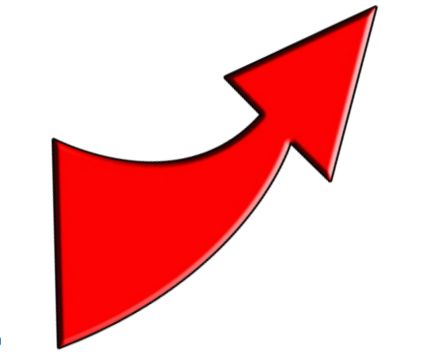


Estimating age- and sex-specific trends in alcohol use in South Africa: a Bayesian approach

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Introduction

Alcohol consumption has widespread, and prevalently harmful, effects on health, and is linked to over 200 detrimental conditions.[1,2] Reliable age- and sex-specific population estimates of trends in alcohol consumption are key for designing prevention activities and the efficient planning of treatment services.[3]

Surveys are the main source of information at this regard, but almost invariably underestimate the real consumption.[5] Because of this, survey estimates are generally rescaled, i.e. multiplied by a fixed coefficient (>1) so that the sum of the consumption across all age and sex categories equals the total consumption recovered from administrative data on production, sales and import/export.[1]

We propose here a novel rescaling method, where the various steps for calculating the rescaling coefficient and adjust the survey data are carried out simultaneously in a Bayesian meta-regression framework. We argue that our implementation provides an improved quantification of the uncertainty associated with the data and the method itself and requires less stringent assumptions compared to previous approaches.

Methods

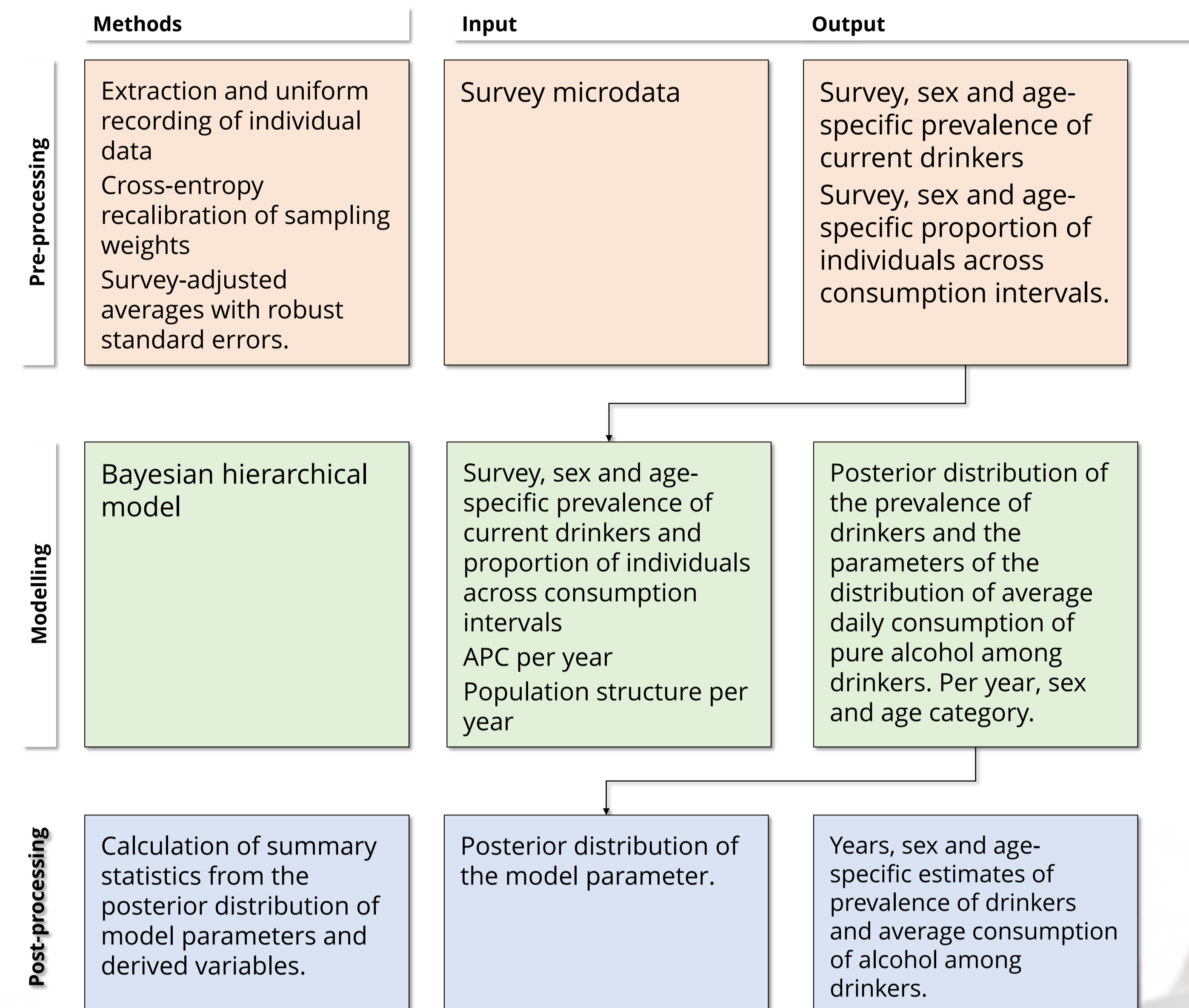
We combined information on: individual consumption from **17 nationally representative population surveys** conducted in South Africa between 1998 and 2016 with administrative data on total alcohol consumption (**alcohol per capita, APC**) at country level.

We pre-processed individual data to calculate, for each survey, sex and age category, raw estimates of the prevalence of drinkers and the distribution of individuals across consumption classes. We then used these aggregated results, together with data on total APC and population structure, as inputs of a **Bayesian model** and generated rescaled **yearly age- and sex-specific estimates** of the prevalence of drinkers and the parameters of the distribution of the average consumption among drinkers, in grams of pure alcohol per day.

From the model outputs we calculated the summary measures of interest. A conceptual overview of the data analysis method is shown in the **Figure**.

The statistical model is built around a set of assumptions the plausibility of which is supported by the studies by Rehm, Kehoe and colleagues [6,7]. For each year and each sex and age category, the model assumes

- (1) the average alcohol consumption among drinkers is **Gamma-distributed**;
- (2) the **ratio between standard deviation and mean** of the average consumption among drinkers is approximately constant across sub-populations and time;
- (3) the **sum of the total consumption across age-sex** groups multiplied by the survey coverage (i.e. the proportion of total consumption accounted for by the survey data) equals the APC;
- (4) **long-term individual consumptions** above 150 grams (12.5 standard drinks) per day are extremely implausible;
- (5) both the prevalence of drinkers and the average consumption among drinkers are **continuous and smooth functions of time and age**.



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Key findings

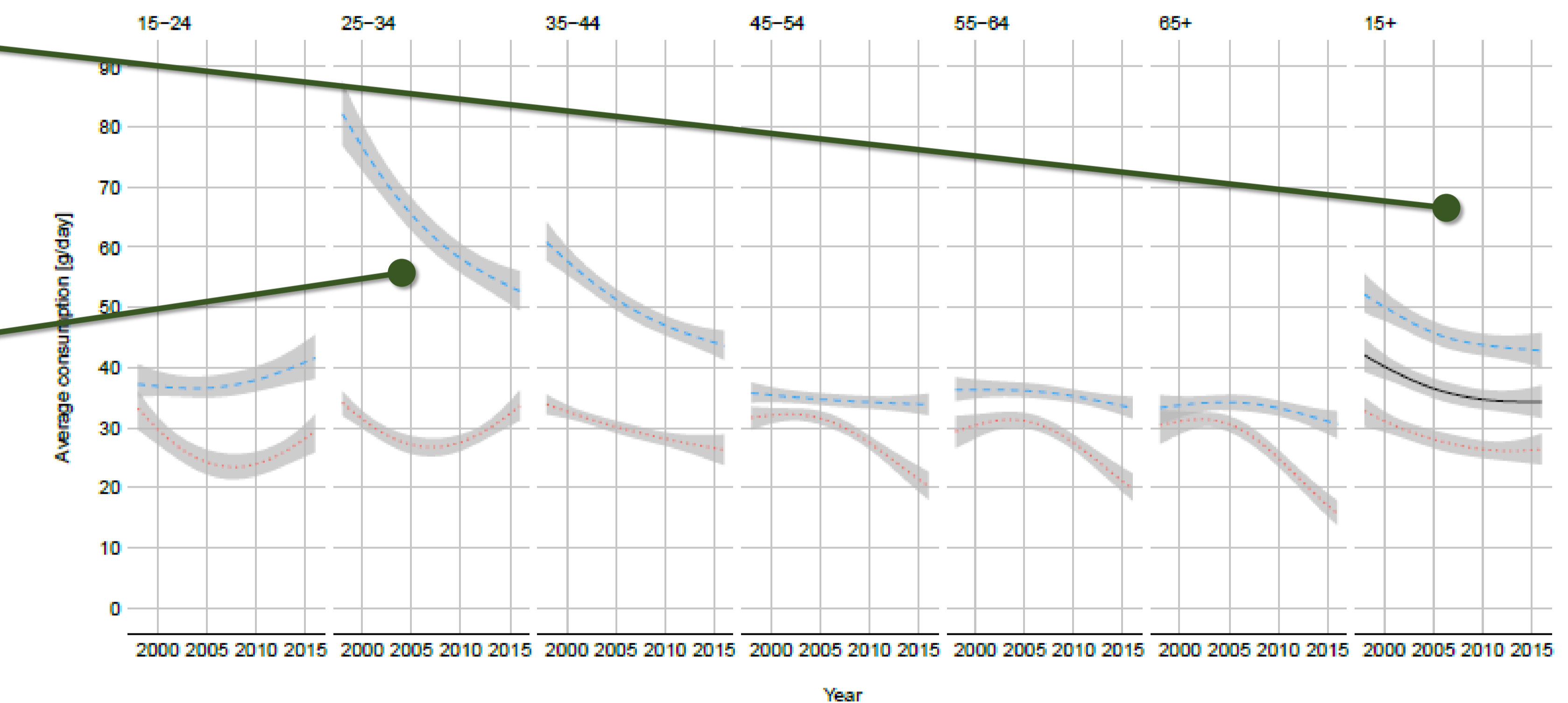
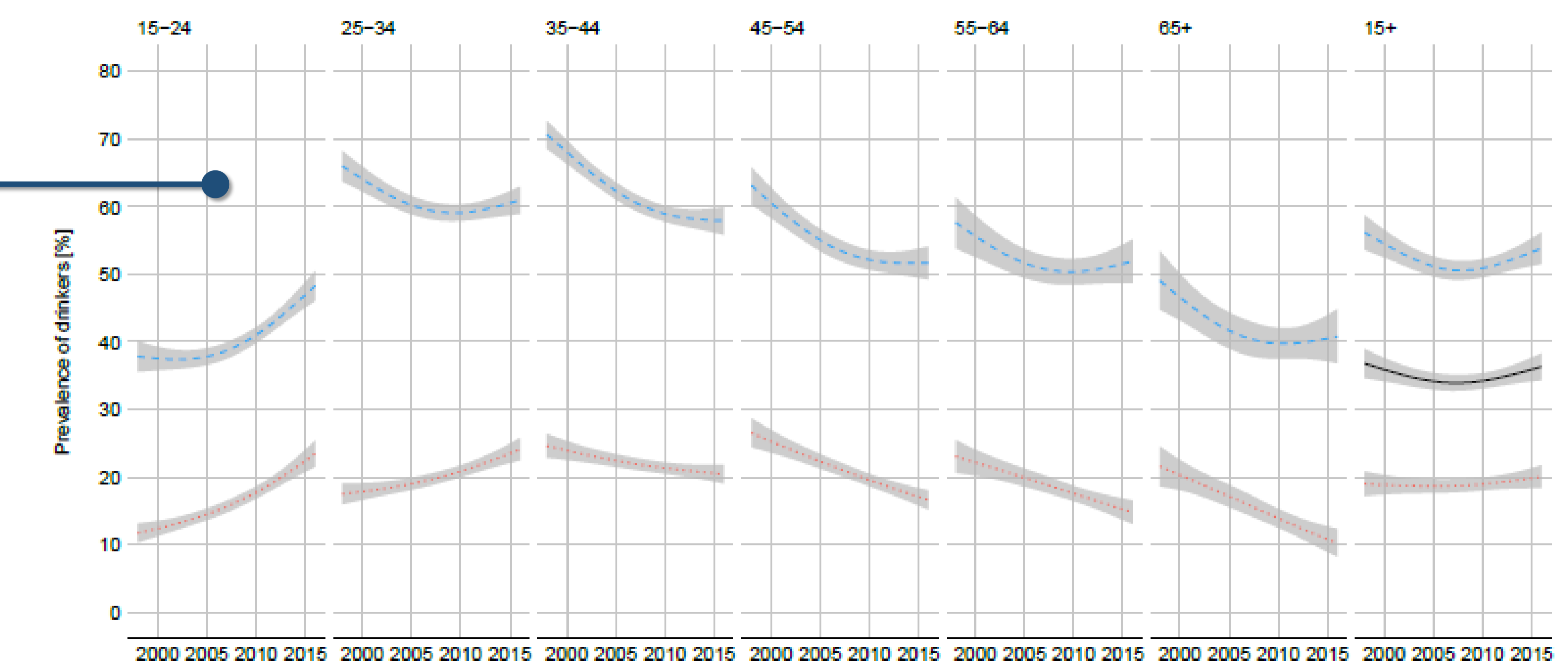
In South Africa, between 1998 and 2016 the **prevalence of drinkers** has substantially increased among young men (under 25) and women (under 35) and decreased in the older age groups Overall, the prevalence was slightly higher in 2016 than in 1998 for women (20% vs. 19%) and slightly lower for men (50.6% vs. 53.9%)

The **average daily consumption among drinkers** decreased from 52,1 g (4.3 standard drinks) to 42.8 g (3.6 drinks) for men and from 32.7 g (2.7 drinks) to 26.4 g (2.2 drinks) for women
The most substantial decrease happened among men in the 25-34 age category, with a reduction by more than 35%, from 6.8 to 4.4 drinks per day

Since 1998, the **proportion of heavy drinkers** has constantly decreased in the older age groups, especially among women.

Among the young of both sexes, after an initial decrease, the **proportion of heavy drinkers** has started **increasing after 2010**, at the expense of the proportion of light drinkers.

The proportion of **intermediate drinkers** has been substantially stable.



Heavy drinker: more than 60 g/day for men and 40 g/day for women



Intermediate drinker: between 24 and 60 g/day (men) and between 12 and 40 g/day (women)



Light drinker: less than 24 g/day (men) and less than 12 g/day (women)