among participating prisoners. Hence, some nonpharmacological interventions for mental illnesses that are reported to show some positive outcomes might also be beneficial to CVD risk reduction. Thus, the preceding findings highlight the need for further research to investigate the link between incarceration, mental illness, and cardiovascular risk factors, including investigating the effectiveness of nonpharmacological risk reduction intervention measures on mental health challenges and CVD risk among prisoners.

CVD Risk Factors and the Prevalence of Other CVD Among Prisoners

Epidemiological research suggests that incarceration is associated with a greater prevalence of chronic medical conditions such as cardiovascular, pulmonary, muscular- skeletal disorders, cancer communicable and sexually transmitted infections, mental health disorders and poor oral health (Binswanger et al., 2009; Condon, Hek, & Harris, 2007; Williams, 2007). An Australian-based study by Richmond et al. (2011) showed that 39% of prisoners had three or more cardiovascular risk factors compared to 10% of the general community sample of most disadvantaged men of a similar age. Significantly more Aboriginal prisoners had three or more CVD risk factors than non-Aboriginal prisoners (55% vs. 36%, $p < 0.01$) and were twice as likely to have four or more CVD risk factors (27% vs. 12%). Jail and prison inmates had a higher burden of most chronic medical conditions than the general population even with adjustments for important socio-demographic differences and alcohol consumption (Binswanger et al., 2009). In as far as CVD is concerned and using multivariate logistic regression analyses, odds ratio's and 95% CI to estimate the strength of associations and adjusting for age and sex, studies by D'Souza et al. (2005) and Binswanger et al. (2009) demonstrated that prisoners had a higher odds for hypertension, angina, left ventricular hypertrophy, myocardial infarction than noninstitutionalized adults. With adjustments for confounding factors such as race, education, employment, birthplace, marital status, and alcohol consumption, persistent elevated odds of hypertension (AOR, 1.6 [95% CI, 1.0–2.5]) remained (Wang et al., 2009). However differences for diabetes, angina, and myocardial infarction were no longer significant (Binswanger et al., 2009). A limitation in the latter study is that inmates were typically young, and self-reports of chronic diseases were not validated with confirmatory testing. Under-reporting of these conditions among prisoners is possible as inmates may be less likely to get screened and diagnosed with certain conditions. For example, the study by Khavjou et al. (2007) demonstrated that incarcerated women with high cholesterol were less likely to be aware of their hypercholesterolemia than nonincarcerated women. A lack of awareness of one's risk factors for developing a particular disease can influence health-seeking behavior. Employing multivariable logistic regression and exploring covariates of the associations using staged models, but first accounting for demographics, clinical risk factors, and behavioral risk factors (drug use and excessive alcohol consumption) and then adding a measure of socioeconomic status, to examine an association between incarceration with end-organ damage related to hypertension, Wang et al. (2009) found that persons with an incarceration history had higher mean (SD) left ventricular mass index (54.0 [14.1] g/m^2 vs. 50.3 [12.9] g/m^2 [$p < 0.001$]) and were more likely to have left ventricular hypertrophy (LVH; 2% vs. 0.6%; $p = 0.005$). Prior incarceration was associated with LVH in unadjusted analyses. However, using Fisher exact, t, and $\times 2$ test as appropriate multivariable logistic regression models, found that for African American men and less-educated individuals, prior incarceration was also associated with LVH in both unadjusted and adjusted models. These results might be helpful in guiding CVD chronic disease prevention and management, the design of educational, risk-reduction, and lifestyle modification programs

for cardiovascular wellness. Furthermore, health interventions to improve CVD wellness should be considered of some at-risk subpopulations that are disproportionately over-represented and affected by CVD risk factors: marginalized and vulnerable ethnic minorities, low socioeconomic status, education, and women among others. Thus, further research of a multiethnic nature is needed to validate the incidence of chronic diseases among at risk prisoners and to tailor novel strategies and risk reduction interventions to improve their cardiovascular health.

CVD Risk Factors Awareness and Lifestyle Interventions Among Prisoners

Poor awareness by people of their risks of CVD and the importance of prevention and treatment of CVD risk factors may influence low rates of lifestyle interventions. Previous studies (Ara, 2004; Speceley, 2005) have demonstrated individuals' perceptions regarding their personal risks of adverse events or illnesses and the ability to forestall these adverse events, influenced the degree to which preventive health behaviors are adopted. Among prisoners, high self-efficacy levels associated with enhanced knowledge about one's risk for an adverse event (Loeb & Steffensmeier, 2006) has lead to better engagement with health promoting behaviors and improved health during incarceration. In a study comparing incarcerated women and nonincarcerated women, Khavjou et al. (2007) demonstrated that unawareness rates for hypertension were similar, but that a significantly higher percentage of incarcerated women (84.6%) than nonincarcerated women (53.6%) with high cholesterol were unaware of their condition (AOR, 3.57; 95% CI, 1.14–11.23, $p < 0.05$).

A Japanese study, (Nara & Igarashi, 1998) focused on female prisoners also demonstrated improvement in outcomes for blood pressure, total cholesterol, triglycerides, and body mass index (BMI) associated with light activity for a period of 30 minutes. These findings were even more significant among pre-menopausal women. A study by LaForest & Algozzine (2003) demonstrated that hyperlipidemia can effectively be managed among incarcerated individuals with a National Cholesterol Education Program ATP II goal attainment intervention. Medication compliance rates of 95% among subjects that followed this program were remarkably high. The WISEWOMEN study by Khavjou et al., (2007) reinforced the importance of lifestyle interventions by indicating that incarcerated women's attendance rates for such interventions were on average higher than that of nonincarcerated women (2 vs. 0.4, respectively, $p < 0.05$). They also demonstrated that intervention take-up rates for incarcerated women (53.3%) were higher compared with 22.6% among nonincarcerated women (AOR, 4.25; 95 CI, 3.15–5.72; $p < .O1$). The same high result was observed in terms of intervention completion rates of 42.5% among incarcerated women and 3.6% among nonincarcerated women (AOR, 21.41; 95% CI, 13.97–32.82; [$p < 0.01$]). Thus, increased prisoner education on the need to recognize their risk for CVD and enhance self-efficacy could strengthen the impact of cardiovascular risk reduction interventions on their health and well-being. Advantages of cardiovascular risk reduction programs must however go beyond prisoner awareness and education of issues pertaining to CVD risk factors only. Working with prisoners to increase their understanding of their roles and responsibilities in participating in available health promotion programs in prisons to improve their well-being, should be an important goal of any cardiovascular health promotion program.

Implications for Clinical Forensic Nursing Practice

First, the review of the literature on CVD risk factors among prisoners shows that incarceration is significantly associated with a higher incidence and prevalence of hypertension and left ventricular hypertrophy. Furthermore that hypertension as the most common CVD risk factor among prisoners affects some prison population subgroups such as some ethnic minorities, young offenders, elderly inmates and women disproportionately and places them at risk for developing it. Incarceration provides an opportunity to screen for complications, assess treatment needs and provide risk reduction lifestyle and behavior modification opportunities and health education tailored by the unique circumstances of these at-risk groups. Forensic nurses play an important role in the prevention of CVD and cardiovascular health promotion among prisoners. Cardiovascular Nurse-led screening, assessment and management for CVD risk factors and in particular hypertension among vulnerable at-risk prisoners is an important first step in the promotion of health. Therapeutic lifestyle changes, which are fundamental to the management of hypertension might help reduce the prevalence and incidence rates among prisoners. The knowledge and understanding gained through this review of the literature on the most prevalent and common risk factors for CVD among prisoners can be helpful to forensic nurses performing the initial screening, coupled with designing and implementing risk prevention strategies such as weight reduction, diet, and exercise strategies tailored to the correctional environment.

Second, smoking, despite some efforts to reduce in some parts of the world, remain unacceptably high among women and young offenders. Hence, efforts to reduce smoking in prisons should be more holistic and person- centered, targeting at-risk subgroups and with some due consideration of the factors influencing smoking habits among prisons. Person-centered lifestyle programmes, tailored to incarcerated circumstances that encourage cardiovascular risk prevention such as smoking cessation, healthy eating, and physical activity

might be beneficial. Also, it is important that prison population subgroups who are disproportionately affected by CVD risk factors have access to person-centered and culturally appropriate services during their incarceration. Since hypertension and smoking pose a serious risk to CVD as a leading cause of death among at-risk prison groups after release from prison, correctional settings should be part of a broader multilevel health quality improvement effort and strategy grounded with a whole-prison or setting approach (Binswanger et al., 2009, Karaminia et al., 2012, Richmond et al., 2011). The latter approach emphasizes the need to improve quality and continuity of CVD prevention and care outcomes through policies focusing on health promotion, including supportive health, disease prevention, health education, and other health promotion initiatives that address the needs of prisons and prisoners, through appropriate intersectorial partnerships and collaboration between correctional facilities and the healthcare sector among others, including the community. This in turn would require some leadership commitment and the more cost-efficient management of limited resources based on best practices grounded in evidence to appropriately redirect limited resources to focus on health screening, education and lifestyle intervention programs to prevent and manage risk factors among prisoners in a sustainable way (WHO, 2007). Forensic nurses are in a suitable position to collaborate with other health professionals, the community and researchers through appropriate institutional channels to advance quality evidence-informed CVD health promotion and care. This may require some capacity building focusing on building their skills and confidence, developing links and partnerships, ensuring that research on CVD risk management is close to practice, developing appropriate dissemination activities for risk reductions, lobbying and advocating for investing in infrastructure, and ensuring sustainability and continuity of CVD risk reduction and management intervention programs (Kettles & Walker, 2007).

Third, this review demonstrated mixed findings in the literature on the link between incarceration, obesity, hyperglycemia, diabetes, and CVD among prisoners, and remains unclear. Although the literature shows that some prisoner subgroups such as women, young offenders, ethnic minorities such as Blacks and Aboriginal peoples have a higher rates of hyperglycemia, obesity, or a high prevalence of hypercholesterolemia, the link thereof with incarceration remains a matter of much debate. This highlights the need for more multiethnic research studies with more powerful designs to investigate the effect of incarceration on these CVD risk factors. Attention should be paid to wider determinants of health in prison environments that address CVD risk, including emerging CVD risk factors. Given the high burden of mental health challenges among prisoners, there is also a need for further studies that investigate the link between mental health conditions, CVD risk factors, and incarceration among prisoners. Another much needed area for research is toward evidence on the outcomes of novel strategies and interventions to improve cardiovascular health and wellbeing among prisoners.

Finally, this review shows that some limited data on the impact that some lifestyle interventions such as simple adjustments in terms of diet, exercise, access to suitable treatment and high self-efficacy levels among prisoners can have beneficial effects on some CVD risk outcomes, such as lowering blood pressure and lowering cholesterol levels thereby lowering the incidence of CVD risk factors among prisoners. Hence, correctional institutions should be a focus of public health interventions and forensic nurses can play a central role in health teaching and health promotion with prisoners to help reduce their risk for CVD. This highlights a need for larger multicentered research studies investigating the effectiveness of preventative measures, lifestyle and behavior modification interventions on CVD health outcomes among prisoners. Specific attention should be paid to at-risk groups such as female and elderly prisoners, young offenders, and ethnic-minorities. Forensic nurse researchers also need to work and collaborate actively with staff to enable them to be involved in research activities that have relevance to their areas of practice. The reconfiguration of correctional risk prevention services, which requires a commitment of leadership at strategic levels, toward a more holistic model might work to promote modest interventions to address cardiovascular risk reduction, improvement in diet choices and diet quality, provide opportunity for physical activities and smoking reduction strategies, and ultimately reduce CVD risk among prisoners.

Conclusion

Incarceration provides a unique opportunity to educate, screen, and implement health promotion strategies among prisoners for CVD risk factors for which they are disproportionately affected. It is evident from this review that studies into the risk factors for CVD among prisoners predominantly looked at the more traditional risk factors for CVD and were also predominantly from developed countries. Studies into the risk factors for CVD among prisoners have often relied on secondary data for some risk factors rather than primary data. In fact, a number of studies (Hackman & Anand, 2003; Helfand, et al., 2009) cautioned against a more widely routine screening approach for some of the emerging risk factors, as their optimal use in both screening practices and risk stratification remain to be determined. Universal screening may not be cost-effective and might pose ethical challenges if it does

not add clinical benefit in all situations. More research is needed on the emerging risk factors for CVD particularly in more diverse settings that incorporate various population determinants, geographical regions and care situations, and consider prisoners at-risk for CVD.

Unlike many other high-risk populations, prisoners are in a unique position to be screened for chronic diseases and to access much needed CVD risk prevention programs and services. Indeed, reported CVD risk factors, such as hypertension, prevalence rates of smoking, physical inactivity, obesity, hypercholesterolemia, among others has a higher incidence and prevalence among prisoners relative to the general population. Nonetheless, the evidence also demonstrated that suitably tailored CVD risk factors preventive strategies or interventions can have positive outcomes. This review highlights the need for further research into the impact of CVD risk factors and prevention strategies on the health of prisoners, especially young offenders, older prisoners, and women.

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References

Agozino, B., & Volpe, S. (2009). Health inequalities in correctional institutions: Implications for health inequalities in the community. *Journal of Correctional Health Care*, *15*(4), 251–267. doi:10.1177/1078345809333407

Anand, S. S., Yusuf, S., Jacobs, R., Davis, A. D., Yi, Q., Gerstein, H., & Lonn, E. (2001). Risk factors, atherosclerosis, and cardiovascular disease among Aboriginal people in Canada: The Study of Health Assessment and Risk Evaluation in Aboriginal Peoples (SHARE-AP). *Lancet*, *358*, 1147–1153.

Anand, S., Yi, Q., Gerstein, H., Lonn, E., Jacobs, R., Vuksan, V., & Yusuf, S. (2003). Relationship of metabolic syndrome and fibrinolytic dysfunction to cardiovascular disease. *Circulation*, *108*, 420–425. doi:10.1161/01.CIR.0000080884.27358.49

Ara, S. (2004). A literature review of cardiovascular disease management programs in managed care populations. *Journal of Managed Care Pharmacy*, *10*(4), 326–344.

Belcher, J. M., Butler, T., Richmond, R. L., Wodak, A. D., & Wilhelm, K. (2006). Smoking and its correlates in an Australian prisoner population. *Drug and Alcohol Review*, *25*, 343–348. doi:10.1080/0959523060074 \ 1198

Binswanger, A., Stern, M., Deyo, R., Heagerty, P., Cheadle, A., Elmore, J., & Koepsell, T. (2007). Release from prison: A higher risk of death for former inmates. *New England Journal of Medicine*, *356*(2), 157–165. doi:10.1056/NEJMsa064115

Binswanger, I., Krueger, P., & Steiner, J. (2009). Prevalence of chronic medical conditions among jail and prison inmates in the USA compared with the general population. *Journal of Epidemiology and Community Health*, *63*, 912–919. doi:10.1136/jech.2009.090662

Bobrik, A., Danishevski, K., Eroshina, K., & McKee, M. (2005). Prison Health in Russia: The larger picture. *Journal of Public Health Policy*, *26*, 30–59. doi:10.1057/palgrave.jphp.3200002

Bowling, A. (2002). *Research methods in Health: Investigating Health and Health Services* (2nd ed.). Buckingham, UK: Open University.

Cashin, A., Potter, E., & Butler, T. (2008). The relationship between exercise and hopelessness in prison. *Journal of Psychiatric and Mental Health Nursing*, *15*, 66–71.

Chiu, M., Austin, P., Manual, D., & Tu, J. (2010). Comparison of cardiovascular risk profiles among ethnic groups using population health surveys between 1996 and 2007. *Canadian Medical Association Journal*, *182*(8), 1–10. doi:10.1503/cmaj.091676

Condon, L., Hek, G., & Harris, F. (2007). A review of prison health and its implications for primary health care nursing in England and Wales: the research evidence. *Journal of Clinical Nursing*, *16*, 1201–1209. doi:10.1111/j.1365–2702.2006.01799.x

Cooper, H. (1989). *Integrating Research. A guide for literature reviews* (2nd ed.). Newbury Park, California: Sage Publications.

Coughlin, S. S. (2011). Post-traumatic stress disorder and cardiovascular disease. *The Open Cardiovascular Medicine Journal*, *5*, 164–170.

Deckelbaum, R., & Akabas, S. (2006). n-3 Fatty acids and cardiovascular disease: Navigating toward recommendations. *American Journal of Clinical Nutrition*, *84*(1), 1–2.

Denney-Wilson, E., Kenny, D., Hardy, L., & Nelson, P. (2007). Associations between overweight and obesity and risk factors for cardiovascular disease and fatty liver in young offenders serving community orders. *Vulnerable Children and Youth Studies*, *2*(2), 165–172. doi:10.1080/17450120701335809

D'Souza, R., Butler, T., & Petrovsky, N. (2005). Assessment of cardiovascular disease risk factors and diabetes mellitus in Australian prisons: Is the prisoner population unhealthier than the rest of the Australian population? *Australian and New Zealand Journal of Public Health*, *29*(4), 318–323.

Fazel, S., & Baillargeon, J. (2011). The health of prisoners. *Lancet*, *377*, 956–965.

Frisbee, S., Chambers, C., Frisbee, J., Goodwill, A., & Crout, R. (2010). Association between dental hygiene, cardiovascular disease risk factors and systemic inflammation in rural adults. *The Journal of Dental Hygiene*, *84*(4), 177–184.

Gleeson, D., & Crabbe, D. (2009). Emerging concepts in cardiovascular disease risk assessment: Where do women fit in? *Journal of the American Academy of Nurse Practitioners*, *21*, 480–487.

Goff, A., Rose, E., Rose, S., & Purves, D. (2007). Does PTSD occur in sentenced prison populations? A systematic literature review. *Criminal Behaviour and Mental Health*, *17*, 151–162. doi:10.1002/cbm

Grant, J., Southall, P., Fowler, D., Mealey, J., Thomas, E., & Kinlock, T. (2007). Death in custody: A historical analysis. *Journal of Forensic Science*, *52*(5), 1177–1181. doi:10.111/j.1556–4029.2007.00500.x

Hackman, D., & Anand, S. (2003). Emerging risk factors for atherosclerotic vascular disease. *JAMA*, *290*(7), 932–940.

Hafizullah, M., Fawad, A., Saqib, M., Gul, A., & Jan, H. (2010). Frequency of cardiovascular risk factors among prisoners. *Pakistan Heart Journal*, *43*(1–2), 3–7.

Health Care Practice Development Unit. (2005). *Evaluation Tool for Quantitative Research Studies*. Salford: University of Salford.

Helfand, M., Buckley, D., Freeman, M., Fu, R., Rogers, K., Fleming, C., & Humphrey, L. (2009). Emerging risk factors for coronary heart disease: A summary of systematic reviews conducted for the U.S Preventative Services Task Force. *Annals of Internal Medicine*, *151*(7), 496–510.

Hobbs, M., Krazlan, K., Ridout, S., Mai, Q., Knuiman, M., & Chapman, R. (2006). *Mortality and morbidity in prisoners after release from prison in Western Australia 1995–2003*. Canberra ACT: Australian Institute of Criminology.

Hummasti, S., & Hotamisligil, G. (2010). Endoplasmic reticulum stress and inflammation in obesity and diabetes. *Circulation Research*, *107*, 579–591. doi:10.1161/CIRCCRESAHA.110.225698

James, D., & Glaze, L. (2006). *Mental health problems of prison and jail inmates*. Washington, DC: Bureau of Justice Statistics. From http://www.bjs.gov/content/pub/pdf/mhppji.pdf

Kang, H., Bullman, T., & Taylor, J. (2006). Risk of selected cardiovascular diseases and posttraumatic stress disorder among former world war II prisoners of war. *Annals of Epidemiology*, *16*(5), 381–386. doi:10.1016/j.annepidem.2005.03.004

Kariminia, A., Butler, T., & Levy, M. (2007). Aboriginal and non-Aboriginal health differentials in Australian prisoners. *Australian and New Zealand Journal of Public Health*, *31*(4), 366–371. doi:10.1111/j.1753–6405.2007.00089.x

Kariminia, A., Butler, T., Jones, J., & Law, M. (2012). Increased mortality among Indigenous persons during after release from prison in New South Wales. *Australian and New Zealand Journal for Public Health*, *36*(3), 274–280. doi:10.1111/j.1753.6405.2012.00844.x

Kettles, A.M., & Walker, H.G.W. (2007). Forensic nursing research: How far we've come. *The British Journal of Forensic Practice*, *9*(4), 35–44.

Khavjou, O., Clarke, J., Hofeldt, R., Lihs, P., Loo, R., Prabhu, M., Will, J. (2007). A captive audience: Bringing the WISE-WOMEN Program to South Dakota prisoners. *Women's Health Issues*, *17, 193–201. doi:10.1016/j.whi.2007.02.008*

Kulkarni, S., Baldwin, S., Lightstone, A., Gelberg, L., & Diamant, A. (2010). Is incarceration a contributor to health disparities? Access to care of formerly incarcerated adults. *Journal of Community Health*, *35, 268–274.*

LaForest, J., & Algozzine, T. (2003). An evaluation of cholesterol managment within a state correctional system. *Journal of Correctional Health*, *10*(1), 75–87.

Lebovitz, H. (2005). Insulin resistance- A common link between type 2 diabetes and cardiovascular disease. *Diabetes, Obesity and Metabolism*, *8*, 237–249. doi:10.1111/j.1463–1326-2005.00521.x

Leddy, M., Schulkin, J., & Power, M. (2009). Consequences of high incarcerated rate and high obesity prevalence on the prison system. *Journal of Correctional Heath*, *15*(4), 318–327. doi: 10.1077/1078345809340426

Livingstone, J.D. (2009). *Mental health and substance use services in correctional settings: a review of minimum standards and best practices*. Vancouver: The International Centre for Criminal Law Reform and Criminal Justice Policy.

Loeb, S., & AbuDagga, A. (2006). Health-related research on older inmates: An integrative review. *Research in Nursing Health*, *26*, 555–565. doi:10.1002/nur.20177

Loeb, S., & Steffensmeier, D. (2006). Older male prisoners: Health Status, Self-efficacy beliefs, and health-promoting behaviours. *Journal of Correctional Health Care*, *12*(4), 269–278. doi:10.1177/1078345806296031

Mackin, P., Bishop, D., Watkinson, H., Gallagher, P., & Ferrier, N. (2007). Metabolic disease and cardiovascular risk in people treatedwith antipsychotics in the community. *British Journal of Psychiatry*, *191, 23–29.*

Malik, S., Wond, N., Franklin, S., Kamath, T., L'Italien, G., Pio, J., & Williams, G. (2004). Impact of metabolic syndrome on mortality from coronary heart disease, cardiovascular disease, and all causes in United States adults. *Circulation*, *110, 1245–1250. doi:10.1161/01.CIR.0000140677.20606.0E*

Maschi, T., Morgen, K., Zgoba, K., Courtney, D., & Ristow, J. (2011a). Age, cumulative trauma and stressfull life events, and post-traumatic stress symptoms among older adults in prison: Do subjective impressions matter. *The Gerontologist*, *51*(5), 675–686. doi:10.1093/geront/gnr074

Maschi, T., Gibson, S., Zgoba, K., & Morgan, K. (2011(b)). Trauma and life events stressors among younf and older adult prisoners. *Journal of Correctional Health Care*, *17*(2), 160–172. doi:10.1177/1078345810396682

Mauri, M., Victoria Pardo, M., Sole, R., & Garcia-Maurino, L. (2005). Cardiovascular risk and HIV-infection in prison inmates. *Medicina Clinica*, *124*(16), 636. From http://www.ncbi.nlm.nih.gov.cyber.usask.ca/pubmed/15871785

McDermott, M., Mandapat, A., Moates, A., Albay, M., Chiou, E., Celic, l., & Greeland, P. (2003). Knowledge and attitutes regarding cardiovascular disease risk and prevention in patients with coronary or peripheral arterial disease. *Archives of Internal Medicine*, *163*, 2157–2162.

McDonald, S., Maguire, G., Duarte, N., Wang, X., & Hoy, W. (2005). Homocysteine, renal disease and cardiovascular disease in a remote Australian Aboriginal community. *Internal Medicine Journal*, *35*, 289–294.

McGrath, C. (2002). Oral health behind bars: A study of oral disease and its impact on the life quality of an older prison population. *Gerodontology*, *19*, 109–114. doi:10.1111/j.1741–2358.2002.00109.x

Meigs, J. (2010). Epidemiology of Type 2 diabetes and cardiovascular disease: Translation from population to prevention. *Diabetes Care*, *33*(8), 1865–1871.

Mendis, S., Puska, P., & Norrving, B. (2011). *Global Atlas on Cardiovascular Disease Prevention and Control*. Geneva: World Health Organization.

Mernitz, H., & McDermott, A. (2004). Exercise and the elderly: A scientific rationale for exercise prescription. *Journal of Clinical Outcome Management*, *11*(2), 106–116.

Nara, K., & Igarashi, M. (1998). Relationship of prison life style to blood pressure, serum lipids and obesity in women prisoners in Japan. *Industrial Health*, *36*, 1–7.

Nathan, D., Cleary, P., Backlund, J., Genuth, S., Lachin, J., Orchard, T., Zinman, B. (2005). Intensive diabetes treatment and cardiovascular disease in patients with type 1 diabetes. *The New England Journal of Medicine*, *353*(25), 2643–2653.

Noonan, M., & Carson, E. (2011). *Prison and jail deaths in custody, 2000–2009 – statistical tables*. Washington, DC: Bureau of Justice Statistics. From http://bjs.ojp.usdoj.gov/index.cfm?ty=pbdetail&iid=1744

Nurse, J., Woodcock, P., & Ormsby, J. (2003). Influence of environmental factors on mental health within prisons: Focus groups studies. *British Journal of Medicine*, *327*, 480–484. Retrieved April 23, 2012, from www.bmj.com/content/327/7413/480.abstract

Osborn, D., Nazareth, I., & King, M. (2006). Risk for coronary heart disease in people with severe mental illness. Cross-sectional comparative study in primary care. *British Journal of Psychiatry*, *188*, 271–277.

Payne-James, J., Green, P., Green, N., McLachlan, G., Munro, M., & Moore, T. (2010). Healthcare issues of detainees in police custody in London, UK. *Journal of Forensic and Legal Medicine*, *17*, 11–17. doi:10.1016/j.jflim.2007.10.011

Plugge, E., Foster, C., Yudkin, P., & Douglas, N. (2009). Cardiovascular disease risk factors and women prisoners in the UK: The impact of imprisonment. *Health Promotion International*, *24*(4), 334–343. doi:10.1093/heapro/dap034

Reichert, J., & Bostwick, L. (2010). *Post-traumatic stress disorder and victimization among female prisoners in Illinois*. Chicago: Illinois Criminal Justice Information Authority. From http://www.saferfoundation.org/files/documents/PTSD Female Prisoners Report 1110.pdf

Richmond, R., Butler, T., Wilhelm, K., Wodak, A., Cunningham, M., & Anderson, I. (2010). Tobacco in prisons: A focus group study. *Tobacco Control*, *18*, 176–182. doi:10.1136/tc.2008.026393

Richmond, R., Wilhelm, K., Idig, D., Butler, T., Archer, V., & Wodak, A. (2011). Cardiovascular risk among Aboriginal and non-Aboriginal smoking male prisoners: Inequalities compare to wider community. *BMC Public Health*, *11*, 783–789. From http://www.biomedcentral.com/1471–12458/11/783

Sazhin, V., & Reznik, R. (2008). Cardiovascular risk factors among forensic patient in the acute psychiatric ward. *The Royal Australian and New Zealand College of Psychiatrist*, *42*, 254–255.

Sethness, R., Rauschhuber, M., Gilliland, I., Lowry, J., & Jones, M. (2005). Cardiac health: Relationships among hostility, spirituality, and health risk. *Journal of Nursing Care Quality*, *20*(1), 81–89.

Sioen, I., Hacquebard, M., Hick, G., Maindiaux, V., Larondelle, Y., Carpentier, Y., & De Henauw, S. (2009). Effect of ALA-Enriched food supply on cardiovascular risk factors in males. *Lipids*, *44*, 603–611. doi:10.1007/s11745–009-3307–5

Speceley, S. (2005). ccess to health services by Canadians who are chronically ill. *Western Journal of Nursing Research*, *27*(4), 465–486. doi:10.1177/0193945904272384

Stoney, C. (2003). Gender and cardiovascular disease: A psychobiological and integrative approach. *Current Directions in Psychological Science*, *12*(4), 129–133. doi:10.1111/1467–8721.01247

Tobias, M., & Turley, M. (2005). Causea of death classified by risk and condition, New Zealand 1997. *Australian and New Zealand Journal of Public Health*, *29*(1), 5–12.

Verger, P., Rotily, M., Prudhomme, J., & Bird, S. (2003). High mortality rates among inmates during the year following their discharge from a French prison. *Journal of Forensic Science*, *48*(3), 1–3.

Wang, E., Pletcher, M., Lin, F., Vittinghoff, E., Kertesz, S., Kiefe, C., & Bibbins-Domingo, K. (2009). Incarceration, incident hypertension, and access to health care – Findings from the coronary artery risk development in young adults (CARDIA) study. *Archives of Internal Medicine*, *169*(7), 687–693.

Wang, T., Pencina, M., Booth, S., Jacques, P., Ingelsson, E., Lanier, K., Vasan, R. (2008). Vitamin D deficiency and risk of cardiovascular disease. *Circulation*, *117*, 1–9. doi:10.1161/CIRCULATIONAHA.107.706127

Warburton, D., Nicol, C., & Bredin, S. (2006). Health benefits of physical activity: The evidence. *Canadian Medical Association Journal*, *174*(6), 801–809. doi:10.1503/cmaj.051351

Whittemore, R., & Knafl, K. (2005). The integrative review: Updated methodology. *Journal of Advanced Nursing*, *52*(5), 546–553.

Williams, N.H. (2007). Prison health and the health of the public: Ties that bind. *Journal of Correctional Health Care*, *13*(2), 80–92. doi: 10.1177/1078345807301143

Wobeser, W., Datema, J., Bechard, B., & Ford, P. (2002). Causes of death among people in custody in Ontario, 1990–1999. *Canadian Medical Association Journal*, *167*(10), 1109–1113.

World Health Organization. (2007). *Health in Prisons: A guide to the essentials in prison health*. Geneva: WHO.