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Executive Summary

The aim of this project was to model the impact of alcohol on mortality, years of life lost and burden of disease for Switzerland for the year 2002 in a way, which is compatible with current effort of the World Health Organization (WHO) in alcohol monitoring and surveillance. Thus, the main results for this project follow the methodology of WHO in each point.

Key elements of the methodology can be described as follows:

- Exposure to alcohol has been estimated based on the Swiss Health Survey where the self-reported data have adjusted for the *per capita* consumption including unrecorded consumption taken from the WHO Global Alcohol Database.
- Risk relations were taken from the Comparative Risk Assessment of WHO, which is based on disease-specific meta-analyses for chronic disease categories, and pooled cross-sectional time series analyses for injuries.
- Deaths, years of life lost (YLLs) and disability-adjusted life years (DALYs) were obtained from the WHO.

The steps of the methodology are described in detail to enable replication of the estimates in further years.

Results show that Switzerland continues to be a country with a very high level of alcohol consumption compared to international standards and consequently high level of alcohol-related disease burden:

- For the year 2002, alcohol caused more than 2'000 deaths, mostly in man (78%). These are net numbers, where the cardioprotective and other beneficial effects of alcohol have already been taken into account. In total, more than 3.3% of all deaths in the year 2002 in Switzerland were attributable to alcohol (5.2% among men, and 1.4% among women), a higher proportion compared to the surrounding countries.
- The largest single disease contributor to alcohol-attributable deaths was liver cirrhosis with more than 600 deaths, but if larger categories were examined, cancer was the largest contributor with more than 1'200 deaths. Ischaemic heart disease was largest contributor alcohol-attributable lives saved, with almost 1'100.
- In the year 2002, alcohol caused a net 29'000 years of life lost due to premature mortality (YLL), and more than 70'000 net disability-adjusted life years (DALYs). Overall, 8.2% of the YLLs in Switzerland (10.5% among men and 4.9% among men) were net attributable to alcohol, as well as 8.8% of DALYs (12.9% among men and

4.2% among men). Again, these proportions were higher than surrounding countries, mainly because of the higher proportions for women.

- For DALYs, neuropsychiatric disorders, especially alcohol use disorders are the most important disease category. Alcohol use disorders are less fatal than other chronic diseases, but in summary measures such as DALYs they are main contributors because of their high prevalence combined with their marked impact on disability.

Given the high burden of disease attributable to alcohol, even in comparison with the surrounding countries, prevention and policy measures should be taken to reduce this burden. Clearly, the overall level of consumption should be reduced, and taxation and other proven cost-effective measures are available to achieve this reduction, including but not limited to restrictions in availability and marketing/advertisements. Moreover, specific measures should be taken to reduce the alcohol-attributable disease among women and young adults.

Key words: alcohol – Switzerland – burden of disease – mortality – years of life lost – disability-adjusted life years

Deutschsprachige Kurzzusammenfassung

Ziel des Projekts war die Schätzung der Zahl alkoholbedingter Todesfälle, verlorener Lebensjahre und Krankheitslast in der Schweiz im Jahr 2002. Die gegenwärtig von der Weltgesundheitsorganisation WHO unternommenen Schritte beim Monitoring von Alkoholfolgen sind in allen Stufen vollkommen vergleichbar zur hier eingesetzten Methodik. .

Die wichtigsten methodischen Details sind:

- Alkoholkonsum als die Einflussvariable wurde aufgrund der Daten der jüngst verfügbaren Schweizerischen Gesundheitsbefragung operationalisiert, wobei der selbstberichtete Konsum aber adjustiert wurde anhand der offiziellen pro-Kopf Verkaufsmengen von Alkohol zuzüglich Schätzungen des nicht versteuerten Alkoholverkaufs.
- Die Stärke des Zusammenhangs zwischen Konsum und Schadensfolgen wurde übernommen aus den Schätzungen der Comparative Risk Assessment (CRA) Studie der WHO. Die CRA-Studie benutzte für diese Schätzung krankheitsspezifische Meta-Analysen für langfristige Folgen (chronische Krankheiten) und spezielle Techniken zur Zeitreihenanalyse über mehrere Länder hinweg bei der Bestimmung kurzfristiger (Unfall-)Folgen.
- Todesfälle, verlorene Lebensjahre und für Funktionseinschränkungen adjustierte Lebensjahre (disability-adjusted life years =DALYs) wurden aus den Datenbanken der WHO übernommen.

Durch die detaillierte Beschreibung jedes einzelnen Schrittes der Schätzmethode wird eine Wiederholung der Schätzungen in späteren Jahren möglich sein, was für künftige Vergleiche essenziell ist.

Die Schweiz zeigt sich im internationalen Vergleich weiterhin als ein Land mit sehr hohem Alkoholkonsum. Deshalb weist sie auch ein hohes Ausmass von alkoholbedingter Krankheitslast auf:

- Im Jahr 2002 sind mehr als 2'000 Todesfälle dem Alkoholkonsum zuzurechnen, die meisten davon betreffen Männer (78%). Diese Zahlen berücksichtigen als Nettoschätzung bereits die kardioprotektiven und anderen positiven Auswirkungen mässigen Alkoholkonsums auf manche Krankheiten. Insgesamt waren gut 3.3% der Todesfälle in der Schweiz alkoholbedingt (bei Männern 5.2%, bei Frauen 1.4%). Dies ist ein jeweils höherer Prozentsatz als in den angrenzenden Nachbarländern.

- Leberzirrhose ist mit mehr als 600 alkoholbedingten Todesfällen die wichtigste spezifische Einzeldiagnose unter den alkoholbedingten Todesfällen. Bei Betrachtung von breiter gefassten Diagnosegruppen sind Krebserkrankungen mit gut 1'200 Todesfällen die wichtigste Todesursache. Ischämische Herzkrankheiten sind die grösste Gruppe bei den durch Alkoholkonsum verhinderten Todesfällen (1'100 Fälle).
- Im Jahr 2002 bedeutete der Alkoholkonsum in der Schweiz netto 29'000 verlorene Lebensjahre und mehr als 70'000 disability-adjusted life years (DALYs). 8.2% aller verlorenen Lebensjahre in der Schweiz im Jahre 2002 waren alkoholbedingt (10.5% bei den Männern und 4.9% bei den Frauen). Bei der gesamten Krankheitslast (gemessen in DALYs) sind 8.8% durch den Alkoholkonsum bedingt gewesen (12.9% bei den Männern und 4.2% bei den Frauen). Auch diese Anteile waren in der Schweiz höher als in den benachbarten Ländern, vorwiegend aufgrund einer relativ höheren Belastung bei den Schweizer Frauen.
- Neuropsychiatrische Diagnosen, insbesondere Alkoholkrankheiten wie Abhängigkeit, Alkoholpsychosen oder Alkoholmissbrauch, stellen hinsichtlich der alkoholbedingten Krankheitslast (DALYs) den grössten Anteil. Alkoholkrankheiten verlaufen seltener tödlich als andere chronische Krankheiten. Aber im Rahmen von Gesundheitsindikatoren mit einem breiteren Ansatz, die nicht nur auf Mortalität fussen, sind sie besonders grosse Einflussfaktoren, weil sie einerseits in der Bevölkerung sehr weit verbreitet sind und weil sie andererseits zu Krankheiten mit schwerwiegenden Krankheitsfolgen führen.

Angesichts der absolut, aber auch im Vergleich mit den benachbarten Ländern sehr hohen alkoholbedingten Krankheitslast sollten gesundheitspolitische Massnahmen insbesondere zur Prävention ergriffen werden. Erstes Ziel wäre dabei die Reduktion des hohen Gesamtkonsums. Massnahmen wie höhere Besteuerung von Alkoholika, Beschränkungen der Verfügbarkeit, sowie Einschränkung von Werbung und Verkaufsförderung haben ihre Wirksamkeit bewiesen und sind kosteneffektiv. Angesichts der spezifischen epidemiologischen Situation in der Schweiz sollten auch speziellen Massnahmen für Frauen und junge Erwachsene ergriffen werden.

Schlüsselwörter: Alkohol – Schweiz – Krankheitslast – Mortalität – verlorene Lebensjahre – für Funktionseinschränkungen adjustierte Lebensjahre (disability-adjusted life years = DALYs)

Glossary

Number in brackets denotes the page of first appearance

AAF **Alcohol-attributable Fraction** - Defined as the fraction (proportion) of the outcome (e.g. deaths, **->** YLL or **->** DALYS) in the population that would not have occurred if the effect associated with alcohol use was absent, i.e. if no alcohol had been consumed in the population (Walter, 1976, 1980). (p.13)

CRA: **C**omparative **R**isk **A**ssessment – Study of the -> WHO, which compared the impact of 26 risk factors on mortality and burden of disease. The main results of the first CRA for the year 2000 were published in the World Health Report 2002 (WHO, 2002). (p.11).

DALY: **D**isability-**A**djusted **L**ife **Y**ears – Summary measure of health which combines years of life lost due to premature mortality (**->** YLL) with years of life "lost" due to disability, i.e. years lived with disabling conditions. The disability years lost are calculated by multiplying the time living with a disease condition by the disability weight of the condition. Disability weights measure the degree of impact of a disease condition on disability, i.e. activity limitations and impairments. Disability weights vary between zero (no disabling effect at all) and one (death). Each disease condition was assigned one or more disability weights, dependent on the severity and progression of the disease, using a complicated procedure that involved expert estimates of the relative impact of different disease conditions (p.20).

Below is a simplified example (without time-discounting and age-weighting) of how the DALY is calculated, using the example of a male in Canada with liver cirrhosis (diagnosed at 50 years old), who dies at age 68.

Example calculation below:
DALY = YLL + YLD
where
YLL = years of life lost due to premature mortality
YLD = years lived with a disability

In this case, the average life expectancy for a man in Canada is 78.0 (http://www.who.int/countries/can/en/),
so the years of life lost by dying at age 68 is
YLL = 78 – 68 = 10 years.

In addition, since he was diagnosed at age 50, he has suffered a number of years and thus has not enjoyed a completely healthy life. This is also taken into account by:
YLD = I x DW x L
where
I = number of incident cases (in our case I = 1)
DW = disability weight that accounts for health state (0 = completely healthy, 1 = dead)
L = length of time lived with disability

Therefore, since in our example the person has lived with cirrhosis for 18 years and the disability weight for cirrhosis is 0.33,
YLD = 18 x 0.33 = 5.94 years.

Thus, the total DALY contribution of this man to burden of disease is
DALY = YLL +YLD = 10 + 5.94 = 15.94 years.

EU:	**E**uropean **U**nion (p.11)
EUR A	WHO Region denoting the richest countries within **Eur**ope: Andorra, Austria, Belgium, Croatia, Cyprus, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Israel, Italy, Luxembourg, Malta, Monaco, Netherlands, Norway, Portugal, San Marino, Slovenia, Spain, Sweden, Switzerland, United Kingdom (p.34)
FAO:	**F**ood and **A**griculture **O**rganization of the United Nations (p.9)
FAOSTAT:	Statistical database of **->** FAO (p.9)
g/day:	**G**rams per **D**ay (p.13)
GAD:	WHO **G**lobal **A**lcohol **D**atabase – A **->** WHO database which is publicly accessible (**www.who.int**) and contains information on alcohol production, consumption, and alcohol-attributable disease burden. (p.9)
RR:	**R**elative **R**isk - The chances of contracting a disease from a particular cause (eg, alcohol use) relative to the chances of contracting a disease in general. For example, if the relative risk of falls related to alcohol 3, it means that people using alcohol are 3 times more likely to be injured in a fall than people who do not use alcohol. (p.21)
UN:	**U**nited **N**ations (p.9)
WHS	**W**orld **H**ealth **S**urvey – Large representative surveys in different countries, conducted by the **->** WHO in the past decade. (p.12)
WDT:	**W**orld **D**rink **T**rends – Publication of the alcohol industry estimating per capita consumption of pure alcohol for different countries based on sales data. (p.9)
WHO:	**W**orld **H**ealth **O**rganization – **->** UN agency responsible for health matters. (p.8)
YLL	**Y**ears of **L**ife **L**ost – Years of life a person would have lived if he/she had not died prematurely. YLL are calculated based on the residual life expectancy at the time of death. Assume the life expectancy for males in a country at age 50 is 81.0 years, then the residual life expectancy conditional on this age is 31.0 years (for another example see **->** DALY above). (p.20)

Introduction and objectives

The aim of this project was to model the impact of alcohol on mortality, years of life lost and burden of disease for Switzerland in a way, which is compatible with current effort of the World Health Organization (WHO) in alcohol monitoring and surveillance. Thus, the main results for this project follow the methodology of WHO in each point.

Methods

In the following the methods for the estimating the various components are given. As the methodology of WHO is applied, these sections are in large parts taken from the report to WHO (Rehm et al. 2006a).

Exposure estimates: key indicators of alcohol consumption at country and regional levels

The following key indicators of exposure are involved in estimating alcohol related burden of disease (Rehm et al. 2004):

- Adult per capita consumption of recorded alcohol
- Adult per capita consumption of unrecorded alcohol
- Prevalence of abstention by age and sex
- Prevalence of different categories of average volume of alcohol consumption by age and sex
- Score for patterns of drinking

We will first discuss each of the indicators separately, and then the overall procedure to estimate exposure for alcohol-attributable burden of disease.

Adult per capita consumption of recorded alcohol

Per capita data on alcohol consumption denote the consumption in litres of pure alcohol per inhabitant in a given year. These data are available for the majority of countries, often in time series, and avoid the underestimation of total volume of consumption commonly seem in survey data (e.g. Midanik, 1982; Rehm, 1998; Gmel and Rehm, 2004). Adult per capita consumption, i.e. consumption by everyone aged 15 and above, is regarded as preferable to per capita consumption per se as the overwhelming portion of alcohol is consumed in adulthood. The age pyramid varies in different countries (United Nations 2005), therefore per capita consumption figures based on the total population tend to relatively underestimate consumption in countries where the larger proportion of the population is below age 15, as is

the case in many developing countries. For more information and guidance on estimating per capita consumption see the "International Guide for Monitoring Alcohol Consumption and Related Harm" (WHO 2000b).

There are three principal sources of data for per capita estimates: national government data, data from the Food and Agriculture Organization of the United Nations (FAO) and from the alcohol industry (Rehm et al., 2003b). Where available, the best and most reliable data generally stem from national governments, usually based on sales figures, tax revenue, and/or production data. Generally, sales data are considered the most accurate, provided that sales of alcoholic beverages are separated from sales of any other possible items sold at a given location, and that sales data are beverage specific. One of the drawbacks of production data is that they are always dependent on accurate export and import data, as otherwise the production figures will yield an under- or an overestimation.

The most complete and comprehensive international dataset on per capita consumption is published by FAO. FAOSTAT, the database of the FAO, publishes production and trade data for almost 200 countries for different types of alcoholic beverages. The estimates are based on official reports of production by national governments, mainly as replies by the Ministries of Agriculture to an annual FAO questionnaire. The statistics on import and export derive mainly from Customs Departments. If these sources are not available, other government data such as statistical yearbooks are consulted. The accuracy of the FAO data relies on member nations reporting the data. It is likely that the data underestimate informal, home and illegal production.

The third main source of data comes from the alcohol industry. In this category the most widely used source is World Drink Trends (WDT), first published by the Commission for Distilled Spirits (World Advertising Research Center 2005). The WDT estimates are based on total sales in litres divided by the total mid-year population and use conversion rates which are not published. WDT also tries to calculate the consumption of both incoming and outgoing tourists. Currently, at least partial data are available for 58 countries. There are other alcohol industry sources, as well as market research companies, which are less systematic, contain fewer countries, and are more limited in time scope.

The WHO Global Alcohol Database (GAD) (www3.who.int/whosis) systematically collects and compares per capita data from different sources on a regular basis (for procedures and further information see WHO 1999; 2004; Rehm et al. 2003b) using UN data for population estimates. The following rules to select the best data for each country have been used:

- For all countries which are "high income" in the World Bank classification such as Switzerland, and where there were WDT estimates, these estimates should be taken[1], as they are based on country specific sales data.
- For all other countries where the WDT has used national government statistics, domestic alcohol industry statistics, or supplemented FAO information with additional local sources, WDT estimates should be used.
- For other countries, FAO estimates should be used.
- Both FAO and WDT should be replaced, if there were government estimates based on written documentation and including sales data for several years.

The use of government statistics as per capita estimates in the GAD has to be approved by the steering committee of GAD. Currently, there are government statistics only for a very small minority of countries. The above specified decision tree assumes the following hierarchy of validity and reliability of data (from most valid/reliable to least valid/reliable):

1. Government statistics based on sales and taxation data
2. Alcohol industry statistics with country specific information on sales
3. FAO
4. Alcohol industry statistics from global sources (this option only to be used when no FAO data exist for the country)

In practice, the algorithm means that many of the developed country estimates are based on either WDT or direct government data, while most estimates for the developing countries are based on FAO data. For countries with both estimates available, sources correlate to a considerable degree (Pearson correlation = 0.74; Rehm et al. 2003a); but it does not seem possible to find an overall explanation for the systematic differences in the data for all countries. Obviously one explanation is that the FAO estimates are based on production data, while WDT is primarily based on sales data. This may lead to FAO estimates being higher, as FAO partly reflects production of beverages that do not show up in sales data either because it is so-called home production, e.g. the production of palm wine or sorghum beer in some African countries, or because WDT does not account for the whole range of beverage categories.

[1] List of countries classified as "high income" according to World Bank: Andorra, Aruba, Australia, Austria, Bahamas, Bahrain, Belgium, Bermuda, Brunei Darussalam, Canada, Cayman Islands, Channel Islands, Cyprus, Denmark, Faeroe Islands, Finland, France, French Polynesia, Germany, Greece, Greenland, Guam, Iceland, Ireland, Israel, Italy, Japan, Kuwait, Liechtenstein, Luxembourg, Monaco, Netherlands, Netherlands Antilles, New Caledonia, New Zealand, Northern Mariana Islands, Norway, Portugal, Qatar, Republic of Korea, San Marino, Singapore, Slovenia, Spain, Sweden, Switzerland, United Arab Emirates, United Kingdom, United States of America, United States Virgin Islands

For the ongoing efforts of the most recent estimate of alcohol-attributable burden of disease, following the methodology of the Comparative Risk Assessment (CRA), for the year 2002, the year with the latest available data on burden of disease in different parts of the world (Mathers et al. 2003), we used an average of the adult per capita information of three years 2001, 2002 and 2003 to get a more stable country estimate.

The main limitations of adult per capita estimates are twofold:

- They do not incorporate most of unrecorded consumption (see below).
- They are only aggregate statistics that cannot easily be disaggregated into sex and age groups. Thus, surveys have to play a crucial role in any analysis of risk of alcohol for burden of disease (see below).

Adult per capita consumption of unrecorded alcohol

Unrecorded consumption stems from a variety of sources (Giesbrecht et al. 2000):

- Home production of alcoholic beverages
- Illegal production and sale of alcoholic beverages
- Illegal and legal import of alcoholic beverages
- Other production and use of alcoholic beverages, not taxed and/or part of the official production and sales statistics.

Most of these categories are self-explanatory. However, the relation between legal import of alcoholic beverages and unrecorded consumption deserves further exploration. Consider Sweden as an example. Alcohol has been traditionally sold in monopoly stores. After joining the European Union (EU) and after a grace period, the very generous travel allowances of the EU became law, which allowed anybody to import several hundreds of beer or wine bottles, if they claimed these imports exclusively for personal use. As a result, recorded sales went down in parts of the country with nearby borders, and this kind of unrecorded consumption went up. For the year 2002 for Sweden, it is thus estimated that about 3 litres of the overall consumption of about 9 litres adult per capita was unrecorded (see Leifman et al. 2003, and GAD).

How is unrecorded consumption estimated? The Swedish data presented above stem from survey information. Currently, survey data are probably the most widely used source for estimating unrecorded consumption (e.g. Leifman 2001), but there are other methods, such as indirect calculations based on use of raw materials for alcohol production (e.g. sugar or fruits), or based on indicators strongly related to overall alcohol consumption such as alcohol

poisoning (e.g. Nemtsov 1998; 2000). Of course, the latter methodology is not possible as part of a study trying to estimate alcohol-attributable burden of disease, as it would lead to circulatory reasoning.

For the current efforts of estimated alcohol-attributable burden of disease for year 2002, we took the country data on unrecorded consumption from the GAD. For countries, where no estimate of unrecorded consumption existed, and where there was World Health Survey (WHS) or other large representative survey indicating more consumption than the recorded consumption, we estimated unrecorded consumption from these surveys.

In the following, an example of the procedure used is given. For Congo, the recorded consumption for 2002 based on the above described procedures amounted to 2.4 litres adult per capita consumption. The abstention rates from the WHS were 48.3% for men and 60.9% for women. The average consumption based on a usual quantity-frequency measure (Gmel and Rehm 2004) was 20.2 g pure alcohol per day for male and 14.2 g for female drinkers. This results in an estimated adult per capita of 3.7 litres pure alcohol. Applying a correction of undercoverage due to asking usual drinking behaviour of 0.8 (i.e. assuming usual quantity and frequency cover 80% of overall consumption), the resulting adult per capita consumption would be 4.6 litres pure alcohol. As a result, a value of 2.2 was entered for unrecorded consumption for the Congo. The above described procedure was applied for 6 countries. On the other hand, if the survey data were much lower than the recorded data only, for countries which had previous estimates of unrecorded consumption (WHO 2004), unrecorded consumption estimates were set to 0. The latter procedure is justified, as many prior estimates were based on expert judgments only.

Prevalence of abstention by age and sex

Prevalence of abstention was assessed by surveys. Abstention information is part of many surveys, not necessarily restricted to health or alcohol surveys. Usually, last year abstention was measured. There is an error introduced this way, as former drinkers who stopped drinking for health reasons have a higher risk for mortality and morbidity compared to lifetime abstainers (Shaper 1990), in most cases exceeding the risk of moderate drinkers (Rehm et al. 2001b).

However, for the present calculations, this error will result in an underestimation of alcohol-attributable burden when risk relations (i.e. Relative Risks, see below) are applied, which are based on lifetime abstention, and in correct estimation if risk relations used are based on all

kinds of abstention. Why is this the case? The current calculations are compute alcohol-attributable fractions (AAFs) based on prevalence of drinking categories. If current drinkers are used instead of lifetime abstainers, the category of abstainers, which does not contribute to the AAFs (see formula below) will be larger, and subsequently the drinking categories smaller, thus contributing to lower AAFs, and the lower burden estimates.

Thus, this decision will never result in an overestimation of alcohol-attributable burden, and thus is acceptable. Moreover, it can be suspected that former drinkers quitting for health reasons are mainly to be found in developed countries, and to a lesser degree in developing countries and emerging economies.

For the current estimate of alcohol-attributable burden for the year 2002, large representative surveys will be used which are in closest proximity to the year 2002. Data on abstention from these surveys is available from 118 out of 184 countries included (64.1% of the countries), representing 92.8% of the adult population in all the countries. For Switzerland, the Schweizerische Gesundheitsbefragung has been used (see Table Results 1 below).

Prevalence of different categories of average volume of alcohol consumption by age and sex

Prevalence of different categories of average volume of alcohol consumption by age and sex was also assessed by survey. The same criteria for survey selection as specified above applied. The categories of drinking as defined in Table Methods-1 were used, constructed in a way that the risk of many chronic diseases such as alcohol-related cancers were about the same for both men and women in the same category, e.g. (Rehm et al. 2003c; 2004). These categories were first used as the basis to derive attributable fractions in the first Australian study on the costs of substance abuse (National Health and Medical Research Council 1992; English et al. 1995) and have been used in many epidemiological and cost of illness studies.

Table Methods-1: Definition of drinking categories

Drinking categories	Men	Women
Abstainer or very light drinker	0 -< 0.25 g/day	0 -< 0.25g/day
Drinking category I	0.25 - < 40g/day	0.25-< 20g/day
Drinking category II	40 - < 60g/day	20 - < 40g/day
Drinking category III	60+ g/day	40+ g/day

Note: the limits of these categories are stated in grams of pure alcohol per day. For reference, a bottle of table wine contains about 70 grams of ethanol; 0.25 g/day corresponds to somewhat less than one glass of wine per month.

Please note, that the results of the surveys constitute only the raw input into the exposure calculations. They have to be made comparable in order to be used in a CRA- like exercise (see next chapter on "Comparatively quantifying exposure").

Score for patterns of drinking

Patterns of drinking impact certain disease categories such as ischaemic heart disease or injuries independently of volume consumed (Rehm et al. 2003c; 2004; in press). To quantify the impact of patterns of drinking, a score has been constructed and validated for the CRA of the year 2000 (Rehm et al. 2001a; 2003b; 2004). The score and its underlying algorithms have been described in detail elsewhere (Rehm et al. 2003b, 2004). It comprises four different aspects of heavy drinking (high usual quantity of alcohol per occasion; frequency of festive drinking at fiestas or community celebrations; proportion of drinking occasions when drinkers get drunk; distribution of the same amount of drinking over several occasions), no drinking with meals and drinking in public places. Those aspects were found to be loading on one underlying dimension in an optimal scaling analysis (Bijleveld et al. 1998). In several analyses with different methodology, they have been found related to ischaemic heart disease (Gmel et al. 2003; Rehm et al. 2004) and to different forms of injury (Cherpitel et al. 2005; Rehm et al; 2004).

Patterns scores have been assessed by a mixed methodology of key expert interviews and surveys. They are part of the GAD, and currently only one score per country has been calculated. There are efforts to apply this methodology sex-specifically.

Comparatively quantifying exposure (with contribution of Jens Klotsche)

Surveys on alcohol are quite diverse in aspects and not necessarily comparable. In alcohol epidemiology, there is a myth that all that is necessary to construct comparable surveys is to use the same questionnaire and instructions. This is not the case. Using the same questionnaire and instructions is neither a necessary nor a sufficient condition for comparability. Let us give just one example: if the questionnaire is heavily constructed around the notion of "standard drinks" (WHO 2000b), and this concept does not exist in a culture, it will just lead to misunderstandings and incomparable results. As social psychology has pointed out for many years, in operationalizing constructs the key is to

achieve the same understanding in the respondents, and not to use the same questions or words (Aronson et al. 1990).

Most important for comparative risk analyses of alcohol, however, is a valid measurement of the amount of drinking. This obviously is not the case, if the same survey questionnaire in one country leads to coverage of 30% of the alcohol consumed, and in another country 70%. Using these two surveys without further statistical processing in a CRA-type study would dramatically overestimate the alcohol-attributable burden in the latter country relatively to the former country. And the example is by no way exaggerated; indeed, more extreme examples can be found! Parenthetically, it should be added, that the same reasoning is valid for other comparisons, e.g. comparing rates of heavy drinking occasions between countries or between different time points in one country, to just give one example. If the underlying surveys of these comparisons have different rates of coverage, the results are likely to be biased.

Thus, consumption has to be adjusted by an external valid yardstick. In general, the most valid measurement of consumption in a country is the adult per capita consumption, as constituted by recorded and unrecorded consumption (Gmel and Rehm 2004). Obviously, this measure is most valid in countries with high percentage of recorded consumption, and/or with a good indication on unrecorded consumption.

If we accept the reasoning that adult per capita consumption is the best indicator for overall consumption in a given country, the question remains as to how to allocate the overall consumption into different sex-age groups. Survey information constitutes the only information available to conduct this task. In order to adjust prevalence of consumption to the adult per capita consumption figure, the prevalence of abstainers was assumed to be correctly estimated by the surveys. This assumption is necessary to undertake the following calculations. It implies that reported drinking status (i.e. abstention or not abstention) is the most valid information from the survey and the least influenced by non-responders.

Table Methods-2 gives a typical picture of survey information for Sweden as an example (data provided by Robin Room based on Leifman et al. 2003). The calculated coverage rate based on GAD data (recorded adult per capita consumption 5.98 litre pure alcohol per year; unrecorded consumption 3 l/year) amounted to 70.2% if one assumed the midpoint of each category as mean, and 90g/day as midpoint of the last, above not limited category.

The drinking categories in Table Methods-2 are more differentiated and not sex-specific compared to the drinking categories described above (see Table Methods-1). These more differentiated drinking categories have the advantage that the statistical operations to achieve comparability are more easily to be carried out and illustrated. In collapsing two categories for each sex (for men: 0.25-<20 g/day and 20 g/day -<40 g/day; for women: 40-<60 g/day and 60+ g/day), the above categories can easily be obtained.

Table Methods-2: Estimated prevalence for Sweden in % for different drinking categories for the year 2002 based on survey

	Men					Women				
Age in years	**15-19**	**20-44**	**45-64**	**65+**	**all**	**15-19**	**20-44**	**45-64**	**65+**	**all**
% of age group among all adult population	7.5	42.0	32.3	18.2	100.0	6.8	39.0	30.6	23.6	100.0
Drinking levels										
0-<0.25 g/day	11.9	6.4	8.7	20.0	10.0	20.0	9.0	11.7	31.9	16.0
0.25-<20 g/day	63.5	65.1	69.6	66.1	66.6	70.0	82.2	81.2	66.0	77.2
20-<40 g/day	15.1	18.1	15.4	10.8	15.7	8.1	6.8	5.4	1.6	5.2
40-<60 g/day	3.6	5.3	3.4	1.5	3.9	1.0	1.1	1.0	0.3	0.9
60+ g/day	5.9	5.1	2.9	1.6	3.8	1.0	1.0	0.7	0.3	0.7
Derived indicators										
average g/day	18.03	19.15	15.91	12.08	16.73	10.80	11.68	10.89	7.47	10.38
contribution to total	1.35	8.04	5.14	2.20	16.73	0.73	4.55	3.33	1.76	10.38
Proportional contribution	8.1	48.1	30.7	13.1	100.0	7.1	43.9	32.1	17.0	100.0

The next assumption to be made is that the survey accurately reflects the proportions consumed between sex and age groups. Using the same assumptions about midpoints, 61.7% of alcohol is consumed by men, and 38.3 by women. Table Methods-2 gives the respective proportions by age groups within men and women.

So far, everything has been descriptive albeit based on assumptions. The next step will introduce an iterative procedure to adjust for adult per capita consumption. First, we estimate the expected frequencies based on the overall adult per capita consumption. Consumption in Sweden is estimated to be 19.3 g/day pure alcohol (converted from 8.98 litres/year). The expected allocation by sex and age can be seen in the first rows of Table Methods-3.

Table Methods-3: Estimated prevalence for Sweden in % for different drinking categories for the year 2002 based on survey adjusted for per capita consumption (iteration 1)

	Men					Women				
Age in years	**15-19**	**20-44**	**45-64**	**65+**	**all**	**15-19**	**20-44**	**45-64**	**65+**	**all**
Expected indicators										
Average per day	25.69	27.28	22.66	17.21	23.84	15.38	16.64	15.51	10.64	14.79
Contribution to total	1.93	11.46	7.32	3.13	23.84	1.05	6.49	4.75	2.51	14.79
Proportional contribution	8.1	48.1	30.7	13.1	100.0	7.1	43.9	32.1	17.0	100.0
First iteration										
0-<0.25 g/day	11.9	6.4	8.7	20.0	10.0	20.0	9.0	11.7	31.9	16.0
0.25-<20 g/day	44.1	46.8	45.7	40.0	45.0	52.8	60.1	58.3	44.9	55.5
20-<40 g/day	27.0	29.8	32.3	31.0	30.6	22.0	23.7	22.6	17.4	21.8
40-<60 g/day	6.4	8.7	7.2	4.3	7.2	2.6	3.8	4.4	2.9	3.7
60+ g/day	10.6	8.3	6.1	4.7	7.1	2.6	3.4	3.0	2.9	3.1
Derived indicators after first iteration										
Average g/day	25.28	25.45	23.38	19.69	23.72	15.56	18.09	17.50	13.79	16.72
difference from expected in %	1.6	7.2	-3.1	-12.6	0.5	-1.1	-8.1	-11.4	-22.8	-11.5

Shaded areas mark deviations of more than 10% between iteration and expected value.

Table Methods-3 also shows the results of the first iteration. In this iteration, assuming a distribution where the median is close to the mean, and using the mean value from the survey distribution, the median of the distribution among drinkers was roughly estimated: for men 50% of the distribution was assumed to be in the lowest drinking category up to 20g/day, for women 66.6%. Note, that this estimation has only to be rough; the initial prevalence estimates for the lowest drinking category will be changed by the following iterations. The rest of the drinking categories were allocated proportionally to the survey so that the sum of all categories added up to 100%. The resulting prevalence proportions yielded an overall volume which was relatively close to the expected volume, fitting better for men than for women. However, even for men, one age group had a deviation of more than 10% to the expected value (see shaded cell for the oldest age group).

In the second iteration, for all drinking categories above 20 g/day, the prevalence rates were adjusted by the factor of expected volume/derived volume of the first iteration, and the lowest drinking category was adjusted at the end to overall add up to 100%. To give an example: for the youngest age group in men, the three prevalence proportions were adjusted

by the factor of 25.69 (expected volume in g/day) divided by 25.28 (g/day as estimated after the first iteration). Then, the differences between expected and derived indicators after the iteration were checked again, and the iterations were repeated, until no proportional difference of more than 10% could be observed. The final result can be seen in Table Methods-4 (in the example reached after the second iteration for men, and the third for women).

Table Methods-4: Estimated prevalence for Sweden in % for different drinking categories for the year 2002 based on survey adjusted for per capita consumption (final iteration)

	Men					Women				
Age in years	**15-19**	**20-44**	**45-64**	**65+**	**all**	**15-19**	**20-44**	**45-64**	**65+**	**All**
Expected indicators										
Average per day	25.69	27.28	22.66	17.21	23.84	15.38	16.64	15.51	10.64	14.79
Final iteration										
0-<0.25 g/day	11.9	6.4	8.7	20.0	10.0	20.0	9.0	11.7	31.9	16.0
0.25-<20 g/day	43.3	43.4	47.0	45.0	45.0	53.3	63.8	63.3	52.5	60.3
20-<40 g/day	27.4	32.0	31.3	27.1	30.6	21.6	20.9	18.8	11.7	18.1
40-<60 g/day	6.5	9.3	7.0	3.8	7.2	2.6	3.4	3.7	1.9	3.1
60+ g/day	10.8	8.9	5.9	4.1	7.1	2.6	3.0	2.5	1.9	2.6
Derived indicators after first iteration										
Average g/day	25.55	26.61	22.94	18.22	23.72	15.43	17.02	16.05	11.52	15.32
difference from expected	0.6	2.5	-1.2	-5.5	0.5	-0.3	-2.3	-3.4	-7.6	-3.4

Discussion on underlying assumptions

The described procedure can be used to produce comparable estimates for alcohol exposure in different countries. However, it is based on a number of assumptions which should be discussed here. First, it assumes, that adult per capita consumption (recorded and unrecorded) is the best estimate for overall consumption level in a country (Gmel and Rehm 2004). While there seems to be consensus that this measure is superior to survey estimates at least for developed countries, there may be problems in regions where the unrecorded is not available or only estimated with large error. On a global scale, this is the case in some developing countries and in the Eastern European region.

The next assumption concerns the valid estimation of abstainer rates by surveys. Alcohol is consumed in such a way, that a relatively large proportion of the alcohol is consumed by a relatively small proportion of the population, both in the developed and the developing world

(Gmel and Rehm 2004; Rehm 1998; Rehm et al; 2004). It may be reasonable to suspect that a lot of the difference between survey and adult per capita is due to alcohol consumed by relatively small groups of high consumers not covered by the usual representative surveys, such as homeless or institutionalized people (Gmel and Rehm 2004). If this reasoning is correct, then relatively little error is introduced by assuming that surveys can validly estimate abstainer rates. On the other hand, surveys probably introduce high errors in the prevalence estimates of high consumption categories, which are being corrected by the procedure introduced.

In estimating comparable prevalence proportions of alcohol consumption in different drinking categories, we rely on calculations which are based on distributional assumptions within drinking categories. Concretely, we assume a symmetric distribution with the midpoint as the mean for the consumption within a category. The estimated prevalence is sensitive towards this assumption. Although this procedure is used almost universally in the field, it is problematic, as alcohol distributions often have been found to be skewed. As a consequence, in further research, procedures based on lognormal or other skewed distributions should be developed. This will take some time, as the properties of alcohol distributions in developing countries are currently poorly understood, and some of the key assumptions in modelling developed countries may not apply.

Finally, there is the argument that the current procedure, while yielding comparable exposure, may lead to overestimation of alcohol-attributable burden. As most surveys in developed countries underestimate consumption, the procedure in these countries leads to higher estimates than in surveys. However, the underlying risk-relations are based on similarly flawed measures from epidemiology, and consequently the attributable burden will be overestimated. Of course, given the beneficial effects of moderate consumption and the non-linear risk relations with other diseases (Gutjahr et al. 2001; Rehm et al. 2004), the overestimate would by no means be linear. Rehm and colleagues (Rehm et al. 2006b) give an estimate for one country, Canada, about the potential error introduced in this procedure. They showed that although for Canada the alcohol exposure estimates varied widely (i.e. by the factor 3), the mortality burden was much less influenced by the proposed method (i.e. less than 25% difference; Rehm et al., 2006b). In addition, it is easily possible to do sensitivity analyses, where only a proportion of total volume is covered, e.g. 75%.

The above argument also fails to take into account the systematic differences in assessment between alcohol and medical epidemiological studies. Medical epidemiological studies usually have only very few questions on alcohol, embedded in other nutrition or lifestyle

assessments, which have been shown to yield higher estimates on alcohol exposure compared to settings where alcohol is the main, or one of the main topics of enquiry (Rehm 1998).

Overall, even though the proposed procedure may constitute a considerable change to current practice in the alcohol field, it should be adopted to future studies, since it achieves comparability between countries and future regions. Of course, further refinements are necessary, but for monitoring and surveillance of risk factors, comparability over time and regions are key and necessary features.

Data indicating burden of disease

Both event-based and time-based measures indicating population health status were used in the present analyses. Mortality, as measured in number of deaths, was the event measure; years of life lost due to premature mortality (YLL) and burden of disease, as measured in disability-adjusted life years (DALYs), constituted the time-based gap measures (Murray et al. 2002; Rehm et al; 2004). The DALY measure combines YLL with years of life lost to living with a disability. Estimates for mortality and DALYs for the years 2002 and 2005 were directly obtained by WHO Headquarters (Dr. C. Mathers). YLL and DALYs were 3% age-discounted and age-weighted to be comparable with the Global Burden of Disease (GBD) study. Population data were obtained from United Nations (UN) population division (United Nations 2005). Age groups used were: 0-4 years, 5-14 years, 15-29 years, 30-44 years, 45-59 years, 60-69 years, and 70+ years.

Relating alcohol exposure to disease and injury outcomes

Defining alcohol-attributable diseases

Alcohol consumption was found to be related to the following GBD categories (for GBD categories: Mathers et al. 2001; for the relationship to alcohol: Rehm et al; 2003c; 2004): conditions arising during the perinatal period: low birthweight; cancers: mouth and oropharynx cancers, oesophageal cancer, colon and rectal cancers, liver cancer, breast cancer and other neoplasms; diabetes mellitus; neuropsychiatric conditions: alcohol use disorders, epilepsy; cardiovascular diseases: hypertensive heart disease, ischaemic heart disease, cerebrovascular diseases: haemorrhagic stroke, ischaemic stroke; cirrhosis of the liver; unintentional injuries: road traffic accidents, poisonings, falls, drownings, and other unintentional injuries; intentional injuries: self-inflicted injuries, violence and other intentional injuries.

These disease categories are the same as for the CRA 2000 with one exception: colorectal cancer has been added. In other words, all of the major review studies in the 1990s and the beginning 2000s concluded a causal relationship between alcohol and the respective disease or injury category selected (Rehm et al. 2003c), except for colorectal cancer, where some of the evidence is newer (Boffetta et al., 2006; Cho et al., 2004).

Risk relations

Table Methods-5 gives an overview on relative risks (RR) for different diseases by drinking categories. Relative Risks denote the chances of contracting a disease given a specific drinking category relative to the chances of contracting this disease as an alcohol abstainer. The drinking categories used in Table Methods-t have been defined in Table Methods-I (see above).

For instance (example taken from Table Methods-5 row 6: liver cancer, and column 5: RR for drinking category II), if the relative risk is 3.03 of developing liver cancer for drinking category II (i.e. drinking 40g – 60g pure alcohol per day for men, or 20g – 40g pure alcohol per day for women), this means that people drinking that amount of alcohol are about 3 times more likely to develop cancer than people who do not use alcohol (= abstainers).

These RR have been derived from the most comprehensive meta-analysis for each disease category (see Rehm et al., 2003c for a definition), i.e. from statistically pooling the results of all the epidemiological studies on the relationship between alcohol consumption and the respective disease. The last column in the Table Methods-5 gives the references where these meta-analyses can be found. The underlying epidemiological studies is usually either case-control or cohort studies.

Table Methods-5: Relative risks for alcohol-attributable diseases and injuries by consumption stratum (reference group is "current abstainers")

Disease condition	ICD-10	GBD code	Drinking category I RR	Drinking category II RR	Drinking category III RR	Sources and comments
Conditions arising during the perinatal period: Low birthweight	P05-P07	U050	M/W 1.00	M/W 1.40	M/W 1.40	(Gutjahr et al. 2001; Rehm et al; 2004)
Mouth and oropharynx cancers	C00-C14	U061	M/W 1.45	M/W 1.85	M/W 5.39	(Gutjahr et al. 2001)
Esophageal cancer	C15	U062	M/W 1.80	M/W 2.38	M/W 4.36	(Gutjahr et al. 2001)
Colon and rectal cancers	C18-C21	U064	M/W 1.00	M 1.16 W 1.01	M 1.41 W 1.41	(Cho et al. 2004)
Liver cancer	C22	U065	M/W 1.45	M/W 3.03	M/W 3.60	(Gutjahr et al. 2001)
Breast cancer	C50	U069	<45 yrs W 1.15 45+ yrs W 1.14	<45 yrs W 1.41 45+ yrs W 1.38	<45 yrs W 1.46 45+ yrs W 1.62	(Ridolfo et al. 2001)
Other neoplasms	D00-D48	U078	M/W 1.10	M/W 1.30	M/W 1.70	(Rehm et al. 2004)
Diabetes mellitus (A regions like Switzerland)	E10-E14	U079	M 0.99 W 0.92	M 0.57 W 0.87	M 0.73 W 1.13	(Gutjahr et al. 2001)
Alcohol use disorders	F10	U086	-	-	-	AF 100%
Unipolar depressive disorders*	F32-F33	U082				(Rehm et al; 2004)
Epilepsy	G40, G41	U085	M 1.23 W 1.34	M 7.52 W 7.22	M 6.83 W 7.52	(Gutjahr et al. 2001)
Hypertensive heart disease	I10-I14	U106	M 1.33 W 1.15	M 2.04 W 1.53	M 2.91 W 2.19	(Corrao et al. 1999)
Ischaemic heart disease*	I20-I25	U107	M/W 0.82	M/W 0.83	M 1.00 W 1.12	(Corrao et al. 2000); (Rehm et al; 2004)
Haemorrhagic stroke (A regions like Switzerland)	I60-I62	U108	M 1.12 W 0.74	M 1.40 W 1.04	M 1.54 W 1.94	(Reynolds et al. 2003)
Ischaemic stroke (A regions like Switzerland)	I63	U108	M 0.94 W 0.66	M 1.13 W 0.84	M 1.19 W 1.53	(Reynolds et al. 2003)
Cirrhosis of the liver	K74	U117	M/W 1.26	M/W 9.54	M/W 13.0	(Rehm et al; 2004)
Road traffic accidents*	and	U150	For all injury categories (shaded areas), the approach assuming that consumption strata specific RRs are generalisable across countries was only used as a sensitivity analysis. The main analyses used region-specific alcohol-attributable			(Rehm et al; 2004)
Poisonings*	X40-X49	U151				(Rehm et al; 2004)
Falls*	W00-W19	U152				(Rehm et al; 2004)

Drownings*	W65-W74	U154	fractions, based on both the level of consumption and drinking pattern (for derivation see Rehm et al., 2004).	(Rehm et al; 2004)
Other unintentional injuries*	Rest of V, W20-W64, W75-W99, X10-X39, X50-X59, Y40-Y86, Y88, Y89	U155		(Rehm et al; 2004)
Self-inflicted injuries*	X60-X84, Y870	U157		(Rehm et al; 2004)
Violence*	X85-Y09, Y871	U158		(Rehm et al; 2004)
Other intentional injuries*	Y35	U160		(Rehm et al; 2004)

RR – relative risk

* AAFs are taken from CRA (based on pooled cross-sectional time-series analyses and calibrated to Australia; cf. Rehm et al., 2004)

[and]V01-V04, V06, V09-V80, V87, V89, V99. For countries with four-digit ICD-10 data, use: V01.1-V01.9, V02.1-V02.9, V03.1-V03.9, V04.1-V04.9, V06.1-V06.9, V09.2, V09.3, V10.4-V10.9, V11.4-V11.9, V12.3-V12.9, V13.3-V13.9, V14.3-V14.9, V15.4-V15.9, V16.4-V16.9, V17.4-V17.9, V18.4-V18.9, V19.4-V19.6, V20.3-V20.9, V21.3-V21.9, V22.3-V22.9, V23.3-V23.9, V24.3-V24.9, V25.3-V25.9, V26.3-V26.9, V27.3-V27.9, V28.3-V28.9, V29.4-V29.9, V30.4.V30.9, V31.4-V31.9, V32.4-V32.9, V33.4-V33.9, V34.4-V34.9, V35.4-V35.9, V36.4-V36.9, V37.4-V37.9, V38.4-V38.9, V39.4-V39.9, V40.4-V40.9, V41.4-V41.9, V42.4-V42.9, V43.4-V43.9, V44.4-V44.9, V45.4-V45.9, V46.4-V46.9, V47.4-V47.9, V48.4-V48.9, V49.4-V49.9, V50.4-V50.9, V51.4-V51.9, V52.4-V52.9, V53.4-V53.9, V54.4-V54.9, V55.4-V55.9, V56.4-V56.9, V57.4-V57.9, V58.4-V58.9, V59.4-V59.9, V60.4-V60.9, V61.4-V61.9, V62.4-V62.9, V63.4-V63.9, V64.4-V64.9, V65.4-V65.9, V66.4-V66.9, V67.4-V67.9, V68.4-V68.9, V69.4-V69.9, V70.4-V70.9, V71.4-V71.9, V72.4-V72.9, V73.4-V73.9, V74.4-V74.9, V75.4-V75.9, V76.4-V76.9, V77.4-V77.9, V78.4-V78.9, V79.4-V79.9, V80.3-V80.5, V81.1, V82.1, V83.0-V83.3, V84.0-V84.3, V85.0-V85.3, V86.0-V86.3, V87.0-V87.8, V89.2, V89.9, V99, Y850.

For most chronic disease categories, alcohol-attributable fractions (AAFs) of disease were derived from combining prevalence of exposure and relative risk estimates based on meta-analyses (Cho et al. 2004; Corrao et al. 2000; English et al. 1995; Gutjahr et al. 2001; Rehm et al. 2004; Ridolfo et al. 2001); using the following formula (Walter1976; Walter1980):

$$AF = [\sum_{i=1}^{k} P_i(RR_i - 1)]/[\sum_{i=0}^{k} P_i(RR_i - 1) + 1]$$

Where
i: exposure category with baseline exposure or no exposure i=0
RR(i): relative risk at exposure level i compared to no consumption
P(i): prevalence of the i^{th} category of exposure

AAFs, as derived from the formula above can be interpreted as reflecting the proportion of disease that would disappear if there had been no alcohol consumption.

For depression and injuries, AAFs were taken from Comparative Risk Analysis (CRA) study (see Rehm et al; 2004, for a detailed description of underlying assumptions and calculations). Protective effects of alcohol consumption on ischaemic heart disease, strokes

and diabetes were not estimated in all non-A regions due to the evidence that the pattern of drinking for most alcohol consumption is not protective in these regions (for physiological mechanisms: McKee and Britton 1998; Puddey et al. 1999; Rehm et al. 2003d; for epidemiological evidence: Gmel et al. 2003; Rehm et al. 2004; in press). Thus, where in A regions a relative risk of less than 1 would represent the protective effect for strokes and diabetes; in non-A regions a relative risk of 1 was used. For ischaemic heart disease, the results of a pooled cross-sectional time-series analyses were used (Rehm et al., 2004). Sensitivity analyses with assumptions of full protective effects will complete the final report.

To estimate stroke subtypes (ischaemic stroke and hemorrhagic stroke), we used the region and age-specific proportions of stroke subtypes so that weighted RRs could be applied (CTR, 2002).

Results

The key results for Switzerland are displayed in Tables Results-1- Table Results-5. Table Results-1 presents prevalence of alcohol consumption in Switzerland in 2002 as estimated by the Swiss Health Survey (weighted to reflect age- and sex-distribution of the Swiss population aged 15 and over). Drinking categories reported in Table Results-1 were taken from English et al. (1995) and correspond to the relative risks shown in Table Methods-5. In total, 15.4% of all adult men in Switzerland in 2002 were abstinent and 34.0% among women. The vast majority of the Swiss population were classified as drinkers in category 1 and very few people reported drinking more than 40 grams per day among men and 20 grams per day among women (drinking category 2 and 3). However, an adjustment for adult per capita consumption derived from alcohol sales statistics resulted in the distribution of drinking level as displayed in Table Results-2. The basis for these adjustments is described above in the methods section, and one characteristic is that the abstention rates remain unchanged. Because alcohol consumption measured by the Swiss Health Survey accounted only for about 50% of the total alcohol consumption in Switzerland, many more drinkers compared to the Swiss Health Survey were classified in category 2 and 3, whereas the proportion of drinkers in category 1 was adjusted downwards.

Table Results-1: Prevalence of drinking in Switzerland 2002 from Swiss Health Survey (weighted analyses by G. Gmel, SFA)

	Men							Women						
Age groups in years	15-29	30-44	45-59	60-69	70 plus	All adults	contribution in g/day	15-29	30-44	45-59	60-69	70 plus	All adults	contribution in g/day
% of population	22.1%	30.6%	25.3%	11.2%	10.8%	100.0%		20.9%	27.8%	24.0%	11.8%	15.5%	100.0%	
Drinking categories														
Abstainers and very light drinkers	21.8%	12.9%	14.1%	12.5%	15.4%	15.4%	0.02	38.5%	32.2%	26.4%	30.1%	45.7%	34.0%	0.04
Drinking category 1	73.0%	81.1%	77.8%	76.8%	76.0%	77.4%	15.50	59.1%	64.0%	68.2%	61.8%	50.3%	61.6%	6.16
Drinking category 2	2.7%	3.6%	5.0%	6.4%	4.9%	4.2%	2.11	1.8%	2.6%	4.0%	6.4%	3.1%	3.3%	0.99
Drinking category 3	2.5%	2.4%	3.1%	4.2%	3.7%	3.0%	2.21	0.6%	1.1%	1.4%	1.7%	1.0%	1.1%	0.62
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	19.84	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	7.82

The drinking categories were based on the following definitions in grams of pure alcohol per day (see National Health and Medical Research Council, Australia, 1992; English et al., 1995):

Drinking categories	*Women*	*Men*
Abstainer or very light drinker	0 -< 0.25g/day	0 -< 0.25 g/day
Drinking Category I	0.25-< 20g/day	0.25 - < 40g/day
Drinking Category II	20 - < 40g/day	40 - < 60g/day
Drinking Category III	40+ g/day	60+ g/day

One drink (either a can of beer or a small glass of wine or one shot of spirits) contains about 12 grams of pure alcohol on average in Switzerland.

Table Results-2: Prevalence of drinking in Switzerland 2002 from Swiss Health Survey adjusted for per capita consumption

	Men							Women						
Age groups in years	15-29	30-44	45-59	60-69	70 plus	All adults	contribution in g/day	15-29	30-44	45-59	60-69	70 plus	All adults	contribution in g/day
Drinking categories														
Abstainers and very light drinkers	21.8%	12.9%	14.1%	12.5%	15.4%	15.4%	0.02	38.5%	32.2%	26.4%	30.1%	45.7%	34.0%	0.04
Drinking category 1	29.5%	31.2%	27.6%	25.2%	27.0%	28.8%	5.76	28.7%	30.7%	30.7%	24.0%	22.2%	28.2%	2.82
Drinking category 2	25.0%	33.8%	36.0%	37.4%	32.7%	32.7%	16.35	24.3%	25.9%	31.8%	36.3%	24.5%	28.0%	8.40
Drinking category 3	23.7%	22.0%	22.4%	24.9%	24.9%	23.1%	17.33	8.6%	11.1%	11.1%	9.7%	7.7%	9.9%	5.43
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	39.46	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	16.69

The distribution of deaths caused by alcohol by age group and sex is displayed in Table Results-3. In total, 2,016 net deaths (1,575 among men and 441 among women) were estimated to be caused by alcohol, taking into account deaths prevented by alcohol. The overall effect of alcohol consumption on mortality in the categories ischaemic heart disease and, to a lesser extent, diabetes mellitus was beneficial among both sexes, in addition among women more deaths by cerebrovascular diseases were prevented than caused by alcohol in Switzerland in 2002. While the number of deaths due to alcohol peaked in the 45-59 and 70+ age group among men with almost equal number of deaths (448 and 457, respectively), the most deaths among women were caused among 45-59 year olds (194), followed by the 60-69 year age group (143). Because the protective effect of cardiovascular diseases among women aged 70 and older was almost as pronounced as the detrimental effect in this age group, the net number of deaths attributable to alcohol in this age group was very low (22).

With regard to cancer among women, breast was the most prevalent cancer site caused by alcohol with roughly half of these deaths occurring in the age group 70+. Among men liver cancer was most prevalent, followed by oral cancers and oesophageal cancer. The effect of alcohol consumption on mortality due to alcohol disorders was relatively weak compared to other disease categories. The beneficial effect of alcohol consumption on ischaemic heart disease was estimated among both sexes with highest prevalence in older age groups. .

In terms of acute disease categories, such as injuries and traffic accidents, self-inflicted injuries were most prevalent among men and women, followed by road traffic accidents among men and falls among women.

Table Results-3: Alcohol-attributable deaths by age, sex and disease category for Switzerland 2002

		Men								Women							
	Total	0-4	5-14	15-29	30-44	45-59	60-69	70+	Total	0-4	5-14	15-29	30-44	45-59	60-69	70+	Total
Low birth weight	**0**	0							0	0							0
Mouth and oropharynx cancers	**240**			0	9	66	61	64	200			0	2	14	7	17	40
Oesophagus cancer	**231**			0	4	45	54	85	187			0	1	7	10	27	44
Colon and rectum cancers	**163**			0	1	16	36	82	134			0	1	4	5	19	29
Liver cancer	**296**			1	4	37	59	137	238			0	0	9	11	38	58
Breast cancer	**200**								0			0	12	51	42	95	200
Other neoplasms	**97**			0	1	4	10	44	60			0	1	2	4	31	38
Diabetes mellitus	**-255**			0	-2	-17	-40	-148	-207			0	0	-2	-6	-39	-47
Unipolar depressive disorders	**2**			0	0	0	0	1	1			0	0	0	0	1	1
Epilepsy	**78**			4	5	12	3	18	41			2	3	7	5	19	36
Alcohol use disorders	**277**	0	0	0	17	74	51	59	201	0	0	0	8	27	23	18	76
Hypertensive heart disease	**415**			0	0	18	27	187	232			0	1	5	10	167	183
Ischaemic heart disease	**-1,068**			0	-10	-67	-104	-468	-649			0	-1	-12	-28	-378	-419
Cerebrovascular disease	**97**			0	3	10	26	183	222			0	-1	-3	-6	-115	-125
Cirrhosis of the liver	**626**			0	31	154	140	111	436			0	16	60	52	62	191
Road traffic accidents	**134**	1	3	40	34	15	7	12	111	0	1	4	5	4	1	6	22
Poisonings	**2**	0	0	0	1	1	0	0	2	0	0	0	0	0	0	0	1
Falls	**118**	0	0	3	10	16	10	47	86	0	0	0	1	2	2	27	32
Drownings	**19**	0	0	2	4	6	1	2	15	0	0	0	1	1	0	1	4
Other unintentional injuries	**134**	2	1	16	30	13	17	26	104	0	0	2	2	3	4	18	30
Self-inflicted injuries	**187**	0	0	24	48	41	21	14	148	0	0	4	9	13	5	8	39
Violence	**23**	0	0	3	5	4	2	0	14	0	0	2	4	2	0	1	9
Other intentional injuries	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	**2,016**	**3**	**4**	**92**	**192**	**448**	**379**	**457**	**1,575**	**1**	**2**	**16**	**65**	**194**	**143**	**22**	**441**

The burden of disease in terms of years of life lost (YLLs) attributable to alcohol in Switzerland in 2002 is presented in Table Results-4. Similar to deaths, the beneficial contribution to cardiovascular diseases among women was most pronounced among women and men over the age of 70. Overall, the age group mostly affected by YLLs due to alcohol was 45-59 years among both sexes. Notable exceptions were road traffic accidents

with a peak among 15-29 year old men and women. The biggest relative importance among both sexes had ischaemic heart disease. Almost as many YLLs prevented by ischaemic heart diseases (-5,412) were caused by cirrhosis of the liver (5,246) among men; among women, cirrhosis of the liver and breast cancer were estimated to have the biggest detrimental effect on YLLs due to alcohol consumption (2,393 and 2,280, respectively) .

Table Results-4: Alcohol-attributable YLLs by age, sex and disease category for Switzerland 2002 (age weighted and discounted 3%)

		Men								Women							
	Total	0-4	5-14	15-29	30-44	45-59	60-69	70+	Total	0-4	5-14	15-29	30-44	45-59	60-69	70+	Total
Low birth weight	**12**	9							9	3							3
Mouth and oropharynx cancers	**2,753**			0	229	1,045	562	428	2,264			11	58	228	69	123	489
Oesophagus cancer	**2,289**			0	90	713	494	568	1,864			0	14	111	99	200	425
Colon and rectum cancers	**1,432**			4	31	250	328	547	1,160			1	15	62	51	143	272
Liver cancer	**2,711**			19	98	593	540	919	2,168			0	0	150	111	283	543
Breast cancer	**2,280**								0			8	298	844	423	707	2,280
Other neoplasms	**806**			7	19	69	91	297	483			0	17	32	42	232	323
Diabetes mellitus	**-2,086**			-15	-55	-268	-367	-989	-1,694			0	-11	-26	-64	-291	-392
Unipolar depressive disorders	**15**			0	0	3	1	6	10			0	0	0	0	4	5
Epilepsy	**1,041**			132	116	195	27	118	588			61	79	121	51	141	453
Alcohol use disorders	**3,474**		0	0	424	1,176	465	396	2,461		0	0	191	453	235	135	1,014
Hypertensive heart disease	**3,252**			0	0	293	244	1,250	1,787			0	31	84	103	1,248	1,465
Ischaemic heart disease	**-8,744**			-7	-258	-1,062	-955	-3,130	-5,412			0	-24	-195	-282	-2,831	-3,333
Cerebrovascular disease	**704**			0	79	160	240	1,223	1,701			-5	-18	-58	-60	-857	-997
Cirrhosis of the liver	**7,639**			0	767	2,449	1,286	745	5,246			0	415	996	520	463	2,393
Road traffic accidents	**3,187**		145	1,367	854	231	63	79	2,740		49	148	120	70	12	48	447
Poisonings	**46**		0	8	14	9	2	0	34		0	0	5	2	2	1	11
Falls	**1,314**		0	110	244	254	90	316	1,014		0	14	34	33	18	201	300
Drownings	**336**		0	62	88	92	10	15	268		0	8	32	15	4	10	68
Other unintentional injuries	**2,297**		105	529	737	209	155	177	1,912		25	83	57	47	37	136	385
Self-inflicted injuries	**3,647**		0	815	1,194	661	191	94	2,955		0	137	238	207	51	59	692
Violence	**533**		11	109	113	64	15	2	315		11	70	100	25	4	8	218
Other intentional injuries	**0**		0	0	0	0	0	0	0		0	0	0	0	0	0	0
TOTAL	**28,939**	**9**	**261**	**3,141**	**4,782**	**7,136**	**3,481**	**3,060**	**21,871**	**3**	**85**	**537**	**1,650**	**3,203**	**1,425**	**164**	**7,067**

Table Results-5 shows details of the burden of disease due to alcohol as measured by disability-adjusted years (DALYs) in Switzerland in 2002. Contrary to deaths and YLLs, 30-44 year olds among both sexes had the highest prevalence of DALYs caused by alcohol consumption (18,952 among men and 5,324 among women). While among men 15-29 year olds followed with 15,105 DALYs, among women 45-59 year olds were estimated to have the second highest prevalence. Up to an age of 59 among both sexes alcohol disorders were by far the leading cause of alcohol-attributable DALYs. In total, 29,914 DALYs due to alcohol disorders were estimated among men and 6,962 among women. For men and women, cirrhosis of the liver was most prevalent among 60-69 year olds and ischaemic heart disease among 70+ year olds.

Table Results-5: Alcohol-attributable DALYs by age, sex and disease category (age weighted and discounted 3%)

		Men								Women							
	Total	0-4	5-14	15-29	30-44	45-59	60-69	70+	Total	0-4	5-14	15-29	30-44	45-59	60-69	70+	Total
Low birth weight	**30**	19							19	10							10
Mouth and oropharynx cancers	**2'923**			1	242	1'114	595	448	2'401			12	62	242	75	130	522
Oesophagus cancer	**2'346**			0	92	733	508	580	1'912			0	14	113	102	204	433
Colon and rectum cancers	**1'646**			4	36	306	390	598	1'334			1	19	75	61	156	312
Liver cancer	**2'752**			19	99	601	549	933	2'201			0	0	152	113	286	551
Breast cancer	**2'673**								0			11	397	1'013	486	765	2'673
Other neoplasms	**806**			7	19	69	91	297	483			0	17	32	42	232	323
Diabetes mellitus	**-3'520**			-46	-275	-833	-648	-1'127	-2'929			-2	-38	-105	-119	-327	-591
Unipolar depressive disorders	**2'589**			553	704	447	148	41	1'894			183	273	181	33	25	695
Epilepsy	**2'692**			378	416	384	119	165	1'462			267	332	292	140	199	1'230
Alcohol use disorders	**36'876**	0	210	10'537	12'926	5'044	716	483	29'914	0	59	2'127	2'869	1'386	349	172	6'962
Hypertensive heart disease	**3'573**			0	0	307	263	1'389	1'960			0	32	87	111	1'384	1'613
Ischaemic heart disease	**-9'195**			-16	-310	-1'191	-1'029	-3'196	-5'742			-9	-36	-231	-309	-2'868	-3'454
Cerebrovascular disease	**1'153**			0	174	313	445	1'433	2'365			-5	-33	-107	-111	-956	-1'212
Cirrhosis of the liver	**9'309**			31	1'059	2'937	1'451	811	6'288			17	626	1'242	609	527	3'021
Road traffic accidents	**3'835**	4	166	1'643	1'033	272	69	82	3'269	3	61	195	157	86	15	50	566
Poisonings	**60**	0	0	11	16	11	3	0	41	0	0	3	8	4	3	1	19
Falls	**1'709**	0	0	227	336	307	107	330	1'306	0	0	45	59	55	28	215	403
Drownings	**340**	0	0	63	88	93	11	15	270	0	0	9	32	15	4	10	69
Other unintentional injuries	**3'267**	28	190	718	920	302	186	191	2'534	6	46	198	170	104	59	150	733
Self-inflicted injuries	**3'721**	0	0	822	1'220	669	194	95	2'999	0	0	143	252	214	53	60	722
Violence	**672**	0	15	154	155	73	16	3	417	0	13	85	114	29	5	9	255
Other intentional injuries	**0**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	**70'256**	**52**	**581**	**15'105**	**18'952**	**11'957**	**4'182**	**3'570**	**54'399**	**20**	**179**	**3'280**	**5'324**	**4'881**	**1'749**	**423**	**15'857**

The number and percentages of deaths due to alcohol in Switzerland, Germany and EUR A are presented in Table Results-6. Overall, among men 5.2% of all deaths were attributable to alcohol in 2002, and 1.4% among women. The figures were higher compared to Germany (3.8% and -4.3%. respectively) or EUR A (3.5% and -2.4%, respectively) where the net effect among women was negative, i.e., more deaths were prevented than caused by alcohol. Cancers were the most prevalent cause of deaths attributable to alcohol in Switzerland for both men and women. This category exceeded cardiovascular deaths prevented by alcohol in Switzerland, while in Germany and EUR A the beneficial contribution of cardiovascular diseases was greater than the detrimental effect of cancer for both sexes. Breast cancer was the most prevalent cause of deaths from cancer due to alcohol among women, among men deaths from liver cancer were followed by oral and oesophageal cancer. Cirrhosis of the liver was the second most prevalent disease category among men in Switzerland, followed by unintentional injuries. Among women in Switzerland, the beneficial effect of cardiovascular disease mortality (mostly ischaemic heart disease) was second in terms of absolute numbers, followed by the detrimental effect of cirrhosis of the liver. Among men in Germany deaths due to cirrhosis of the liver caused by alcohol were more prevalent compared to deaths from cancer, whereas cancer was by far the leading cause of deaths among Swiss men. Worldwide, more deaths were prevented by alcohol than caused due to the beneficial effect of alcohol on ischaemic heart disease among women. Globally, among both sexes the number of cardiovascular disease deaths prevented by alcohol consumption were most prevalent, followed by the detrimental effect on cancer and cirrhosis of the liver.

Table Results-6: Deaths* attributable to alcohol consumption in Switzerland, Germany and EUR A in 2002 (in 1'000)

	Switzerland				Germany				EUR A			
	no.		%		no.		%		no.		%	
	M	W	M	W	M	W	M	W	M	W	M	W
Maternal and perinatal conditions (low birth weight)	0.000	0.000	0.0	0.0	0.009	0.007	0.1	0.0	0.034	0.025	0.0	-0.1
Cancer	0.818	0.408	52.0	92.5	7.231	5.026	49.0	-27.0	36.809	22.793	54.3	-47.4
Diabetes mellitus	-0.207	-0.047	-13.2	-10.7	-0.857	-0.930	-5.8	5.0	-3.290	-3.108	-4.9	6.5
Neuropsychiatric disorders	0.243	0.113	15.4	25.7	4.661	1.288	31.6	-6.9	12.912	3.953	19.1	-8.2
Cardiovascular diseases	-0.195	-0.361	-12.4	-81.8	-10.925	-29.227	-74.0	156.9	-42.962	-94.527	-63.4	196.5
Cirrhosis of the liver	0.436	0.191	27.7	43.2	9.477	3.597	64.2	-19.3	31.850	13.012	47.0	-27.0
Unintentional injuries	0.318	0.090	20.2	20.3	3.694	1.196	25.0	-6.4	25.594	7.840	37.8	-16.3
Intentional injuries	0.162	0.048	10.3	10.9	1.465	0.422	9.9	-2.3	6.824	1.898	10.1	-3.9
All alcohol-attributable deaths	**1.575**	**0.441**	**100.0**	**100.0**	**14.755**	**-18.622**	**100.0**	**100.0**	**67.772**	**-48.114**	**100.0**	**100.0**
All deaths	30.345	30.574			385.388	430.013			1950.000	1970.000		
Percentage of all deaths attributable to alcohol	**5.2%**	**1.4%**			**3.8%**	**-4.3%**			**3.5%**	**-2.4%**		

* numbers are rounded to the nearest thousand. Zero (0) indicates fewer than 500 alcohol-attributable deaths in the disease category

In terms of years of life lost (YLLs) as displayed in Table Results-7, the burden due to alcohol consumption was estimated to be 10.5% of all-cause YLLs among men in Switzerland, and 4.9% among women. Similar to mortality burden cancer was the leading cause of YLLs due to alcohol among both sexes; however, among men the burden of YLLs caused by unintentional injuries attributable to alcohol exceeded the number of YLLs due to cirrhosis of the liver. Contrary to mortality burden, among men in Germany the most prevalent cause of YLLs due to alcohol was cirrhosis of the liver, followed by YLLs prevented by cardiovascular diseases, and then with almost equal share cancer and unintentional injuries. Worldwide, cardiovascular diseases among men were only the fourth most prevalent cause of YLLs attributable to alcohol while this disease

category was the leading cause of deaths due to alcohol among men. Because deaths due to ischaemic heart disease tend to occur later in life the effect of this disease category on YLLs is less pronounced compared to mortality alone, although other disease categories were less prevalent in terms of deaths. No changes in relative importance compared to mortality alone were estimated among women in Germany and globally. In sum, the top three disease categories were similar across Switzerland, Germany and the world, however with a different order. Due to higher prevalence of ischaemic heart disease in the population, the protective effect of alcohol consumption in Germany was more pronounced compared to the world or Switzerland. Noteworthy was also the higher relative importance of intentional injuries in Switzerland compared to Germany or the world.

Table Results-7: YLLs* attributable to alcohol consumption in Switzerland, Germany and EUR A in 2002 (in 1'000)

	Switzerland				Germany				EUR A			
	no.		%		no.		%		no.		%	
	M	W	M	W	M	W	M	W	M	W	M	W
Maternal and perinatal conditions (low birth weight)	0.009	0.003	0.0	0.0	0.292	0.229	0.1	-0.3	1.114	0.829	0.1	-0.7
Cancer	7.938	4.333	36.3	61.3	81.346	56.232	27.8	-66.8	406.401	258.511	30.4	-211.9
Diabetes mellitus	-1.694	-0.392	-7.7	-5.5	-9.312	-7.455	-3.2	8.9	-37.538	-25.453	-2.8	20.9
Neuropsychiatric disorders	3.059	1.472	14.0	20.8	71.410	18.859	24.4	-22.4	199.884	60.077	15.0	-49.3
Cardiovascular diseases	-1.924	-2.865	-8.8	-40.5	-85.257	-226.738	-29.1	269.4	-334.978	-735.853	-25.1	603.3
Cirrhosis of the liver	5.246	2.393	24.0	33.9	126.908	49.544	43.3	-58.9	427.765	173.927	32.0	-142.6
Unintentional injuries	5.967	1.212	27.3	17.2	78.508	17.433	26.8	-20.7	528.526	108.532	39.6	-89.0
Intentional injuries	3.270	0.911	14.9	12.9	29.055	7.746	9.9	-9.2	144.790	37.458	10.8	-30.7
All alcohol-attributable YLLs	**21.871**	**7.067**	**100.0**	**100.0**	**292.950**	**-84.150**	**100.0**	**100.0**	**1335.964**	**-121.971**	**100.0**	**100.0**
All YLLs	207.539	144.394			2909.683	2095.351			14133.000	9830.000		
Percentage of all YLLs attributable to alcohol	**10.5%**	**4.9%**			**10.1%**	**-4.0%**			**9.5%**	**-1.2%**		

* numbers are rounded to the nearest thousand. Zero (0) indicates fewer than 500 alcohol-attributable YLLs in the disease category

Table Results-8 compares the burden of disease as measured in disability-adjusted life years (DALYs) in Switzerland, Germany and EUR A. In both countries and EUR A as a whole, neuropsychiatric conditions were the most prevalent disease condition among both sexes, except for women in Germany and EUR A where it was the second most prevalent cause in absolute numbers, however, the cardioprotective effect of low to moderate regular alcohol consumption prevented more than twice as many DALYs compared to neuropsychiatric conditions among women in Germany and to a lesser extent in EUR A. In total, 12.9% of all DALYs in 2002 among men in Switzerland were attributable to alcohol, this rate was comparable to Germany (13.4%) and EUR A (12.2%). Among women in Germany almost as many DALYs were prevented as were caused by

alcohol. Among women in Switzerland, the burden in terms of DALYs was less detrimental compared to deaths or YLLs whereas the burden was more detrimental in Germany and EUR A compared to mortality and YLL burden due to alcohol.

Table Results-8: DALYs* attributable to alcohol consumption in Switzerland, Germany and EUR A in 2002 (in 1'000)

	Switzerland				Germany				EUR A			
	no.		%		no.		%		no.		%	
	M	W	M	W	M	W	M	W	M	W	M	W
Maternal and perinatal conditions (low birth weight)	0.019	0.010	0.0	0.1	0.392	0.324	0.1	2.8	1.755	1.419	0.1	0.4
Cancer	8.331	4.816	15.3	30.4	85.660	63.063	11.7	551.0	425.555	289.368	12.8	84.1
Diabetes mellitus	-2.929	-0.591	-5.4	-3.7	-20.201	-11.120	-2.8	-97.2	- 104.457	- 45.281	-3.1	-13.2
Neuropsychiatric disorders	33.271	8.886	61.2	56.0	468.187	115.043	63.9	1005.2	2'008.786	509.204	60.2	148.0
Cardiovascular diseases	-1.417	-3.053	-2.6	-19.3	-81.598	-252.620	-11.1	-2'207.3	- 313.038	- 828.914	-9.4	-241.0
Cirrhosis of the liver	6.288	3.021	11.6	19.1	154.317	64.589	21.1	564.3	520.850	225.561	15.6	65.6
Unintentional injuries	7.420	1.791	13.6	11.3	94.995	23.861	13.0	208.5	643.717	152.646	19.3	44.4
Intentional injuries	3.416	0.976	6.3	6.2	30.456	8.306	4.2	72.6	151.130	39.953	4.5	11.6
All alcohol-attributable DALYs	**54.399**	**15.857**	**100.0**	**100.0**	**732.207**	**11.445**	**100.0**	**100.0**	**3'334.298**	**343.956**	**100.0**	**100.0**
All DALYs	420.560	378.056			5480.607	4910.882			27'329.000	24'396.000		
Percentage of all DALYs attributable to alcohol	**12.9%**	**4.2%**			**13.4%**	**0.2%**			**12.2%**	**1.4%**		

* numbers are rounded to the nearest thousand. Zero (0) indicates fewer than 500 alcohol-attributable DALYs in the disease category

Discussion

Overall, before we discuss the implications for prevention, we would like to do point out some methodological caveats:

- For consistency purposes and lack of alternatives, we took the mortality, YLL and DALY data from the WHO databank. Switzerland has not yet conducted a burden of disease study, so these were the only data sources available. Especially the number of DALYs may prove to be only an approximation when Swiss data will become available.
- The RRs were derived from meta-analyses, and are assumed to be consistent across countries, mainly because they reflect biological mechanisms. This assumption is probably not problematic for Switzerland, as most studies included in the meta-analyses are from European or North American countries with similar genetic background and not too different health care systems.
- The AAFs for injury may be more problematic, as the relationship between alcohol and injury has been shown to be quite influenced by culture. Here, it seems urgently necessary that Swiss studies will be used to put the results of this study in perspective (e.g. the ongoing work of Dr. G. Gmel at the University Hospital of Lausanne could be used for this purpose).
- The estimates for the age groups 70 years and older are certainly an overestimate, both for beneficial and detrimental effects. RRs have been shown to decrease with age. While there are quantifications of this effect for major tobacco-related risks, no quantification exists for alcohol-attributable disease (see also Rehm et al., 2006b, for references and further information).
- The procedure for adjustment of the survey data may overestimate consumption in heavy drinking categories, if the key assumption for this procedure, i.e. that undercoverage is a result of missing certain heavy drinking populations such the homeless and the institutionalized, is not valid (see Gmel and Rehm, 2004). Rehm and colleagues (2006b) give some sensitivity analyses for potential consequences for burden of disease, if different assumptions for adjusting survey data hold true.

All in all, despite these caveats, the estimates are the best possible for Switzerland, and in lack of better estimates should influence policy.

We see three main conclusions of the above results for Switzerland:

- Overall consumption is quite high, not only compared to global averages (Rehm et al., 2006a), but also within the developed world (see also Room et al., 2005; Anderson

and Baumberg, 2006). Thus, all the best practices laid out in Babor et al. (2003) and Anderson and Baumberg (2006) with respect to reducing overall consumption should apply to Switzerland. There are in particular:

- **Taxation**: There is clear evidence that consumers react to prices for goods including alcohol. Newer economic literature found this behaviour even in people with alcohol dependence (see chapter in Babor et al., 2003). For Switzerland, the analyses of the recent tax cut for liquor confirmed the general postulate, that decreases in taxation and subsequently decreases in price were accompanied by increases in consumption and alcohol-related harm (Mohler-Kuo et al., 2004; Kuo et al., 2003). The differential impact on different types of drinkers was not that clear in Switzerland, but from a public health point, the increase in consumption and problems is the most important point. Given the relatively low tax rate in Switzerland, and given the fact, that the relative price (i.e. the proportion of disposable income necessary to obtain alcohol beverages) decreased in almost all regions of Europe over the past decades (Anderson and Baumberg, 2006), an increase of the taxation of alcoholic beverages should be a priority for alcohol policy in this country. Clearly, taxation is not only effective but cost-effective, and this statement is still true if unrecorded consumption in Switzerland would increase by tax evasion (see Chisholm et al., 2006, for a model calculation for Eur A).

  Please note, that the active mechanism here is the relationship between price and demand of alcoholic beverages, and this price can also be increased by **cantonal or communal duties** for alcohol sales at special events to achieve the same effect, i.e. lowering consumption and alcohol-attributable harm (Gruppe Schweizer Alkoholpolitik, 2005).

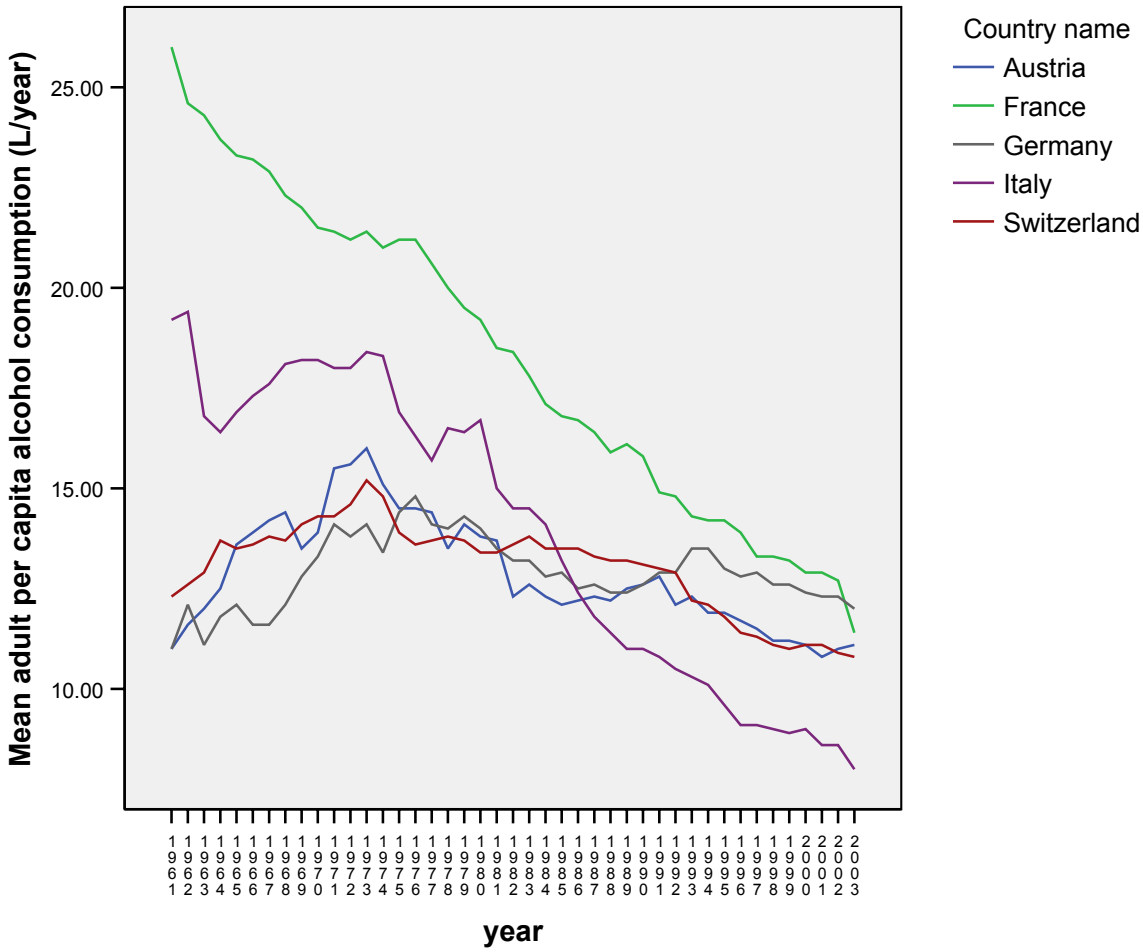
- Reductions in **availability**, as laid out in detail by Gruppe Schweizer Alkoholpolitik (2005):
  - Better cantonal enforcement of the minimal drinking age and larger fines for infractions;
  - Better regulations for the density of alcohol outlets, e.g. by involving communal restrictions based on residents choice;
  - Reduction of opening hours especially for gas stations selling alcohol;
  - Refusal to sales of alcohol in specific events, such as sports events;
  - More visible separation of alcoholic beverages from other drinks and alimentation (based on article 37a of the Lebensmittelverordnung, §1).

- With restrictions because of the evidence base, measures against advertisements of alcohol beverages. Although more recent research strengthened the evidence base on the effectiveness of bans for alcohol advertisement and marketing (e.g. summarized in Anderson and Baumberg, 2006), some of the aggregate level studies show only borderline effects (Rehm, 2004). However, given the precautionary principle (Babor et al., 2003), such bans should be implemented in Switzerland.

- In comparison with Germany and Western Europe as a whole, the relative impact of alcohol consumption on women in Switzerland is higher. Thus, specific policy measures should be developed for this group.

- The impact of alcohol on young adults seems especially high. Thus, specific measure should be developed to reduce alcohol-attributable harm in this age group. This does include, but should not be restricted to measures for adolescents. It will have to include measures to reduce binge drinking, as this pattern of alcohol consumption is particularly related to accidents, a major risk factor for burden of disease in younger age groups. Steps like the recent lowering of BAC for traffic participation in Switzerland are in the right direction. However, other measure in injury prevention (falls, poisonings, suicides) are necessary as well.

Overall, the above described burden of disease attributable to alcohol consumption is alarming. Contrary to some of its neighbours, such as France or Italy (see graph below), Switzerland has failed to consistently and substantially reduce its adult *per capita* consumption in recent decades.



The consequences of this lack unfortunately are visible in current health statistics. It will take increased efforts, and creativity to reduce the burden of disease in this country with a strong culture of drinking, and no signs to re-evaluate the risks of drinking in public opinion, again like in France or Italy. On the positive side, there are evidence-based efforts to reduce alcohol-attributable health harm, which are not only effective, but also cost-effective (Babor et al., 2003; Chisholm et al., 2004; Rehm et al., 2006c). It will depend on the courage of political decision making to implement these measures in Switzerland.

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Appendix: Outcome tables in different format, separating detrimental and beneficial effects

Table Comp-1: Deaths* attributable to alcohol consumption in Switzerland, Germany and EUR A in 2002

	Switzerland				Germany				EUR A			
	no.		%		no.		%		no.		%	
	M	W	M	W	M	W	M	W	M	W	M	W
Maternal and perinatal conditions (low birth weight)	0.000	0.000	0.0	0.0	0.009	0.007	0.0	0.1	0.034	0.025	0.0	0.0
Cancer	0.818	0.408	33.7	39.5	7.231	5.026	24.4	37.9	36.809	22.793	29.2	41.7
Diabetes mellitus	0.000	0.000	0.0	0.0	0.000	0.000	0.0	0.0	0.000	0.000	0.0	0.0
Neuropsychiatric disorders	0.243	0.113	10.0	11.0	4.661	1.288	15.7	9.7	12.912	3.953	10.2	7.2
Cardiovascular diseases	0.454	0.183	18.7	17.7	3.094	1.727	10.4	13.0	12.243	5.164	9.7	9.4
Cirrhosis of the liver	0.436	0.191	17.9	18.4	9.477	3.597	32.0	27.1	31.850	13.012	25.2	23.8
Unintentional injuries	0.318	0.090	13.1	8.7	3.694	1.196	12.5	9.0	25.594	7.840	20.3	14.3
Intentional injuries	0.162	0.048	6.7	4.7	1.465	0.422	4.9	3.2	6.824	1.898	5.4	3.5
Total 'detrimental effects' attributable to alcohol	2.432	1.033	100	100	29.631	13.262	100	100	126.267	54.685	100.0	100.0
Diabetes mellitus	-0.207	-0.047	24.2	8.0	-0.857	-0.930	5.8	2.9	-3.290	-3.108	5.6	3.0
Cardiovascular diseases	-0.649	-0.544	75.8	92.0	-14.02	-30.96	94.2	97.1	-55.205	-99.691	94.4	97.0
Total 'beneficial effects' attributable to alcohol	-0.856	-0.591	100	100	-14.876	-31.885	100	100	-58.495	-102.799	100.0	100.0
All alcohol-attributable deaths	**1.575**	**0.441**	**100.0**	**100.0**	**14.755**	**-18.623**	**100.0**	**100.0**	**67.772**	**-48.114**	**100.0**	**100.0**
All deaths	30.345	30.574			385.388	430.013			1,950.201	1,969.721		
Percentage of all deaths attributable to alcohol	**5.2%**	**1.4%**			**3.8%**	**-4.3%**			**3.5%**	**-2.4%**		

* numbers are presented in thousands.

Table Comp-2: YLLs* attributable to alcohol consumption in Switzerland, Germany and EUR A in 2002

	Switzerland				Germany				EUR A			
	no.		%		no.		%		no.		%	
	M	W	M	W	M	W	M	W	M	W	M	W
Maternal and perinatal conditions (low birth weight)	0.009	0.003	0.0	0.0	0.292	0.229	0.1	0.1	1.114	0.829	0.1	0.1
Cancer	7.938	4.333	27.4	36.8	81.346	56.232	19.5	34.3	406.401	258.511	22.2	37.9
Diabetes mellitus	0.000	0.000	0.0	0.0	0.000	0.000	0.0	0.0	0.000	0.000	0.0	0.0
Neuropsychiatric disorders	3.059	1.472	10.6	12.5	71.410	18.859	17.1	11.5	199.884	60.077	10.9	8.8
Cardiovascular diseases	3.488	1.465	12.0	12.4	28.964	13.960	7.0	8.5	119.588	42.103	6.5	6.2
Cirrhosis of the liver	5.246	2.393	18.1	20.3	126.908	49.544	30.5	30.2	427.765	173.927	23.4	25.5
Unintentional injuries	5.967	1.212	20.6	10.3	78.508	17.433	18.9	10.6	528.526	108.532	28.9	15.9
Intentional injuries	3.270	0.911	11.3	7.7	29.055	7.746	7.0	4.7	144.790	37.458	7.9	5.5
Total 'detrimental effects' attributable to alcohol	28.978	11.789	100	100	416.483	164.003	100	100	1,828.068	681.438	100.0	100.0
Diabetes mellitus	-1.694	-0.392	23.8	8.3	-9.312	-7.455	7.5	3.0	-37.538	-25.453	7.6	3.2
Cardiovascular diseases	-5.412	-4.329	76.2	91.7	-114.221	-240.697	92.5	97.0	-454.566	-777.957	92.4	96.8
Total 'beneficial effects' attributable to alcohol	-7.106	-4.721	100	100	-123.533	-248.152	100	100	-492.104	-803.410	100.0	100.0
All alcohol-attributable deaths	**21.871**	**7.068**	**100.0**	**100.0**	**292.950**	**-84.149**	**100.0**	**100.0**	**1335.964**	**-121.972**	**100.0**	**100.0**
All deaths	207.539	144.394			2,909.683	2,095.351			14,133.339	9,830.315		
Percentage of all deaths attributable to alcohol	**10.5%**	**4.9%**			**10.1%**	**-4.0%**			**9.5%**	**-1.2%**		

* numbers are presented in thousands.

Table Comp-3: DALYs* attributable to alcohol consumption in Switzerland, Germany and EUR A in 2002

	Switzerland				Germany				EUR A			
	no.		%		no.		%		no.		%	
	M	W	M	W	M	W	M	W	M	W	M	W
Maternal and perinatal conditions (low birth weight)	0.019	0.010	0.0	0.0	0.392	0.324	0.0	0.1	1.755	1.419	0.0	0.1
Cancer	8.331	4.816	13.2	22.8	85.660	63.063	9.8	21.7	425.555	289.368	10.9	22.9
Diabetes mellitus	0.000	0.000	0.0	0.0	0.000	0.000	0.0	0.0	0.000	0.000	0.0	0.0
Neuropsychiatric disorders	33.271	8.886	52.8	42.1	468.187	115.043	53.6	39.6	2,008.786	509.204	51.2	40.3
Cardiovascular diseases	4.324	1.613	6.9	7.6	39.308	15.344	4.5	5.3	168.881	46.230	4.3	3.7
Cirrhosis of the liver	6.288	3.021	10.0	14.3	154.317	64.589	17.7	22.2	520.850	225.561	13.3	17.8
Unintentional injuries	7.420	1.791	11.8	8.5	94.995	23.861	10.9	8.2	643.717	152.646	16.4	12.1
Intentional injuries	3.416	0.976	5.4	4.6	30.456	8.306	3.5	2.9	151.130	39.953	3.9	3.2
Total 'detrimental effects' attributable to alcohol	63.070	21.113	100	100	873.314	290.529	100	100	3,920.674	1,264.381	100.0	100.0
Diabetes mellitus	-2.929	-0.591	33.8	11.2	-20.201	-11.120	14.3	4.0	-104.457	-45.281	17.8	4.9
Cardiovascular diseases	-5.742	-4.666	66.2	88.8	-120.906	-267.964	85.7	96.0	-481.918	-875.145	82.2	95.1
Total 'beneficial effects' attributable to alcohol	-8.671	-5.257	100	100	-141.107	-279.084	100	100	-586.375	-920.426	100.0	100.0
All alcohol-attributable deaths	**54.399**	**15.856**	**100.0**	**100.0**	**732.207**	**11.445**	**100.0**	**100.0**	**3,334.299**	**343.955**	**100.0**	**100.0**
All deaths	420.560	378.056			5,480.607	4,910.882			27,329.000	24,395.683		
Percentage of all deaths attributable to alcohol	**12.9%**	**4.2%**			**13.4%**	**0.2%**			**12.2%**	**1.4%**		

* numbers are presented in thousands.