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## Changes in smoking, sports participation and overweight: Does neighborhood prevalence matter?



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## ABSTRACT

We investigated whether the prevalence of health-related behaviors and overweight in neighborhoods is associated with changes in smoking, sports participation and overweight over 13 years of follow-up in Dutch adults residing in 86 neighborhoods of Eindhoven in 1991. We showed that living in neighborhoods with a high prevalence of non-smoking, no sports participation and overweight increased the odds of quitting smoking, quitting sports and becoming overweight. After adjustments for age, gender, education and neighborhood deprivation this association remained significant for becoming overweight. Neighborhood prevalence of health-related behaviors and overweight appears to be a currently neglected but relevant determinant of changes in health-related behaviors.

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### 1. Introduction

The relevance of area characteristics for health and health-related behaviors is now well accepted (Chaix, 2009; Cummins and Macintyre, 2006; MacIntyre and Ellaway, 2003; Roux, 2001). Studies have shown that neighborhood characteristics are associated with overweight and health-related behaviors, such as smoking and physical inactivity (Giskes et al., 2006; van Lenthe et al., 2005; van Lenthe and Mackenbach, 2002). In search for specific contextual determinants of these behaviors, much emphasis has been placed on physical environmental characteristics, such as accessibility and availability of facilities (van Lenthe et al., 2005; Wendel-Vos et al., 2007). The importance of the social environment has also been considered: neighborhood social cohesion is for example commonly linked to physical activity (Cradock et al., 2009; Echeverria et al., 2008; McNeill et al., 2006; Ross, 2000). A contextual determinant of health behaviors that has surprisingly little been studied is the prevalence of health-related behaviors.

The reasoning behind examining neighborhood prevalence of health-related behaviors stems from the idea that healthy and

unhealthy behaviors spread from person-to-person. Individuals interact with each other and therefore influence other people's behavior, for example through peer pressure, conscious or unconscious copying of behavior (social mimicry) (Go et al., 2010; Lakin et al., 2003). This has been supported by behavioral theories as well as empirical evidence. For instance, according to the *Social Learning Theory* (Bandura, 1977) people may quit smoking, because they watch other people in their environment quit smoking and consider this behavior favorable (observational learning). According to the theory of *Diffusion of Innovations* (Rogers, 2003) adoption of a certain behavior spreads through social networks and depends on the number of people in the environment that engage in a certain behavior. In addition, empirical studies have shown that both smoking cessation and obesity (or norms associated with obesity) spread from person-to-person in a social network (Christakis and Fowler, 2007, 2008).

The purpose of this study is to investigate the association between neighborhood prevalence of health-related behaviors at baseline and changes in these behaviors during follow-up. In order to rule out neighborhood level confounding (Chaix et al., 2010), adjustments will be made for neighborhood deprivation, because it is associated with neighborhood prevalence of health-related behaviors as well as behavioral change over time and may capture physical and social contextual factors related to deprivation (Giskes et al., 2006; van Lenthe and Mackenbach, 2002).

The Dutch GLOBE study is a prospective cohort study, which provides information on smoking, sports participation and overweight

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for a large sample over a period of 13 years in the city of Eindhoven (van Lenthe et al., 2004). It provides a unique opportunity to investigate the importance of the prevalence of health-related behaviors and overweight for subsequent (behavioral) changes. In three different studies we hypothesized that: (1) smokers living in a neighborhood with a high prevalence of non-smokers are more likely to quit during follow up, (2) participants in sports living in neighborhoods with a high prevalence of persons not participating in sports are more likely to quit during follow up and (3) normal weight persons living in neighborhoods with a high prevalence of overweight are more likely to become overweight during follow up.

## 2. Methods

### 2.1. Study population

Longitudinal data were obtained from the Dutch prospective GLOBE study. The area of study included the city of Eindhoven, which was the fifth largest city of The Netherlands with approximately 135,000 inhabitants between the age of 15 and 75 years in 1991. The city has 116 neighborhoods, of which 86 are predominantly residential neighborhoods.

Baseline data were collected in 1991 using postal questionnaires. An a-select sample of 27,070 non-institutionalized subjects between the age of 15 and 75 years living in or near the city of Eindhoven were selected to participate. The response was 70.1%, resulting in 18,973 respondents (van Lenthe et al., 2004), of which 10,450 persons resided in 86 neighborhoods of the city of Eindhoven. On average, these neighborhoods had 121.5 respondents (min.=5, max.=386). In the wave of data collection in 2004, an additional subsample was invited of participants who resided in the city of Eindhoven in 1991 and who still resided there in 2004 (van Lenthe et al., in press). This resulted in 2837 respondents living in the city of Eindhoven in both 1991 and 2004.

Only non-institutionalized respondents with valid measurements (i.e. no missing or impossible values) on the outcomes in 1991 and 2004 were included. The age range at follow-up was 28–88 years. Three studies were conducted: (1) smoking cessation, (2) quitting sports participation, and (3) becoming overweight. The study population of the three studies consisted of (1) smokers at baseline ( $n=760$ ), (2) respondents who participated in sports at baseline ( $n=1317$ ) and (3) respondent without overweight at baseline ( $n=1674$ ).

### 2.2. Measures

Smoking status, sport participation and overweight status were obtained from the 1991 and 2004 postal questionnaires. All remaining measures were obtained from the baseline (1991) postal questionnaire.

#### 2.2.1. Smoking status

Self-reported smoking status was measured by asking respondents the following question: “Do you smoke?” Respondents could answer with “yes”, “no, but used to smoke” (former smokers), and “never smoked before”. Based on information about the amount of cigarettes smoked per day, those reporting at least 1 cigarette per day were considered smokers. The outcome of interest was change in smoking status, i.e. quitting smoking. Answers were categorized into: unchanged behavior (continuing smoking) and quitting smoking.

#### 2.2.2. Sports participation

In 1991, sports participation was measured through a single question: “Do you participate in sports?” Respondents could

answer with “no”, “yes, < 1 hour/week”, “yes, 1–2 hours/week”, “yes, > 2 hours/week”. In 2004, the standardized and validated SQUASH questionnaire was used (Wendel-Vos et al., 2003). Respondents could record up to four different sport activities in an open question. For each activity, the frequency, the average duration and the intensity were reported. Sports participation was dichotomized into “yes” for respondents who participated in sports weekly and “no” for those who did not participate in sports weekly. The outcome of interest was the change in sports participation. Answers were categorized into: unchanged (continuing doing sports) and quitting sports participation.

#### 2.2.3. Overweight status

Information about body height (cm) and body weight (kg) was obtained through self-reported open questions. Body mass index (BMI) was calculated as: weight (kg)/height (m)<sup>2</sup>. Overweight was defined as BMI $\geq$ 25 (WHO, 2012). The outcome of interest was change in overweight status. Answers were categorized into: unchanged (no overweight), becoming overweight.

#### 2.2.4. Neighborhood prevalence of non-smoking, no sports participation and overweight

Calculations for neighborhood prevalence of non-smoking (i.e. former and never smokers together), no sports participation and overweight were based on the total eligible population at baseline that lived in the city of Eindhoven. This included 10,239 respondents for smoking, 10,298 respondents for sports participation, and 10,092 respondents for overweight. Based on these sample sizes, unstandardized prevalence rates of non-smoking, no sports participation and overweight at baseline were calculated for the 86 neighborhoods in the city of Eindhoven. Neighborhood prevalence of non-smoking ranged from 40.5% to 90%, no sports participation from 0% to 78.2% and overweight from 10% to 60%. These prevalence rates were not standardized, because the proposed mechanism is based on what individuals experience in their environment without taking age and sex distributions into account. This measure was further categorized into quartiles, each with 25% of neighborhoods (see footnote in Table 1).

#### 2.2.5. Age, gender and education

Respondent provided information on age, gender, and educational level at baseline. Educational level was measured by self-reported questions about the respondent's highest attained level of education. Responses were categorized as follows: lower (primary and lower secondary), middle (higher secondary), higher (tertiary). Educational level has proven to be a good indicator of socioeconomic status in the Netherlands (Van Berkel-Van Schaik and Tax, 1990; van Lenthe and Mackenbach, 2002).

#### 2.2.6. Neighborhood deprivation

Neighborhood deprivation at baseline is measured following van Lenthe and Mackenbach (2002). Neighborhoods were ranked based on: the percentage of subjects with primary school as highest attained educational level per neighborhood (mean=22.6%, min=0%, max=44.1%); the percentage of subjects that are unskilled manual workers per neighborhood (mean=15.1%, min=0%, max=31%); the percentage unemployed subjects per neighborhood (mean=11.4%, min=0%, max=29.1%). Quartiles were constructed using the summed rankings (van Lenthe and Mackenbach, 2002).

### 2.3. Statistical analysis

To examine the association between neighborhood prevalence of non-smoking, no sports participation and overweight and

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