



# Association Between Neighbourhood Greenness and BMI: Results from the Heinz Nixdorf Recall Study

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**Abstract:** Rising rates of overweight and obesity is still an unsolved problem. According to Robert Koch Institute 67% of men and 53% of women in Germany are overweight and quarter of adults are obese. That prompts to justify further investigation in factors involved in weight gain. World Health Organization suggests that obesity is broadly managed through the changes in people's lifestyle. Obesity-related studies in developed countries show that the environment, in which people live, has a significant impact on obesity. In particular, green space is seen as a stimulator of physical activity. However, information is lacking about the impact of neighbourhood greenness on bodyweight in urban areas. The aim of this study is to investigate the association between neighbourhood greenness and body mass index (BMI) of urban dwellers in a population-based study in a metropolitan region.

We used the data of the Heinz Nixdorf Recall (HNR) study; a cohort study was conducted in three adjacent cities (Bochum, Essen, Mulheim) in the Ruhr area. During the baseline (2000-2003) 4,814 men and women aged 45-75 years, were randomly selected and examined. Two follow-up examinations took place five and ten years after the baseline. In this study, the data of the baseline (n=4780) and the 10-years follow-up (n=3050) were analysed.

Neighbourhood greenness was measured using Normalized Difference Vegetation Index (NDVI); calculated for different buffer sizes (100m, 500m, 1000m) around each participant's residence address. BMI was calculated using measured height and weight of participants. Potential confounders were defined by literature research and using the approach of Directed Acyclic Graph (DAG). Accordingly, age, sex, smoking, number of comorbidities, and socio-economic status were identified for adjustment. For the cross-sectional analyses (at the baseline and the 10-years follow-up) we used multiple linear regression to compute coefficients  $\beta$  and corresponding 95% confidence intervals (95%CI). Here we report our results regarding the 1000m buffer size.

Overall, 28% of the participants at the baseline (NDVI:  $\mu=0.35$ ,  $SD=0.06$ ) were Obese, increasing to 31% 10-years later (NDVI:  $\mu=0.31$ ,  $SD=0.05$ ). We observed a significant decrease of BMI of 0.35kg/m<sup>2</sup>(95%CI: -0.59, -0.12) per 0.1 unit increase in NDVI in the fully adjusted model at the baseline. Similar results were observed using 10-years follow-up data  $\beta=-0.39$ kg/m<sup>2</sup>(95%CI: -0.76, -0.01). Stratification by sex revealed a stronger decrease in BMI of women compared to men (resp.  $\beta=-0.52$ kg/m<sup>2</sup>(95%CI: -0.90, -0.15);  $\beta=-0.19$ kg/m<sup>2</sup>(95%CI: -

0.48, 0.09)). This effect was even higher in 10-years follow-up (resp.  $\beta=-0.82\text{kg/m}^2$ (95%CI: -1.42, -0.22);  $\beta=0.03\text{kg/m}^2$ (95%CI: -0.42, 0.47)).

Our results show evidence for a distinct negative association between BMI and neighbourhood greenness, with a particular impact on women. Our findings emphasize the role of green space in urban areas and its positive impact on public health as well on climate change.