

Detrimental effects of alcohol consumption are a major cause of morbidity and mortality. In Germany, approximately 17560 annual deaths are directly attributable to alcohol use and 42000 annual deaths are alcohol-associated ¹. According to the German Centre on Addiction Problems (Deutsche Hauptstelle für Suchtfragen), about 1.6 million people are addicted to alcohol ².

For a long time, alcohol research has predominantly focused on the harmful health effects caused by excessive and chronic alcohol consumption. The list of acute and chronic health risks is long and includes accidents, liver cirrhosis, pancreatitis, cardiac muscle disease, hypertension, various cancers, metabolic disorders, mental disorders and alcoholism. In the last few decades, the body of evidence for beneficial health effects of moderate alcohol consumption has grown, primarily in relation to a reduction of coronary heart disease risk. In the interim, protective cardiovascular effects of moderate alcohol consumption have been shown in a multitude of epidemiological studies conducted for different populations ³⁻⁷. However, results on the amount of alcohol associated with potential cardiovascular benefits are conflicting. In addition, the question whether the salutary effects of moderate alcohol consumption outweigh its hazards is still being discussed.

Historical background

Reports of the use of alcoholic beverages go back to the 3rd century before Christ. Alcoholic beverages were already known by the ancient Egyptians. The ancient Greek were one of the first European cultures who embedded alcohol into everyday life. Wine in particular was used for religious rites, but also as (luxury) food. In addition, alcohol was put to use for medical purposes already very early. Caesar, for instance, recommended his Roman soldiers to drink one litre of wine every day to prevent epidemics. At the beginning of the Middle Ages and with the development of distillation, new possibilities emerged for a more specific use of high proof alcohol in medicine.

This, however, also led to a period of higher alcohol consumption associated with alcohol-related health consequences. It was around 1800 when physicians like Trotter and Hufeland first defined the concept of alcoholic dependence or addiction as a disease, expressed by an urge to drink alcoholic beverages. Progress in medicine enabled to relate alcohol consumption with various severe health defects in different parts of the body ⁸.

The association between chronic heavy alcohol consumption and heart disease was detected in the 19th century. In 1884, Bollinger linked cardiac dilatation and hypertrophy diagnosed in

Bavarians - also called “Münchener Bierherz” (Munich beer heart) - to the relatively high average beer consumption of 432 litres per year in Munich ⁹. Over the years, this finding was confirmed by records on alcohol-induced heart muscle diseases. In 1915, it was first observed that there is a relation between heavy drinking and hypertension ¹⁰.

In fact, already in 1786 a first report on a salutary effect of alcohol consumption was published, when Herberden recognised a considerable relief of angina pectoris with alcohol ¹¹. In the early 1900s, a first observational study conducted by Carbot documented an inverse association between alcohol consumption and atherosclerotic disease ¹². The protective cardiovascular effect of alcohol consumption was initially explained by a ‘solvent’ action of alcohol and, in addition, by the assumption that heavy drinking causes premature death, this means, before cardiovascular disease could occur ¹³. It was not until the 1970s that well-designed studies on the association between alcohol consumption and cardiovascular disease as well as total mortality were published ¹⁴. They confirmed the potential of alcohol, when consumed in moderation, to lower the risk of cardiovascular morbidity and mortality. This potential beneficial health effect, however, reversed itself with higher alcohol consumption levels ^{13,15}.

Alcohol terminology

The term *alcohol* comprises organic chemical compounds with one or more hydroxyl groups ¹⁶. In a consumer’s context, alcohol consumption refers to the intake of *ethanol* with alcoholic beverages. Additionally, alcohol can be ingested with food, although usually in negligible amounts.

One difficulty faced by alcohol researchers and other experts in the broader alcohol field, but also by the public, is the lack of consensus on the definition of the term *moderate*. *Moderate* is derived from the Latin word *moderare* and stands for *to control* or *to restrain*. A wide variety of definitions has been offered depending on the underlying sense and respective implication, comprising drinking levels that are “non-intoxicating”, “statistically normal”, “non-injurious”, “problem-free” and “optimal” ¹⁷. Accordingly, the amounts of alcohol that have been regarded as moderate range between 0 and 80 g/day ¹⁸⁻²⁰. The World Health Organisation defined 10-30 g/day (cited in ²¹) and the German Nutrition Society 12 g/day for women and 24 g/day for men as moderate alcohol drinking levels ²². It was beyond the scope of this thesis to define a generally accepted standard definition of moderate alcohol consumption. In this thesis an alcohol consumption up to 40 g/day is considered as moderate.

Another problem concerns the risk assessment of alcohol consumption, in so far as there is no unique or generally accepted definition of the term *binge drinking*. Conventionally, binge drinking relates either to occasional bursts of heavy drinking by young and/or non-dependent people or to a drinking session of alcohol-dependent people, which may last quite some time²³. In general, the concept of binge drinking implies an amount of alcohol sufficient to reach intoxication on one occasion or in the course of one drinking session²⁴. The quantification of such an intoxicating amount, however, is difficult, as it varies greatly with individual tolerance, drinking experience, drinking context as well as body weight and composition^{25,24}. Moreover, there is no consent on the question how many drinking occasions are acceptable in a given time period in order to distinguish binge drinking from frequent or chronic heavy drinking. Accordingly, the definitions of binge drinking being used are wide-ranging and rather arbitrary, without empirical evidence for the selected cut-off points. Binge drinking was defined as ten or more drinks in one session (with 7.9 g alcohol per drink) by Bloomfield et al.²⁶, as nine or more drinks per day on one or two days per week or every day by McElduff et al.^{27,28} and as eight or more drinks per occasion (with approximately 13 g alcohol per drink) by Murray et al.²⁹. Other authors refer to lower limits³⁰⁻³². Some studies have paid attention to possible gender differences, defining binge drinking as four drinks or more per occasion for women and five drinks or more per occasion for men during the previous month^{33,34}. A more general approach is to apply the term binge drinking to an intake above half the number of weekly units tolerated on a population level in one session^{35,36}.

Rationale and outline of the thesis

Until 1999, a risk assessment of alcohol consumption for Germany that included scientifically based drinking guidelines was not available. This had to be changed for three main reasons. Firstly, an increasing number of studies has reported health benefits of moderate alcohol consumption in relation to cardiovascular disease. Certain doubts have emerged among the population but also among researchers, how to judge the described beneficial health effects in view of the overall health effects of alcohol consumption. Secondly, Germany ranks among the countries with the highest per capita alcohol consumption according to a pan-European comparison³⁷. In order to attenuate the alcohol-associated detrimental social and economic consequences and to improve public health, a reduction of alcohol consumption is assumed to be a basic requirement³⁸. In this context, it is necessary to collect information about a responsible handling of alcohol. Thirdly, a risk assessment of alcohol consumption allows a closer

identification of population groups with an alcohol consumption probably related to harmful health effects. This information offers perspectives for a more focused intervention on a public health scale.

Thus, the specific objectives of this thesis have been:

- To analyse potential beneficial effects of moderate alcohol consumption on the circulatory system in the German adult population.

Blood lipids, certain haemostatic factors as well as homocysteine are major risk factors of cardiovascular disease. Differences in the levels of these cardiovascular risk factors have been compared in **Chapter 2**, according to alcohol consumption groups using cross-sectional data of the representative German National Health Interview and Examination Survey 1998.

- To evaluate the scientific knowledge on harmful and beneficial health effects of moderate alcohol consumption in order to define tolerable upper alcohol intake levels for the German adult population.

A systematic review of relevant epidemiological studies is presented in **Chapter 3**. The conflicts in research findings on risks and benefits of moderate alcohol consumption for several diseases have been disentangled. An approach following that of the Food and Nutrition Board for deriving Dietary Reference Intakes for the USA was chosen to guarantee a maximum of safety for the public.

- To depict the current alcohol drinking behaviour in Germany. In this context, characteristics associated with higher alcohol consumption have been identified.

Based on the German National Health Interview and Examination Survey 1998 and the affiliated German Nutrition Survey 1998, the prevalence of an alcohol consumption above the tolerable upper alcohol intake levels in regard to socio-demographic background and lifestyle habits has been analysed in **Chapter 4**. In **Chapter 5**, the examination of alcohol-associated characteristics has been deepened by the use of a multiple linear regression model. This statistical model based on the main findings of Chapter 4 additionally included aspects of quality of life.

Finally, the findings of this thesis are presented in a broader context in **Chapter 6**, taking also methodological aspects into account. On the basis of our main results, public health implications have been derived and, in addition, suggestions for future research have been made.

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