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Review article

Socioeconomic inequalities in prostate cancer survival: A review of the evidence and explanatory factors

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ABSTRACT

Although survival rates after prostate cancer diagnosis have improved in the past two decades, survival analyses regarding the socioeconomic status (SES) suggest inequalities indicating worse prognosis for lower SES groups. An overview of the current literature is lacking and moreover, there is an ongoing discussion about the underlying causes but evidence is comparatively sparse. Several patient, disease and health care related factors are discussed to have an important impact on disparities in survival. Therefore, a systematic review was conducted to sum up the current evidence of survival inequalities and the contribution of different potential explanatory factors among prostate cancer patients.

The PubMed database was screened for relevant articles published between January 2005 and September 2014 revealing 330 potentially eligible publications. After systematic review process, 46 papers met the inclusion criteria and were included in the review.

About 75% of the studies indicate a significant association between low SES and worse survival among prostate cancer patients in the fully adjusted model. Overall, hazard ratios (low versus high SES) range from 1.02 to 3.57. A decrease of inequalities over the years was not identified. 8 studies examined the impact of explanatory factors on the association between SES and survival by progressive adjustment indicating mediating effects of comorbidity, stage at diagnosis and treatment modalities.

Eventually, an apparent majority of the obtained studies indicates lower survival among patients with lower SES. The few studies that intend to explain inequalities found out instructive results regarding different contributing factors but evidence is still insufficient.

1. Introduction

Prostate cancer has emerged as one of the most prevalent cancers worldwide (Bray et al., 2013). Particularly in Europe, North America and Australia prostatic neoplasms are widespread. In terms of inequalities studies mostly have shown higher incidence rates among higher socioeconomic status (SES) groups (Aarts et al., 2010; Clegg et al., 2009; Faggiano et al., 1997; Gilligan, 2005; National Cancer Intelligence Network, 2009; Shafique et al., 2012a). Studies analysing population-based prostate cancer mortality data found inconsistent associations with SES (Albano et al., 2007; Elstad et al., 2011; Krieger et al., 2012; Menvielle et al., 2008). Therefore, it is remarkable that previous overviews highlighted lower survival rates and higher excess mortality especially for lower status groups among prostate cancer patients (Coleman et al., 2004; Gilligan, 2005; Kogevinas and Porta, 1997; Kravdal, 2000; Quaglia et al., 2013; Woods et al., 2006) whilst overall, the survival concerning prostate cancer has improved (De Angelis et al., 2014). One can assume that the identification of potential explanatory factors could point to reduce inequalities, and furthermore the number of avoidable deaths (Ellis et al., 2012). Moreover, as survival is considered as a potential quality of care indicator for prostate cancer, improvements in health care could be deduced (Spencer et al., 2003).

Information about underlying causes to explain socioeconomic differences in prostate cancer survival and case fatality is sparse. Possible explanations can be divided into three groups (Auvinen and Karjalainen, 1997; Frederiksen et al., 2009; Woods et al., 2006): factors linked to the tumour (stage at diagnosis, biological characteristics), the patient (comorbidity, health behaviour, psychosocial factors) and the health care (treatment, medical expertise, screening).

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There is an ongoing discussion about the role of health care management as a contributing factor to social disparities in survival among prostate cancer patients (Chu and Freedland, 2010). For instance, Lyratzopoulos et al. (2010) found out that patients from England with lower SES were less likely to receive radical surgery or radiotherapy (and watchful waiting more likely) than those from least deprived SES groups, also when age, disease stage, period of diagnosis, tumour type or hospital (but not comorbidity) were taken into consideration. Data from other studies conducted in England, Australia and the USA also has shown that socioeconomically disadvantaged men have a decreased likelihood of having radical prostatectomy compared to patients with lower SES who received more often hormone therapy, active surveillance, watchful waiting and partly radiation (Fairley et al., 2009; Hayen et al., 2008; Krupski et al., 2005). Furthermore, screening uptake is lower among prostate cancer patients with low SES in different health care settings (Ross et al., 2011; Williams et al., 2011). Also, stage at diagnosis is discussed extensively as an explanatory factor (Auvinen and Karjalainen, 1997; De Angelis et al., 2014; Woods et al., 2006). Recent Anglo-American studies have shown an association between lower SES and an advanced stage at diagnosis for prostate cancer while adjusting for several covariates (Clegg et al., 2009; Lyratzopoulos et al., 2013). Moreover, patient factors as comorbidity or health behaviour can interact with treatment modalities or disease stage and additionally have a potential impact on inequalities in survival (Berglund et al., 2011; Hall et al., 2005b). Berglund et al. (2011) report in their study an increased likelihood of surveillance as treatment among patients with severe comorbidity while radical prostatectomy was significantly less likely to be offered. Furthermore, all cause and competing cause mortality but not prostate cancer specific mortality was higher in patients with severe comorbidity.

However, despite the increasing efforts in research about social disparities in prostate cancer survival, the latest comprehensive (non-systematic) overview dates back to nearly one decade (Woods et al., 2006). It comprises 14 studies reporting data for prostate cancer patients, and moreover, it is still unclear which are the most relevant factors contributing to the differences. Therefore, a systematic review was conducted to address two major topics: first, to give a current overview of the studies and their evidence about the association between socioeconomic status and prostate cancer survival since 2005, and second, to work out which explanatory factors contribute to these differences following Woods et al. (2006) and Auvinen and Karjalainen (1997). Thus, patient, disease and health care factors are considered as potential mediators.

2. Methods

A systematic review in the PubMed database was performed on the basis of the PRISMA guidelines (Moher et al., 2009) using a combination of following keywords in title and abstract: socio*, inequalit*, income, education*, occupation*, survival, excess mortality, case fatality, prognosis, prostate, cancer, common cancer*, major cancer*, cancer site*. The search strategy was completed by the two MeSH Terms 'prostatic neoplasms' and 'survival analysis'. Publications that have been released between January 2005 and September 2014 were included as the last comprehensive review examining social inequalities in cancer survival including prostate cancer was published online 2005 (Woods et al., 2006). Additionally, the bibliographic references of the eligible studies were screened for further relevant publications. For more detailed information about the search strategy see Appendix I.

Studies were rated as eligible if they (1) were written in English or had English abstract, (2) were published or in-press in a peer reviewed journal, (3) reported data from a primary study and not an editorial or review, (4) were prospective or retrospective cohort studies that analysed survival, case fatality or excess mortality among prostate cancer patients, (5) introduced indicators of SES as predictor or covariate that enables to identify the impact of SES on survival. Studies that only adjust for SES without explicitly reporting the effects on prostate cancer survival were excluded. Furthermore, SES had to be determined by indicators of education, income or occupational position on individual level or regional level indicated by, for instance, census tracts. Analyses using macro-economic factors on country level were not enclosed. Studies and research that focus solely on ethnic or racial disparities were also excluded, just as studies only referring to insurance status. Data was extracted regarding author and publication date, location of the study, period of diagnosed cancer cases, sample size, SES indicators, type of measurement, adjusted variables and main findings in terms of survival or risk of death of patients with low versus high SES.

In a second step, the extracted studies were screened for potential explanatory factors contributing to social inequalities in survival that were identified by progressive adjustment in multivariate analyses. To calculate the percentage reducing contribution of these factors to inequalities in survival, the change of hazard ratio (HR) or relative excess risk (RER) was assessed by using the formula: $([HR/RER_{\text{Basic Model}} - HR/RER_{\text{Basic model + explanatory factors}}])/[HR/RER_{\text{Basic model}} - 1]) \times 100$ (Louwman et al., 2010; Skalicka et al., 2009). Basic model was the model only adjusted for age, race/ethnicity, year of diagnosis and in one case for stage.

A meta-analysis was not conducted as the included studies showed a considerable methodological heterogeneity regarding their designs including varying time frames as well as measurement instruments to capture potential predictors and outcomes. In addition, the performed statistical analyses varied largely, the number and quality of considered confounders were diverse, and the reported effect measures were heterogeneous.

3. Results

The PubMed search generated 330 publications that were screened by title and abstract resulting in 78 potential relevant articles. Of these, 40 were included in this review after extensive full-text screening. Main reasons for exclusion were that indicators of SES were missing in the analyses or SES was just introduced as confounding variable without presenting its impact on survival, no survival analyses among a patient cohort were conducted, no prostate cancer but other cancer sites were examined or the paper did not contain original data. For more information about the study selection see Appendix II. Additionally, 6 studies were identified by scanning the reference lists resulting in 46 studies in total that were included in the review (Table 1). Most of the studies were conducted in the USA (n = 15; thereof one study in USA and Canada) and Europe (n = 20), i.e. UK (n = 9), Netherlands (n = 3), Sweden (n = 3), Ireland, Germany, Denmark, Finland, Switzerland (in each case n = 1). Further countries of investigation were Australia (n = 6), New Zealand (n = 2), Colombia (n = 1), Japan (n = 1) and Taiwan (n = 1).

33 studies indicate a significant association between SES and survival among prostate cancer patients (fully adjusted model if multivariate analyses were conducted) (Aarts et al., 2013a, 2013b; Australian Institute of Health and Walfare (2013); Berglund et al., 2012; Bravo et al., 2014; Burns et al., 2014; Byers et al., 2008; Chang et al., 2012; Du et al., 2006; Freeman et al., 2011; Hall et al., 2005a; Hellenthal et al., 2010; Hussain et al., 2008; Jansen et al., 2014; Jeffreys et al., 2009; Li et al., 2012; Louwman et al., 2010; Luo et al., 2013; Marsa et al., 2008; Niu et al., 2010; Prasad et al., 2014; Rachet et al., 2010; Robbins et al., 2007a, 2007b;