

# Geographically weighted regression modelling using Poisson distribution for factors influencing good SPH at district level, South Africa

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## Abstract:

Self-perceived health (SPH), also known as self-rated health or self-assessed health, is a widely used outcome measure of health in social epidemiology studies (Wu et al., 2013; Mokhele et al., 2023). Self-perceived health is a measure expressing the general condition of health of individuals, with an individual indicating an individual's overall subjective perception of their physical or mental health status ranging from excellent to poor, therefore it does not focus only on one specific dimension of health [Ho et al., 2007; Mokhele, et al., 2023]. In South Africa, few studies have explored factors associated with SPH. For instance, Mlangeni et al. (2019) investigated factors affecting poor SPH amongst individuals from KwaZulu-Natal province using data from the 2012 South African national household survey while Mokhele et al. (2023) investigated factors associated with deteriorated SPH status among informal settlement dwellers using data from the 2015 Informal Settlements Survey in South Africa. Factors associated with good SPH in general population have not been explored using nationally representative data, in particular at local level in South Africa.

Geographically weighted regression (GWR) has been developed to capture spatial variation of relationships between sets of variables by calibrating a multiple regression model which allows different relationships to exist at different points in space (Brunsdon et al., 1996). Geographically weighted regression has been widely used to explore factors associated with primary outcome variable at local level, with some few cases in South Africa (Antczak and Miszczyńska, 2020; Dlamini et al., 2022; Fundisi et al., 2023). For instance, Antczak and Miszczyńska (2020) used GWR to assess the relation between socioeconomic factors and good or very good SPH in European countries in the years 2005–2018. They found that the proportion of people with good or very good SPH differs across Europe and is spatial dependent.

Therefore, this study aimed to determine factors influencing good SPH at district level in South Africa using geographically weighted regression (GWR) with Poisson distribution. The paper used data from the fifth South African National HIV Prevalence, HIV Incidence, Behaviour and Communication Survey (SABSSM V) of 2017. Geographically weighted regression using Poisson distribution and local bivariate relationships were performed using ArcGIS Pro. The 2017 SABSSM data was utilised as it was the latest national representative data at lower level, thus district level, that assessed good SPH across the country.

Geographically weighted regression using Poisson distribution results showed that being female, unemployed, young, never married, having two or more sexual partners and having no condom use at first sexual intercourse were significant factors influencing good SPH among respondents across the country, with pseudo  $R^2 = 0.97$  and  $AICc = 798$ . Local bivariate relationships showed the relationship between good SPH and each explanatory variable; thus, being female (47 districts had positive linear and 5 districts had convex relationship), being unemployed (49 districts had positive linear and 3 districts had concave relationship), being young (46 districts had positive linear and 6 districts had convex relationship), having never married (13 districts had positive linear and 39 districts had concave relationship), having two or more sexual partners (46 districts had positive linear and 6 districts had convex relationship) and having no condom use at first sexual intercourse (51 districts had positive linear and 1 district had concave relationship). All these relationships were significant with  $p < 0.05$ .

Modelling local spatial heterogeneity between dependent and explanatory variables between different districts using GWR and local bivariate relationships ensures that decision and policy makers are able to provide spatially targeted interventions and solutions to relevant local communities compared to when global models are applied. The significance of these findings is that health districts will have an opportunity to develop effective, efficient and geotargeted

interventions at district levels and to support vulnerable groups with available limited resources as interventions and their intensity vary across districts based on the nature and type of local relationships between good SPH and each explanatory variable.

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