

# A measure of alcohol affordability for Sweden: Capturing trends among different demographic groups

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## Abstract

The World Health Organization has rated alcohol abuse as one of the leading risk factors for population health worldwide and emphasises the relevance of alcohol affordability (AA) measures as important instruments to monitor alcohol control policy. The present study suggests an AA index that is suitable for measuring AA in Sweden, where off-premises alcohol is exclusively distributed by Systembolaget, the government-owned chain of liquor stores. Sweden provides uniform off-premises prices for alcohol and extensive register data, which profits the accuracy of this index. By allowing for AA comparisons across types of alcoholic beverages (beer, wine, spirits) and price categories, as well as across population groups (age, sex and family composition), and by being transferable to other Nordic countries with uniform off-premises prices, this study will facilitate governmental monitoring and supervision of the alcohol policy in Nordic countries. The suggested AA index is defined as the ratio of the median equivalised disposable income and the price per litre of 100% ethanol for alcohol, scaled to equal 100% in the base year. The

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income can be measured for the reviewed population or a subgroup, and the price measure can include all sold alcoholic beverages or separate them by beverage type and/or price category. Thereby, the index measures the number of litres of 100% ethanol that are affordable with the median income. Applying the index to the publicly available data for 2011–2019 from Statistics Sweden and Systembolaget reveals that alcohol in Sweden generally became more affordable, with high-priced alcoholic beverages becoming comparably more affordable than low-priced alcohol. However, low-priced beer became less affordable over the last decade. Future studies may validate the AA index against alcohol consumption.

### Keywords

alcohol affordability index, low-priced alcohol, review, subgroup analysis

The World Health Organization (WHO) rated harmful use of alcohol as one of the leading risk factors for population health worldwide. In the Global Strategies to Reduce Harmful Use of Alcohol from May 2010, the WHO recommended, *inter alia*, pricing policy, as well as monitoring and supervision of alcohol use as strategies to reduce the harmful use of alcohol and emphasised the relevance of alcohol affordability (AA) (World Health Organization, 2010). Affordability considers price and income concurrently, and the concept fundamentally implies the quantity of resources required to buy a unit of the product under investigation. While AA is expected to affect alcohol consumption, an AA index does not explicitly study consumption and harm but rather serves as a policy instrument, easing regular reviews on AA. By revealing how much alcohol prices need to be adjusted after a change in income to make AA equal before/after the change in income, the AA index carries forward crucial information to policy makers about the development of the alcohol control policy (Karlsson et al., 2010).

The aim of the present study is twofold. The first aim is to review the AA index literature and the second aim is to provide and apply an AA index for Sweden, where off-premises alcohol (>3.5 volume percent) is exclusively distributed by Systembolaget, the government-owned chain of liquor stores. Sweden provides, in contrast to most other countries, uniform off-premises prices for alcohol and extensive

register data, which should profit the accuracy of the index (development of a price measure for settings with non-uniform prices lies outside the scope of the current study). The measure should allow for AA comparisons across time, different types of alcoholic beverages, price categories, as well as across population subgroups within the country (sex, age and family composition), and shall be transferable to other Nordic countries with uniform off-premises prices for alcohol. Thereby, this study will facilitate governmental monitoring and supervision of the alcohol market in Nordic countries.

The AA index that is suggested in this study reveals how the number of litres of 100% ethanol that are affordable with the median equalised disposable income of the reviewed population changes over time. Specifically, the AA index is defined as the ratio of the median equalised disposable income and the price per litre of 100% ethanol for alcohol, scaled to equal 100% in the base year. The income can be measured for the reviewed population or a subgroup, and the price measure can include all sold alcoholic beverages or separate them by beverage type and/or price category.

Applying this index to the publicly available data from Statistics Sweden (SCB) and Systembolaget reveals that alcohol in Sweden generally became more affordable during 2011–2019 but the most affordable beverages (*i.e.*, low-priced beer), became less affordable. This may

indicate that consumers who are likely consuming low-priced beer, for example heavy drinkers (Gill et al., 2015), face a lower affordability of beer, whereas the general public encounters a higher affordability.

## Literature review

The AA literature evolved from the more extensive tobacco affordability literature, both of which will be reviewed in chronological order below. In addition, Table 1 gives an overview of the affordability measures used in previous literature investigating AA.

### *Minutes of labour approach*

In 1998, the WHO proposed to measure tobacco affordability by examining how many minutes of labour (MoL) are required to purchase a pack of cigarettes (World Health Organization, 1998). Guindon et al. (2002) were the first to apply this method, called the MoL approach, to measure the average number of working minutes required to purchase a pack of cigarettes in more than 80 countries. The MoL approach has subsequently been used by multiple authors in the tobacco affordability literature (Blecher & van Walbeek, 2009; Bogdanovica et al., 2011; Mackay et al., 2006) and the AA literature (Blecher et al., 2018; Häikiö, 2007; Health Promotion Agency (HPA), 2018; Imlach Gunasekara & Wilson, 2010). In Estonia, AA has been measured in a similar way by investigating how many litres of beer and vodka could be bought from an average monthly salary (Pärna, 2019). However, the MoL approach does not account for social benefits (Blecher et al., 2018), i.e., it does not consider students, unemployed persons and retirees. Thus, it does not represent the income level of the whole population and is thus unsuitable for the aim of this study.

### *Relative income price approach*

In 2004, Blecher and van Walbeek (2004) developed the relative income price (RIP) approach to

measure the affordability of cigarettes. RIP is calculated by dividing the nominal price of a good (e.g., pack of cigarettes) by a nominal income measure (e.g., per capita gross domestic product [GDP]), and has subsequently often been applied in the tobacco affordability literature (Bandi et al., 2013; Blecher et al., 2017; Blecher et al., 2013; Blecher & van Walbeek, 2004; Blecher & van Walbeek, 2009; Guindon et al., 2010; He et al., 2018; Kan, 2007; Kostova et al., 2014; Mackay et al., 2006; Nargis et al., 2019), as well as the AA literature (Blecher et al., 2018; Kan & Lau, 2013; Kerr et al., 2013). Thus, the RIP method may include all population subgroups and allow for subgroup analysis.

Kerr et al. (2013) investigated long-term trends of AA from 1950 to 2011 in the United States, and measured AA as the percentage of mean disposable income needed to buy one drink of a particular brand every day in a given year, which reveals the cost of regular low-risk drinking and can easily be increased to reflect higher drinking amounts. The beverage volume was converted into standard drinks (0.6 ounces of ethanol), and alcohol brand choices for comparison were primarily based on product popularity and availability over time. For spirits, both the cheapest available brand and one of the most popular brands were used, which was representative of other cheap or popular brands. Since data on income distribution and the mean or median disposable income of certain groups have not been available for the United States, the authors measured the cost burden of very heavy drinking on low-income households as the percentage of the upper limit of the lowest quintile of total household income needed to buy 10 drinks per day of selected brands.

Kan and Lau (2013) investigated the AA for 65 cities worldwide in 2009. The authors calculated the proportion of the median income required to buy a low-priced Scotch whiskey (700 mL), which was used as the indicator reflecting the overall price level of alcoholic beverages, because it was significantly correlated to the prices of other alcoholic beverages.

**Table 1.** Overview of existing alcohol affordability measures.

Author (year)	Title	Country	Aim of the study	Method	Affordability measure	Income measure	Price measure
Häikiö (2007)	Alkon historia (The history of Alko Inc.)	Finland	Implementing the "Koskenkova index", named after the most popular domestic brand of vodka	MoL	Number of hours a blue-collar worker needs to work to buy a bottle/litre of vodka	Median gross hourly earnings	Price of a bottle/litre of vodka
The NHS Information Centre (2008)	Statistics on Alcohol: England	England	To give an overview of health issues related to alcohol in England	NHS's AA	AA = (real households' disposable income index / real alcohol price index) × 100 (> 100: alcohol is relatively more affordable)	Real disposable income index (total household income minus payments of income tax or other taxes, social contributions and other current transfers, converted to real terms)	Real alcohol price index (measure of alcohol price vis-à-vis the price of all other goods)
Rabinovich et al. (2009)	The Affordability of Alcoholic Beverages in the European Union	European Union	Analysis of the alcohol affordability in 20 member states of the EU, 1996–2003	NHS's AA	AA = (real households' disposable income index / real alcohol price index) × 100 For young people: AA = mean equivalised net income / real alcohol price index	Real disposable income index (total household income minus payments of income tax or other taxes, social contributions and other current transfers, converted to real terms)	Real alcohol price index (measure of alcohol price vis-à-vis the price of all other goods)
Imlach Gunasekara and Wilson (2010)	Very cheap drinking in New Zealand: some alcohol is more affordable than bottled water and nearly as cheap as milk	New Zealand	Investigating temporal trends in alcohol affordability in New Zealand	MoL	Minutes of work to earn sufficient to buy enough alcohol to reach the legal blood alcohol limit (80 mg/dL), based on a conservative value of four standard drinks in each alcohol category for an average adult (4 standard units)	Average gross hourly earnings	Price per standard unit: volume of containers (litres) × % alcohol by volume (mL/100 mL) × 0.789 = number of standard drinks (calculated for beer, wine and spirits)

(continued)

Table 1. (continued)

Author (year)	Title	Country	Aim of the study	Method	Affordability measure	Income measure	Price measure
Seabrook (2010)	A new measure of alcohol affordability for the UK	England	Revision of the official UK measure of alcohol affordability published by the NHS	NHS's AA	AA = (per capita disposable income index / alcohol price index) $\times$ 100 (both nominator and denominator in nominal terms)	Income = QWIND - (ADFS + LQOB4C3 + QWMC) ADFS: housing costs LQOB4C3: repayments of mortgage principle QWMC: attributed insurance income Income per adult = Income/adult population (household's income (used by NHS) is divided by capita of UK)	Nominal alcohol price index
The NHS Information Centre (2010)	Statistics on Alcohol: England	England	Correction of their original index from 2008; accepted only one of three suggestions made by Seabrook (2010)	NHS's AA	AA = (real per capita disposable income index / real alcohol price index) $\times$ 100 For young people: AA = mean equivalised net income / real alcohol price index	Real per capita disposable income index (total household's income divided by capita; suggested from Seabrook, 2010)	Real alcohol price index (measure of alcohol price vis-à-vis the price of all other goods)
Wall and Casswell (2013)	Affordability of alcohol as a key driver of alcohol demand in New Zealand: a co-integration analysis	New Zealand	Co-integration analysis to examine the relationship between real price, affordability and consumption in New Zealand. Separate analyses for wine, beer, spirits and ready-to-drinks (spirits based pre-mixed drinks)	NHS's AA	AA = index of earnings / alcohol price series	Average weekly earnings index	Alcohol price series: alcohol price index (for alcohol and different beverage types)

(continued)

Table 1. (continued)

Author (year)	Title	Country	Aim of the study	Method	Affordability measure	Income measure	Price measure
Kan and Lau (2013)	Comparing alcohol affordability in 65 cities worldwide	Worldwide	Investigating the affordability of alcohol products for 65 cities in 2009	RIP	Proportion of the median income required to buy low-priced Scotch whiskey (700 mL), which was used as the indicator reflecting the overall price level of alcoholic beverages, because it was significantly correlated to the prices of other alcoholic beverages	Median daily income of the lowest 7 (out of 14) earning occupations from the UBS survey	Since low-priced Scotch whiskey was significantly correlated to the prices of other alcoholic beverages, it was used as the indicator reflecting the overall price level of alcoholic beverages
Kerr et al. (2013)	U.S. alcohol affordability and real tax rates	United States	Examining long-term trends in U.S. AA from 1950 to 2011, with attention paid to alternative measures of income and prices	RIP	1. (Inverse) Index: AA = (price of one standard drink per day of the cheapest spirits as well as popular brands of spirits, beer and wine / mean per capita disposable income per day). 2. Measure of the cost burden of very heavy drinking on low-income households: percentage of upper limit of the lowest quantile of household income needed to buy 10 drinks a day of selected brands	1. Mean per capita disposable income 2. Upper limit of lowest quintile of household income based on total income	1. CPI (alcoholic beverage Consumer Price Index; covers both on- and off-premises beer, wine and spirits prices and combines these into home, away-from-home and overall alcoholic beverage price indices. 2. Prices of specific brands available over time from two state-controlled retail systems 3. Prices of lower-priced brands, typically 1 or 2 brands of which data are available on a long-term basis → Brand prices are adjusted for inflation using the overall CPI to compare prices

(continued)

Author (year)	Title	Country	Aim of the study	Method	Affordability measure	Income measure	Price measure
Nelson (2014)	Alcohol Affordability and Alcohol Demand: Cross-Country Trends and Panel Data Estimates, 1975 to 2008	OECD countries	Analysing data for alcohol consumption per capita (ages 15+ years) for 2 samples: first, 17 countries in the OECD for the period 1975–2000; second, 22 countries in the EU for the period 2000–2008	NHS's AA	AA = (real per capita GDP index / real alcohol price index)	Per capita GDP in U.S. dollars, adjusted for PPP	Real price index of 1 L of alcohol. Country nominal price divided by country GDP deflator, expressed relative to 2000 price (PPP-adjusted)
Jiang and Livingston (2015)	The Dynamic Effects of Changes in Prices and Affordability on Alcohol Consumption: An Impulse Response Analysis	Australia	Investigating how changes in alcohol price and affordability are related to aggregate level alcohol consumption, and stressing the importance of cross-price elasticity	NHS's AA	AA = (per capita disposable income index / alcohol or beverage-specific price index) × 100 (all beverages together, and beer, wine, spirits separately; both nominator and denominator in nominal terms)	Average income index (average weekly earnings)	Nominal alcohol price index
Herttua et al. (2017)	Influence of affordability of alcohol on educational disparities in alcohol-related mortality in	Finland and Sweden	Estimating the association between affordability of alcohol overall and different types of alcoholic beverages and alcohol-related	NHS's AA	AA = (average taxable income / alcohol price index) × 100 (both nominator and denominator in nominal terms)	Average taxable income	Nominal alcohol price index

(continued)

**Table 1.** (continued)

Author (year)	Title	Country	Aim of the study	Method	Affordability measure	Income measure	Price measure
Health Promotion Agency (HPA) (2018)	Finland and Sweden: a time series analysis  Trends in affordability of alcohol in New Zealand	New Zealand	mortality among men and women across three educational groups in Finland and Sweden using time series analysis  Studying trends over time in alcohol prices and affordability in New Zealand to inform government policy and decision making on the price of alcohol	NHS's AA MoL	1. AA = average hourly gross earnings / alcohol CPI series 2. Minutes of work needed to earn a standard drink: median hourly gross earnings for people in paid employment (CPI average price per standard drink/ median earnings per minute) 3. Minutes of work needed to earn a standard drink for the lowest priced alcohol advertised	1. Average hourly gross earnings 2. Median hourly gross earnings	1. Alcohol CPI series for AA 2. Price per standard drink for MoL
Blecher et al. (2018)	An international analysis of the price and affordability of beer	International	To measure the affordability of beer in up to 92 countries from 1990 to 2016	RIP MoL	1. RIP of beer = nominal price/nominal income (percentage of per capita GDP required to buy 100 cans of the cheapest beer) 2. MoL = (median net earnings) needed to buy 100 cans of the cheapest beer	1. Per capita GDP 2. Robustness check: median income in many occupations (used 6 surveys to conduct a discrete time series of median earnings)	The cheapest of the following four observations is used: a local beer brand (in units of 1 L) or a premium/top-quality brand of beer (in units of 330 mL), bought in either a high-volume supermarket or a mid-price retail supermarket Average retail price of beer and vodka
Pärna (2019)	Alcohol consumption and	Estonia	Investigating trends in alcohol	MoL	Quantity of beer or vodka in litres, that	Average net monthly salary	Average retail price of beer and vodka

(continued)



Table 1. (continued)

Author (year)	Title	Country	Aim of the study	Method	Affordability measure	Income measure	Price measure
	alcohol policy in Estonia 2000–2017 in the context of Baltic and Nordic countries		consumption from 2002 to 2017		could be bought with the average net monthly salary		

Note. AA = alcohol affordability; ABV = alcohol by volume; CPI = consumer price index; GDP = gross domestic product; MoL = Minute of Labour Approach; NHS's AA = AA index that is based on the National Health Service's AA index for England; OECD = Organisation for Economic Co-operation and Development; PPP = purchasing power parity; RIP = Relative Income Price Approach.

The income data were taken from the Union Bank of Switzerland (UBS) survey, which is a periodical survey with daily wages of various occupations (from bus drivers to engineers) across continents (Union Bank of Switzerland, 2009), and the authors took the median daily income from the lowest seven (out of 14) earning occupations.

Blecher et al. (2018) measured the AA of beer from 1990 to 2016 in up to 92 countries. The authors used both the MoL approach as well as the RIP approach. For the latter, Blecher et al. calculated the percentage of per capita GDP required to buy 100 cans of the cheapest beer. To identify the cheapest beer price, the authors used the cheapest of the following four observations: a local beer brand (in units of 1 L) or a premium/top-quality brand of beer (in units of 330 mL), bought in either a high-volume supermarket or a mid-price retail supermarket. As an alternative to using per capita GDP, Blecher et al. performed a robustness check applying the median income over many occupations, which was obtained from six surveys.

Depending on the income measure, using the RIP approach can allow for AA comparison across time, beverage types and population sub-groups (including students, unemployed persons and retirees) and therefore may be suitable to achieve the aim of this study.

### *The National Health Service's (NHS) AA approach*

The latest approach to measure AA has its origin in the official UK measure of AA published by the NHS Information Centre. It is the only AA measure that does not deduce from the tobacco affordability literature, and calculates the AA by dividing the real disposable income of the total population by the real alcohol price index (The NHS Information Centre, 2008). This approach has subsequently been used by Rabinovich et al. (2009), who analysed the AA in 20 member states of the EU during 1996–2003.

Sharp criticism regarding the NHS's approach has been published by Seabrook (2010), who suggested, *inter alia*, the following two adjustments: first, the total income of the UK should be divided by the number of adults in the population, giving income per adult; and second, using nominal prices instead of real (i.e., general inflation adjusted) prices would make the index simpler and less vulnerable to unexpected effects resulting from specific products driving changes in the inflation and retail prices. Using nominal alcohol prices and income makes the prices of other goods irrelevant, whereas using real prices raises the question of whether the price changes of other goods make alcohol more or less affordable. The NHS's AA index, which is based on real prices and income, implies that increasing food prices make alcohol more "affordable" relative to food. However, the increasing food prices might leave less money to spend on alcohol. Thus, adjustments for inflation may have counter-intuitive effects (Seabrook, 2010), which can be circumvented by using nominal alcohol prices and income. For their subsequent report in 2012, the NHS reacted to Seabrook's criticism, but did only substitute the total household disposable income by per capita disposable income (Health and Social Care Information Centre, 2012). This adjusted index has subsequently been used by Nelson (2014) to indicate the AA across countries in the Organisation for Economic Cooperation and Development (OECD).

Recently, multiple researchers used data on individual income instead of disposable income generated from GDP, as suggested by Seabrook (2010), to determine AA (Health Promotion Agency (HPA), 2018; Herttua et al., 2017; Jiang & Livingston, 2015; Wall & Casswell, 2013). Most of them (Health Promotion Agency (HPA), 2018; Jiang & Livingston, 2015; Wall & Casswell, 2013) used average work income, and thereby excluded the non-working population. For Sweden and Finland, Herttua et al. (2017) used this method to estimate the association

between AA and alcohol-related mortality among men and women across three educational groups. Instead of disposable income, Herttua et al. used individual taxable income, which comprises wages, capital income and taxable income transfers, but excludes certain social benefits and allowances not subject to taxation.

Since the NHS's index and its modifications allow for comparisons of AA across time, beverage types and, depending on the income measure, across subgroups, it may be used to fulfil the aim of this study.

## Methods

The literature review revealed that the rather similar RIP and the AA index originating from the NHS's approach could potentially be used in this study as both allow for comparison across time, population groups (sex, age and family composition) and different types of alcoholic beverages, as well as across different price segments. Both approaches combine an income measure and an alcohol price measure, whereby the RIP approach uses the alcohol price measure as the nominator and the income measure as the denominator, and the approach based on the NHS's AA index divides the income measure by the price measure. Thus, potential income and price measures available in Sweden and the preferable composition of the index will be discussed below.

### *Income measure*

Frequently used income measures in the previous literature are GDP and work income, but other income measures are conceivable. Per capita GDP is generally regarded as a good indicator of average living standards and has frequently been used in AA studies (e.g., Blecher et al., 2018; Blecher & van Walbeek, 2004, 2009). However, since it does not reflect the income distribution within a country, and therefore does not allow for subgroup analyses, per capita GDP cannot be used to achieve the

aim of this study. Several authors use work income (Health Promotion Agency (HPA), 2018; Jiang & Livingston, 2015; Kan & Lau, 2013; Wall & Casswell, 2013) as an income measure instead. The worldwide data on work income generated from the UBS survey (e.g., Union Bank of Switzerland, 2009) are attractive for cross-country comparisons, but exclude students, unemployed persons and retirees, which is an important disadvantage since our aim is to measure AA across all population groups.

According to Seabrook (2010) and Kerr et al. (2013), using individual disposable income data is most recommendable. Disposable individual income includes all forms of income after taxes, and thereby likely best represents average individual purchasing power. It allows for the comparison of AA across population subgroups (including students, unemployed persons and retirees) and thus fulfils our requirements. Using individual disposable income equalised according to household income and the number of adults and children in the household improves this measure further. Having children induces child-related income but leads to higher expenses as well. Families likely see their collective income as a family income and may split it equally among the partners, especially when one parent faces income reductions due to caring for their children at home. SCB provides data on equalised disposable income and uses an equivalence scale that assigns a weight of 1 to the first adult, 0.51 to the second adult, 0.60 to subsequent adults, 0.52 to the first child and 0.42 to subsequent children living in the household.

To minimise the effect of outliers, we use the median equalised disposable income (median income hereafter) instead of the mean, because the median represents the “average” earner, who is at the mid-point of earners (half earn more and half earn less), and allows for greater accuracy in countries with large income dispersions (e.g., Blecher et al., 2018; Kan & Lau, 2013). Other percentiles can be used to study different population subgroups based on income.

SCB provides data on the median income for the Swedish population and its subgroups. While the price of alcohol is constant across different subgroups, the median income must be determined separately for each subgroup. Income data differentiated by sex, age and family composition are publicly available. Data that allow to differentiate across other subgroups, for example by income or education level, must be applied for.

### *Price measure*

The alcohol price measure used in the literature differs depending on whether the researchers uses an alcohol price index provided by national statistics (e.g., Herttua et al., 2017; The NHS Information Centre, 2008) or generated their own price measure. For example, Pärna (2019) used the average retail price of beer and vodka, Blecher et al. (2018) used the cheapest price per bottle, Kan and Lau (2013) used the bottle price of a particular beverage that is significantly correlated to the prices of other alcoholic beverages, Kerr et al. (2013) used the price per standard drink of one or two lower-priced brands, which were selected based on data availability, and the Health Promotion Agency (HPA) (2018) calculated the alcohol price per standard drink in New Zealand by considering the one percentile lowest prices per beverage type.

Most studies that use an alcohol price index utilise the real alcohol price index, which puts the alcohol price index in relation to the price index of all other goods (e.g., Nelson, 2014; Rabinovich et al., 2009; The NHS Information Centre, 2008). However, Seabrook (2010) and Herttua et al. (2017) argue that nominal prices, as opposed to real prices, are simpler and less vulnerable to unexpected effects resulting from specific products driving changes in the price index of all goods. We follow Seabrook and Herttua et al. and use the nominal alcohol price to investigate the AA for three reasons. First, the AA index does not incorporate elasticities of demand or

consumption. Therefore, AA does not depend on the prices of other goods. Second, while using nominal alcohol prices disregards the prices of other goods, using real prices raises the question of whether the price changes of other goods increase or reduce AA. For example, the NHS's AA index, which is based on real prices, implies that rising food prices make alcohol more affordable relative to food. However, the increasing food prices might leave less money to spend on alcohol. Thus, adjustments for inflation may have counter-intuitive effects (Seabrook, 2010) that can be circumvented by using nominal alcohol prices. Third, correcting both the nominator and denominator for inflation would lead to the same results as using both the nominator and denominator in nominal terms (although the latter could potentially lead to the counter-intuitive effects as mentioned above). Since using income and price measures in nominal terms is both easier and reduces the risk of measurement errors (Seabrook, 2010), we prefer this option.

A nominal off-premises alcohol price index for Sweden can be obtained from SCB. SCB's alcohol price index is based on the price change of each individual alcoholic product sold by Systembolaget in each calendar year and shows a weighted average (where the price of each beverage is weighted by its revenue from the previous year) of those individual price changes for each beverage type. The measure is based on bottle prices and does not consider the different and changing strength of alcoholic beverages. Accounting for the alcohol content and using the nominal average price, and not the average price change, makes the AA index easier to interpret, for which reason using an individual price measure is our preferred option.

The various individual price measures for the AA index used in previous literature come with several disadvantages. Using the price of a particular beverage that is significantly correlated to the prices of other alcoholic beverages (e.g.,

Kan & Lau, 2013) does not allow for comparisons across beverage types nor across the lowest priced beverages. Moreover, focusing only on the cheapest beverage in each beverage category (Blecher et al., 2018; Health Promotion Agency (HPA), 2018; Kerr et al., 2013) does not cover the typical drinking habits of the population. Most people tend to buy the popular brands and not the cheapest ones available. Therefore, we use the average price of all beverages in every beverage category (beer, wine, spirits), based on sales volume; and to capture the price of alcohol in the lowest price segment, we use the average price of the 10% cheapest beverages in every beverage category, based on their number of sales. Using the average price makes the measurement less vulnerable to outliers. Further, investigating both the AA of all beverages based on their popularity, as well as the AA of the cheapest beverages, likely gives some more insight into the AA of the society at large, as well as for heavier drinkers, who tend to consume the beverages that are cheapest in relation to their alcohol content (e.g., Gill et al., 2015).

Various measurands for the average price are conceivable and entail different advantages. The price per standard drink (e.g., Kerr et al., 2013) is easy to interpret and makes comparison across beverage types possible. Therefore, it should be preferred over bottle prices. However, it could lead to difficulties comparing AA across countries, because the size of a standard drink varies considerably between countries. We use price per litre of 100% ethanol, as it is the most standardised measurand, and has been used previously in Sweden to examine the price elasticity of alcohol (Norström, 2005).

The average price of 1 L of 100% ethanol of all beverages as well as of the 10% cheapest beverages in each beverage category can be generated from Systembolaget's *Försäljningsstatistik* (sales statistics). The *Årsrapporter* (yearly reports) contain yearly information from 2009 onwards, including a

list of all articles with information on beverage category, bottle size, price and number of litres sold. The alcohol content is not consistently provided in these publicly available data, but upon request Systembolaget provides the data including alcohol content.

To determine the average nominal price of 1 L of 100% ethanol, we convert each beverage's bottle price to a litre price of 100% ethanol and weight the beverages by the quantity of sales. To get the average price per beverage category, as well as for all alcoholic beverages combined, the weighting is done separately for each beverage category, as well as across all alcoholic beverages combined. To calculate the average price in the lowest price segment, we sort the beverages by price per litre of 100% ethanol and calculate the average price, based on the quantity of sales, of the cheapest 10% of all alcoholic beverages together, as well as for the beverages in each category (beer, wine, spirits) separately. A potential concern regarding a price measure based on the proportion of sales is that people might change their consumption preferences and, for example, buy more expensive beverages. That would lead to a lower AA, even though the price level of alcoholic beverages might not have changed. This concern cannot be completely ruled out, but one can assume that such changes in taste evolve very slowly and are therefore negligible. A strength of using the average price of all sales is that it minimises the potential bias and reflects the AA consumers actually face.

### *Measurement specifications*

While the RIP approach uses the alcohol price measure as the nominator and the income measure as the denominator, the approach based on the NHS's AA index suggests dividing the income measure by the price measure. Although there is no practical difference, the advantage of the latter is that the index evolves in the same direction as alcohol affordability, i.e., if income increases or alcohol prices

decrease, the AA index increases. Therefore, we use the following index, which reveals how many litres of 100% ethanol are affordable given the median monthly income of the reviewed population (or subgroup):

$$\text{AA index} = \frac{\text{median equivalized disposable income}}{\text{average price of one liter of 100\% ethanol}}$$

Subsequently, the index will be scaled to equal 100% in the base year. The index consists of nominal income and alcohol price measures and captures how income and alcohol prices affect AA. Even though general inflation is not directly included in the index, it may still indirectly affect AA when alcohol prices do not change to the same extent as the general inflation level does, as reflected by an increase in income levels.

The AA can be determined for the whole population, as well as for different subgroups. For this, the respective median income in the subgroup (or different percentiles of the income distribution) is used and divided by the price per litre of 100% ethanol for alcohol as such, as well as the price per litre of 100% ethanol for each beverage type separately. To examine how AA evolved across beverage groups, the respective average price of 1 L of 100% ethanol of each beverage group is taken. Further, the AA can be examined across different price segments. For example, to indicate the AA in the lowest price segment, the average price per litre of 100% ethanol of the cheapest 10% of beverages in each category will be used as the price measure.

### **Alcohol affordability in Sweden**

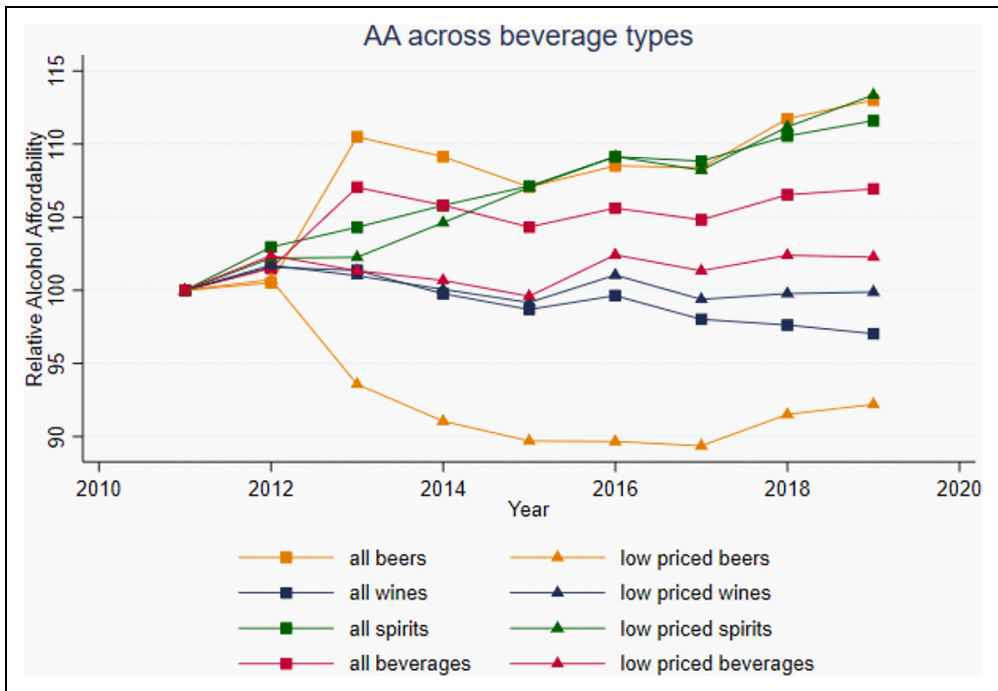
To examine the AA across different price categories of alcoholic beverages and across individuals in different age groups and with different sex and family composition in Sweden during 2011–2019, we used publicly available data from SCB and Systembolaget.

Data from Systembolaget are available for the years 2009–2020, whereas SCB’s publicly available data on median income are available for the years 1991–2019. The latter is based on survey data on Household Finances (HEK) during 1991–2013, and Incomes and Taxes (IoS) during 2011–2019. There are differences in the median income between the two surveys in the overlapping years, which may lead to diverging measures of AA. We therefore base the analysis solely on the data from IoS, i.e., the years 2011–2019.

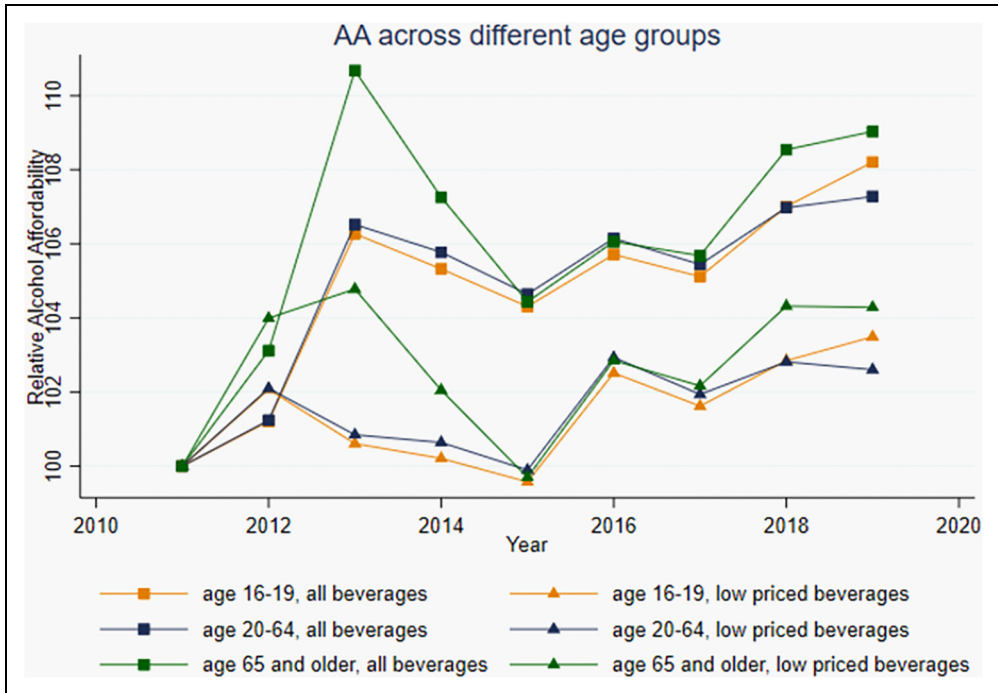
Figure 1 displays the affordability of beer, wine and spirits, as well as all alcoholic beverages combined and differentiates between all beverages in each group and the 10% cheapest

beverages in each group. The series are scaled to equal 100% in the base year 2011. All sold alcoholic beverages, as well as the 10% cheapest beverages in *all beverage categories* combined, have become more affordable. Separating the beverages by category, *all beer* and *all spirits* have become more affordable over time, while the affordability of *all wine* has decreased slightly. Looking at the 10% cheapest beverages in each group, the trends for *wine* and *spirits* are similar but the trend for *beer* differs. While *beer* in general has become more affordable, *beer in the lowest price category* has become less affordable.

Figure 2 displays the AA index for the age groups 16–19 years, 20–64 years and 65 years



**Figure 1.** Relative number of litres of 100% ethanol that can be afforded with the yearly median equivalised disposable income in Sweden. Note: The base year of the index is 2011. Beers include beverages considered as beers, ciders and mixed drinks. The average price of *all* beers, wines, spirits and all beverages is weighted by the share of sales of each beverage. The average price of the *low-priced* beers, wines, spirits and all beverages is based on the cheapest 10% of beverages in each category and weighted by the share of sales of the beverage in the category.



**Figure 2.** Relative number of litres of 100% ethanol that can be afforded with the yearly median equivalised disposable income of the respective age groups in Sweden. Note: The base year of the index is 2011. The average price is weighted by the share of sales of each beverage.

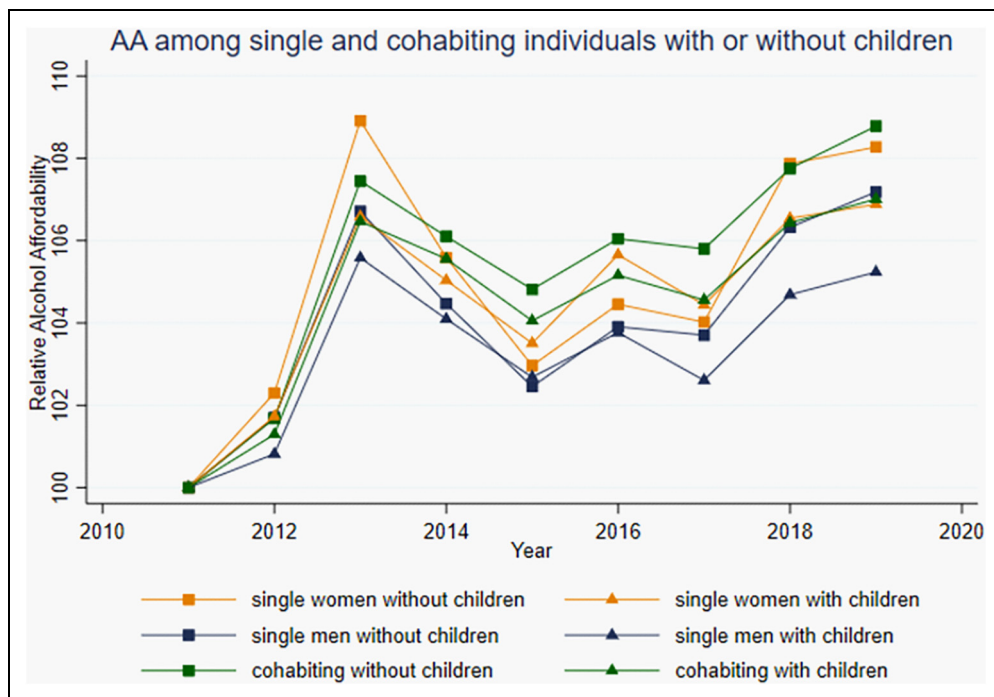
and older, and shows that AA increased from 2011 to 2019 across all age groups, and that all sold alcoholic beverages combined became relatively more affordable than the 10% cheapest alcoholic beverages. The jump in AA across individuals aged 65 years and older in 2013 likely reflects the historically high real increase in income pension in 2013 (Pensionsmyndigheten [The Swedish Pensions Agency], 2012), and the decreases in AA in the years 2014, 2015 and 2017 coincides with the increase in alcohol tax in these years (Skatteverket, 2008, 2014, 2015, 2017).

Figure 3 displays that alcohol has become more affordable for the different family compositions and that alcoholic beverages have become relatively more affordable for individuals without children, than for individuals with children (children in that study are aged 0–19 years). As before, the development is in

line with the changes in income level and alcohol tax changes. Figures 4 and 5 outline in absolute terms the AA across beverage types and age groups.

## Discussion

Applying the index to the publicly available data for 2011–2019 from SCB and Systembolaget revealed that alcohol in Sweden generally became more affordable across all investigated subgroups. However, low-priced beer, which is the cheapest alcoholic drink available (Figure 4), became less affordable. Thus, the AA of the cheapest available beverages has decreased and may make beer less affordable for population groups who tend to consume low-priced beers, such as heavy drinkers (Gill et al., 2015) and presumably under-aged drinkers. In contrast, the majority



**Figure 3.** Relative number of litres of 100% ethanol that can be afforded with the yearly median equivalised disposable income of a person in the respective subgroup in Sweden. Note: The base year of the index is 2011. Individuals are considered to have children if their children are aged 0–19 years. The average price of alcoholic beverages is weighted by the share of sales of each beverage.

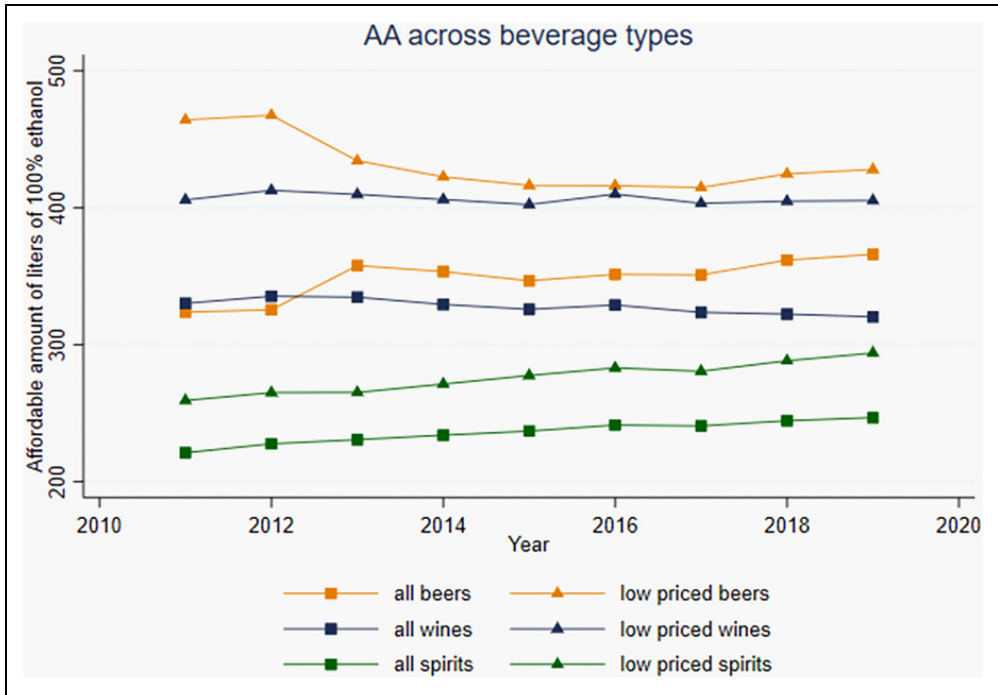
of consumers, who consume not primarily the cheapest beers available, encounter a higher affordability of beer. Further, the results reveal that the affordability of low-priced beverages increased relatively less than the affordability of all alcoholic beverages combined. This suggests that consumers who do not primarily consume the cheapest drinks available encounter a higher increase in AA than population groups who tend to consume low-priced beverages.

There are, nevertheless, limitations to the AA index proposed in this study. First, it does not include on-premises alcoholic beverages. Second, it does not account for imported or self-produced alcoholic beverages. The share of alcoholic beverages bought at Systembolaget varies across regions, with the lowest rate in Skåne, which is known for high alcohol import rates, and the highest rate in Norrland

(Ramstedt et al., 2009). Thus, the actual informational content of the AA index may vary across regions. Third, using the median equivalised disposable income reveals higher income levels of teenagers, compared to retired persons (Figure 5). This is likely due to teenagers living in families with a higher income that is equivalised across the family members than retired persons do. While this is not an issue for comparing percentual changes in AA across different groups, it might lead to a misleading absolute number of litres of 100% ethanol that can be afforded across subgroups.

Further, the AA index is a simplification, which has the advantage of making it an easy policy tool to measure and track AA over time, but which entails three shortcomings regarding the prediction of alcohol consumption. First, the AA measure does not link directly to a policy



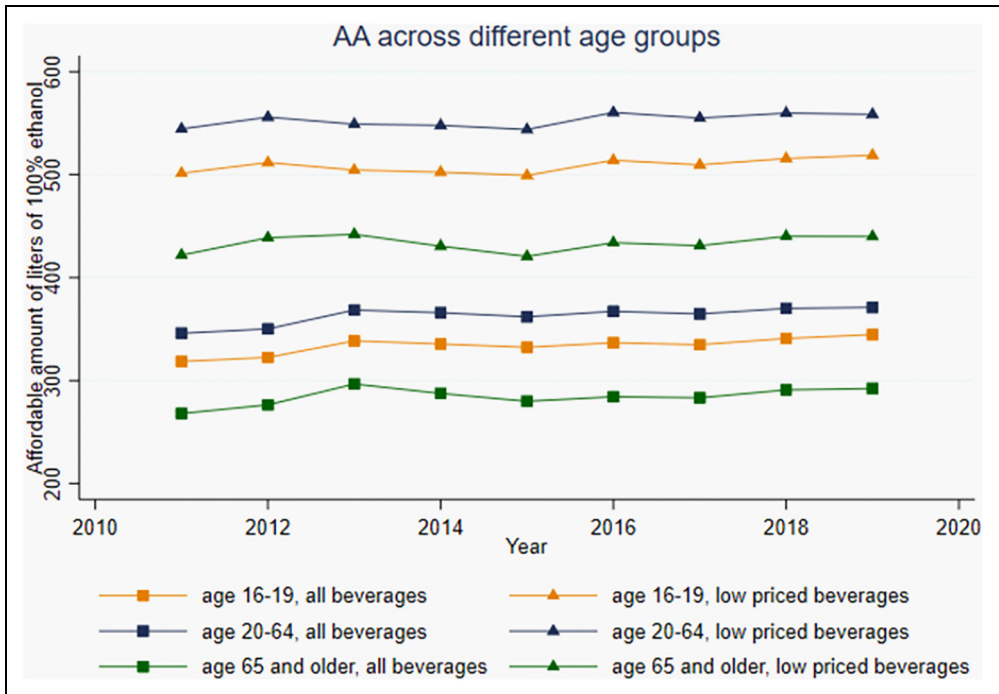


**Figure 4.** Number of litres of 100% ethanol that can be afforded with the yearly median equivalised disposable income in Sweden. Note: Beers include beverages considered as beers, ciders and mixed drinks. The average price of *all* beers, wines and spirits is weighted by the share of sales of each beverage. The average price of the *low-priced* beers, wines and spirits is based on the cheapest 10% of beverages in each category and weighted by the share of sales of the beverage in the category.

instrument and politics can only aim to change AA indirectly by changing taxes or imposing price regulations. To investigate how concrete changes in taxes or price regulations affect alcohol consumption, examining the relationship between taxation, price regulation and alcohol consumption directly may be the better choice (Rabinovich et al., 2009). Second, AA does not take elasticities of demand into account, and the effect on an individual's demand for alcohol will be different depending on whether the income or the price changes. To overcome this limitation, one would have to distinguish between the separate effects (i.e., income and price of alcohol, *ceteris paribus*) on the consumption of alcohol (Rabinovich et al., 2009). Third, according to the principles of price elasticity of demand, increased AA might affect alcohol

consumption and harm differently. On the one hand, higher AA may rise alcohol-related harm because of increased excess drinking. On the other hand, higher AA may also affect people's choices as people might buy more expensive beverages of a higher quality (Gruenewald et al., 2006) or buy more beverages to store them for later use (Robinson et al., 2013). For goods that can be stored easily, such as alcoholic beverages, demand in the short run might be more elastic than long-run demand. Further, changes in AA of alcohol in Systembolaget may lead to switches to or from illicit, imported or self-produced alcoholic beverages.

Despite these discussed shortcomings, future research may investigate the relationship between the AA index and alcohol consumption and harm to examine the relevance of the AA index.



**Figure 5.** Number of litres of 100% ethanol that can be afforded with the yearly median equivalised disposable income of the respective age groups in Sweden. Note: The average price is weighted by the share of sales of each beverage.

Overall, an extensive discussion of the numerous variants of AA indices with different income and price measures used by previous literature was needed to develop an AA index that takes advantage of the uniform off-premises prices for alcohol and the extensive register data of Sweden. Our AA index shows how the number of litres of 100% ethanol that are affordable with the median equivalised disposable income of the reviewed population changes over time and allows for affordability comparisons across different types of alcoholic beverages, price categories, as well as across population groups (e.g., by sex, age and family composition). Thereby, it is intended to serve as a policy instrument that helps policy makers in Sweden and other Nordic countries with uniform off-premises prices, establishing an effective price policy and to evaluate alcohol control policy in the long run.


### Declaration of conflicting interests

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