



Temporal changes in sugar-sweetened soft drink intake and variation across municipalities in the Capital Region of Denmark

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ABSTRACT

We aimed to examine the changes in sugar-sweetened soft drink intake across the Capital Region of Denmark from 2007 to 2013 and to examine the association between intake and neighbourhood socioeconomic status. The study included data from three health surveys in 2007 ($n = 30,426$), 2010 ($n = 42,218$) and 2013 ($n = 34,330$) in the Capital Region of Denmark. Frequency of soft drink intake was derived from questionnaires among residents aged 25–79 years and linked with information from central registers. Municipality social groups (MSG) 1–4 of decreasing affluence were defined as a composite measure. Logistic regression analyses were conducted for individuals with an appropriate soft drink intake (<once/week) and for individuals with a frequent soft drink intake (≥ 3 times/week). The proportion of individuals reporting an appropriate soft drink intake increased by 71% during 2007–2013 ($p < 0.0001$). A corresponding decrease was found in the proportion of individuals reporting a frequent soft drink intake. Compared to MSG 1, odds of an appropriate soft drink intake were significantly lower in MSG 3–4: OR = 0.87 (95%CI 0.83–0.91) and OR = 0.89 (95%CI 0.85–0.92), respectively. Compared to MSG 1, odds of a frequent soft drink intake were significantly higher in MSG 3–4: OR = 1.24 (95%CI 1.63–1.31) and 1.17 (95%CI 1.10–1.25), respectively. A significant interaction between MSG and educational level was found among individuals reporting a frequent soft drink intake ($p = 0.02$). The results show an encouraging reduction in frequency of soft drink intake among capital residents in the period of 2007–2013. A social gradient was observed in soft drink intake across MSG.

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1. Background

To implement relevant public health strategies it is important to monitor the prevalence and temporal changes in specific risk behaviours for health and disease. Soft drink intake has been associated with an increased body weight and increased risk of chronic diseases such as type 2 diabetes (Vartanian et al., 2007). Putative underlying mechanisms include excess energy intake, incomplete compensation for liquid calories at subsequent meals and adverse glycaemic effects (Vartanian et al., 2007; Malik and Hu, 2015). The increasing knowledge of the detrimental effects of a high intake of soft drinks is reflected in the Danish dietary guidelines (Ministry of Environment and Food of Denmark, 2013).

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Health related behaviours and chronic diseases are found to vary according to place of residence, and this variation is often explained by individual social differences such as educational level (Diderichsen et al., 2011; Mendis and Banerjee, 2010; Macintyre et al., 2002). However, factors within the local environment constrain individual level behaviours and choices, through mechanisms such as availability (the structural environment) and normative attitudes towards health (the functional environment) (Leventhal and Brooks-Gunn, 2000; Jencks and Mayer, 1990; House JS et al., 1988; Sallis et al., 2006). Thus environmental factors are receiving increasing attention to assess their influence on health (World Health Organization, 2009; Lipek et al., 2015).

The social ecological models emphasize the nested arrangement of family, school, neighbourhood, and community context (Sallis et al., 2006). In light of these models, the composition of the environment i.e. the socioeconomic status (SES) and deprivation of a neighbourhood, can to some extent be viewed as a proxy for unmeasured structural and functional exposures. Deprived neighbourhoods are believed to have fewer health-promoting facilities and different social norms. Thus individuals residing within these areas are potentially exposed to substantially more unhealthy habits in their daily lives. This may have

important implications for the initiation and maintenance of health behaviours e.g. soft drink intake, and the persistence of health inequalities across place of residence (Leventhal and Brooks-Gunn, 2000; World Health Organization, 2009).

Knowledge of soft drink intake in relation to the field of environmental exposures is limited. Pabayo et al. (Pabayo et al., 2012) found that a larger proportion of Canadian children regularly consumed soft drinks when living in low SES neighbourhoods in comparison to those living in higher SES neighbourhoods (Pabayo et al., 2012). Other studies indicate that low SES of a neighbourhood is associated with a frequent consumption of fast food and processed meals, a poorer nutritional status, less physical activity, and a higher prevalence of smoking and obesity (Igel and Grande, 2015; Turrell and Giskes, 2008; Thornton et al., 2009; Hanson and Chen, 2007; Pickett and Pearl, 2001). Yet, results are conflicting (Mozaffarian et al., 2012; Giskes et al., 2011; Fleischhacker et al., 2011; Feng et al., 2010). This is often explained by the heterogeneity in study designs and contextual differences that make it difficult to compare the impact of neighbourhood characteristics across states, countries, regions etc. Thus, neighbourhood SES could be an important determinant of soft drink intake among residents in the Danish population. Finally, associations between the environment and health behaviours may be modified by individual factors (Jencks and Mayer, 1990; World Health Organization, 2009; Feng et al., 2010).

Attention to the prevalence of exposures and relative risks can ensure that preventive efforts and public health policy will focus on those population sub-groups and geographical areas where most benefit can be expected. Therefore this study aimed to examine the changes in soft drink intake in the Capital Region of Denmark from 2007 to 2013. Furthermore, we aimed to examine the association between intake of soft drinks and municipality deprivation, and whether this association is modified by individual educational level.

2. Methods

2.1. The Danish capital region health survey

The present study is based on data from three cross-sectional health surveys conducted in the 29 municipalities of the Capital Region of Denmark in 2007, 2010 and 2013 (Glümer et al., 2008; Hammer-Helmich et al., 2011; Robinson et al., 2014). The surveys

were conducted in September in 2007 and from February to April in 2010 and 2013. A random sample of individuals in each municipality was drawn from the Danish Civil Registration System (CRS) (Pedersen et al., 2006). This register identifies all inhabitants in Denmark by a unique 10-digit personal identification number (CPR), which allows record linkage on an individual level to data from complete national registers on e.g. education and income.

The total sample included 69,800 individuals in 2007 and 95,150 individuals in both 2010 and 2013 (Fig. 1). In all three survey years the municipality of Copenhagen was divided into ten areas according to the official administrative districts, and these were treated as individual municipalities in the sampling process resulting in a total of 38 municipalities. In 2007 1800 persons aged 25 years or older were sampled from each municipality. Due to differences in population size between municipalities the sample size in Frederiksberg Municipality was increased to 3000 persons. In 2010 and 2013 2450 persons aged 16 years or older were sampled from each municipality and the sample size in Frederiksberg Municipality was 4500 persons.

Each individual received a mailed invitation and a paper questionnaire (a web-based version was also available in 2010 and 2013). The questionnaire contained questions on health behaviour. The response rate was 52.3% (N = 36,472) in 2007, 52.3% (N = 49,806) in 2010 and 43.5% (N = 41,356) in 2013 (Fig. 1). Among those who did not respond to the questionnaire a higher proportion was men, unemployed, had a short educational, had a low gross income, and was of another ethnicity than Danish, for all three survey years (Glümer et al., 2008; Hammer-Helmich et al., 2011; Robinson et al., 2014).

2.2. Soft drink intake

Frequency of sugar-sweetened soft drink intake (carbonated or non-carbonated) was assessed from the survey questionnaires. Questions were based on a validated 48-item food frequency questionnaire (Toft et al., 2015). Participants were asked the following question: "How often do you drink sugar-sweetened soft drinks?", with six possible responses (rarely or never, 1–3 times/month, 1–2 times/week, 3–4 times/week, 5–7 times/week, and more than once/day). This categorization allowed us to examine associations among individuals who *assumably* have an appropriate soft drink intake according to the Danish Dietary Guidelines (max of ½ L/week) and those who have a frequent soft drink intake. Appropriate soft drink intake was defined as 1) soft drink

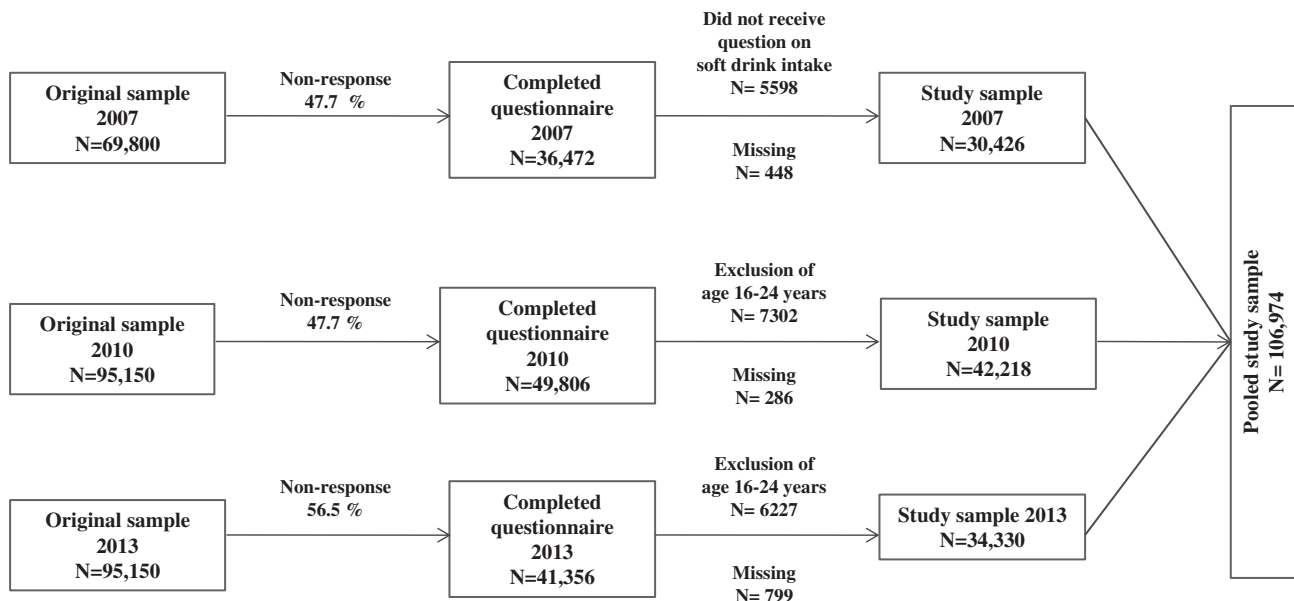


Fig. 1. Flowchart of three health surveys in the Capital region of Denmark in 2007, 2010 and 2013.

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