

ALCOHOL CONSUMPTION AND HEALTH:

CONTRIBUTIONS TO THE EXPLANATION OF THE U-SHAPED CURVE

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ALCOHOL CONSUMPTION AND HEALTH:
CONTRIBUTIONS TO THE EXPLANATION OF
THE U-SHAPED CURVE

ALCOHOLGEBRUIK EN GEZONDHEID:
EEN BIJDRAGE AAN DE VERKLARING VAN
DE U-VORMIGE CURVE

THESIS

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ERRATUM

Please note that there is a mismatch in the order of the chapters as described in the General Introduction. “The health risk of abstainers” is presented in Chapter 6 of the thesis and **not** in Chapter 4 as stated in the General Introduction. Similarly, Chapters 5 and 6 correspond to Chapters 4 and 5 of the thesis, respectively.

CHAPTER 1

General Introduction

1 GENERAL INTRODUCTION

1.1. Introduction

For many years, scientists have studied the relationship between consumption of alcoholic beverages - wine, beer and spirits - and health. An overview of the major risks and benefits associated with alcohol consumption is given in Table 1.1.

Alcohol has a number of adverse effects on health - it contributes to liver diseases including liver cancer; to breast, throat (esophageal), larynx, pharynx, oral cavity cancers; to injuries and poisoning; and to blood pressure increases (Andreasson et al., 1988; Anderson, 1995; Smith-Warner et al., 1998). At low levels of consumption, however, alcohol has also been associated with beneficial health effects. Many epidemiological studies have suggested that there is a U- or J-shaped relationship between alcohol consumption and all-cause mortality (Marmot et al., 1981; Camacho et al., 1986; Poikolainen, 1995). Light and moderate drinkers have lower mortality rates than either abstainers or heavy drinkers (the two ends of the U-shaped curves). The lower mortality risk among light and moderate drinkers is largely due to a reduction in the risk of coronary heart disease (CHD), a major cause of death in industrialized countries. The increased risk at higher levels of consumption are explained by other causes of death, such as suicide, accidental injuries, and several other diseases such as liver cirrhosis or hemorrhagic stroke (Gordon & Doyle, 1987; Romelsjo, 1995; Bondy, 1996). The shape and the level of the curves vary according to the distribution of alcohol consumption in the population as well as with the prevalence of the condition under study and the background risk for developing the mentioned condition.

The health benefits of light to moderate drinkers are not restricted to their lower mortality risk. Light and moderate drinkers seem to have lower rates of myocardial infarction, ischaemic stroke, non-insulin dependent diabetes, common cold, and better subjective health than abstainers or heavy drinkers (Palomaki & Kaste, 1993; Rimm et al., 1995; Poikolainen et al., 1996; Rimm et al., 1996).

Table 1.1 Overview of risks and benefits associated with alcohol consumption

RISKS ASSOCIATED WITH HIGH CONSUMPTION	BENEFITS ASSOCIATED WITH MODERATE CONSUMPTION
Liver injury (alcoholic hepatitis, liver cirrhosis, liver cancer) Pancreatitis	Longevity Myocardial Infarction
High blood pressure	Coronary heart disease (CHD)
Hemorrhagic stroke	Ischaemic stroke
Suicide, accidents, injuries, poisoning	Subjective health
Cancer (oral cavity, pharynx, larynx, oesophagus, liver, breast) Poisoning, alcohol psychosis, dependence	Non-insulin dependent diabetes Common cold
Violence, legal problems, family disruption Work-related problems	Euphoria, mood stimulant, relaxation Stress-buffer

Besides these health effects, alcohol consumption has also social and psychological consequences. Alcohol induces feelings of euphoria, is a mood-stimulant, enhances social interaction, produces relaxation and it is known for its stress-buffering properties. However, alcohol consumption is also related to violence; it has family and work-related adverse consequences such as family violence and disruption, unemployment, reduction in work productivity or sickness absence (Romelsjo, 1995; Bondy, 1996). Besides the effects of alcohol on the drinker, the effect of alcohol on the health of people other than the drinker is of great importance from the public health standpoint.

1.2 What constitutes 'light to moderate' drinking?

There are no universally accepted definitions of 'light', 'moderate' or 'excessive' drinking. Most of the studies on the relationship between alcohol consumption and health are based on some sort of average measure for alcohol intake. Some studies have summarized alcohol

intake into ounces, grams, glasses or units per month, week, or day. How much alcohol constitutes a “drink” or a “unit”? Wine, beer and spirits differ in the concentration of alcohol: from about 5% in beer, to 11-13% in wine and about 40% for spirits. The amount of wine, beer and spirits contained in a standard glass also varies, from 250 ml contained in a glass of beer to about 100 ml in a glass of wine and about 30 ml in the case of spirits. Therefore, the alcohol content of a standard unit is equivalent for all types of beverages: One standard unit contains between 8-10 grams of ethanol.

Some health benefits have been observed for levels of alcohol consumption as low as 1 glass every second day but some researchers have reported benefits even at levels of 5 or 6 glasses per day (Jackson, 1994; Maclure, 1993; Rehm et al., 1997). One drink per day, in any case, is the amount most frequently reported as associated with health benefits (Poikolainen, 1995).

But does light-moderate drinking simply mean drinking below certain average number of units per week? The temporal variation of the drinking has been recently added to the picture. At a given level of alcohol intake, regular drinkers have been reported to be better off than occasional drinkers (Wannamethee & Shaper, 1996; McElduff & Dobson, 1997; Russell et al., 1991). Thus, current definitions of light to moderate drinking account not only for average consumption but also for drinking pattern (Rehm et al., 1996).

1.3 What is the interpretation of these U-shaped curves?

Results seem to be consistent. In case-control and prospective studies in various countries looking at both sexes and across racial groups, abstainers and heavy drinkers seem to have poorer health status when compared to light and moderate drinkers (e.g. Poikolainen, 1995; Maclure, 1993; Shaper, 1990). The interpretation of the findings, however, remains controversial (Klatsky et al., 1990; Thorogood et al., 1993). Three alternative (and/or complementary) explanations for the findings have been proposed: Causation, selection and confounding.

1.3.1 Causation

Many researchers accept the hypothesis that the low health risk observed among light or moderate drinkers compared to abstainers and heavy drinkers represents a causal protective effect of alcohol at moderate levels. Supporting this hypothesis we find evidence for plausible biological mechanisms for the explanation of the findings (Maclure, 1993). Alcohol increases HDL cholesterol levels, decreases the risk of thrombosis by increasing blood-clotting activity, decreases platelet aggregation and fibrinogen, insulin resistance, and decreases blood pressure (Wannamethee & Shaper, 1991; Langer et al., 1992; Hendriks et al., 1994). Components of alcoholic beverages other than alcohol have

also been studied in order to determine whether these biological effects were due to alcohol as such or to other components present in alcoholic beverages (Maxwell et al., 1994). Antioxidants such as flavonoids, for example, have been suggested to be responsible for the additional health benefits observed among wine drinkers. Some other mechanisms are also possible. The tension-reduction-hypothesis postulates that alcohol has stress-buffering effects (Cappell & Greeley, 1987). In fact, a large proportion of the drinkers reports drinking in order to cope with stress (Allan and Cooke, 1985; Krause, 1991). If light-moderate drinking buffers the effects of stress on health, in the presence of stress, light-moderate drinkers are likely to benefit from the stress-buffering properties of alcohol and enjoy better health (Jones, et al., 1982). Abstainers, on the contrary, are hypothesized to be more prone to suffer the effects of stress on health. At high levels of consumption, alcohol would no longer provide buffering effects but aggravate the stressful situation (Cappell & Greeley, 1987). Given the high prevalence of both, light-moderate drinking and of stress in industrialized societies (where the benefits of light-moderate drinking have been reported), based on the stress-buffering effects of alcohol consumption, health benefits are likely to be observed among light-moderate drinkers. These mechanisms could explain the health benefits observed at low levels of consumption.

High consumption of alcohol, on the other hand, may also cause health damage. At the aggregate level, per capita alcohol consumption has been associated with higher death rates from injuries, violence, suicide, poisoning, hemorrhagic stroke as well as cancers of the mouth, pharynx, larynx, liver and breast (Andreasson et al., 1988; Anderson, 1995; Smith-Warner et al., 1998).

For most problems, drinking is not the single cause, but one of the factors that lead to increased risk of harm. Other factors, including genetic predisposition and circumstantial conditions, contribute to the risk of harm and are aggravated by the use of alcohol. For some conditions such as liver cirrhosis, the higher the intake, the higher the risk.

1.3.2. Selection

In the presence of disease (whether or not related to heavy drinking), subjects are likely to abstain from drinking or to stop drinking ("sick-quitters"). Individuals who stop drinking because of ill health would provoke an artificial elevation in the risk among abstainers (Shaper et al., 1988; Shaper, 1990). Several researchers also argue that part of the risk observed among abstainers is explained by the contamination of the group of abstainers with the presence of former (heavy) drinkers that stopped drinking due to problems related to (heavy) drinking. Former heavy drinkers who stop drinking, originally at the right end of the U-shaped curves, would artificially increase the health risk in the abstainers' group since they carry along their already elevated health risk (Andreasson, 1998; Thorogood et al., 1993). Furthermore, individuals

who are more vulnerable may never start drinking or quit drinking at young ages. This has been referred to in the literature as susceptibility bias (Vaillant, 1983; Foets & van Baar, 1993).

1.3.3. Confounding

An alternative interpretation for the health benefits of light-moderate drinkers lies in the fact that abstainers and heavy drinkers could differ from light-moderate drinkers in characteristics other than their alcohol consumption. In order to be able to conclude that alcohol protects against a number of health problems, a comparison **must** be made between groups that differ exclusively with regard to alcohol consumption. Both, abstainers and heavy drinkers, however, may differ from light-moderate drinkers in lifestyle factors, such as smoking, dietary habits or physical activity; and in psychosocial characteristics and personality, stressors, social networks, life circumstances or coping strategies. These characteristics rather than their abstention or their high alcohol consumption may be responsible for their disadvantageous health condition (Hart et al., 1999; Fillmore et al., 1998; Skog, 1996; Mertens et al., 1996).

1.4 Aim and structure of this thesis

The purpose of this study is to gain insight into the explanation of the U-shaped curve. In order to do so, the relationship between alcohol consumption with regard to objective as well as subjective health will be described, putting special emphasis on the study of several aspects of drinking pattern such binge drinking, frequency of the consumption and type of alcoholic beverage consumed (Part I). Furthermore, the role of psychosocial stressors and the stress-buffering effects of alcohol consumption will be assessed (Part II). How can these aspects contribute to the explanation of the U-shape?

Figure 1 provides a graphic representation of the relationships assessed in the present study.

Chapter 2: Data source

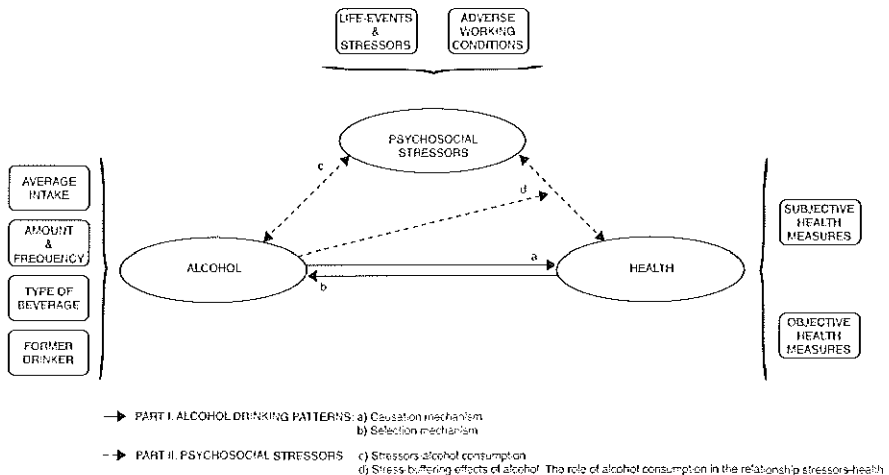
A detailed description of the study population and the methodology used for the present study is provided in Chapter 2 of this thesis.

Part I: Alcohol consumption and health: various health measures and alcohol drinking patterns

Light-moderate drinking has been associated with benefits for a number of objective as well as subjective measures. The mechanisms underlying these U-shaped curves are not well understood. There is evidence for some biological explanation (HDL cholesterol, changes in blood

pressure), and such biological mechanisms would at least partly explain the protective effects found for cardiovascular diseases. But would a purely biological mechanism also explain the higher resistance of light-moderate drinkers to common cold, or their better subjective health? Most of the studies investigating the relationship between alcohol consumption and health looked at total volume of alcohol consumed (average alcohol intake measured in either grams/day, units/week or any other equivalent measure), while disregarding other drinking pattern aspects, such as binge drinking, drinking settings or type of beverage consumed (Rehm, et al., 1996). Only recently, a number of scientific efforts have been directed to the study of these other aspects of drinking (Rehm et al., 1996; Single & Wortley, 1993; Room et al., 1995). Corroborating or refuting the findings of other researchers for objective health and adding information on the role of drinking pattern in the relationship between alcohol consumption and more subjective health outcomes will bring insight into the understanding of the mechanisms underlying the U-shaped curve. Are light and moderate drinkers better off because they drink light-moderate amounts of alcohol? Or do they have a healthier drinking style (i.e., are more likely to be regular drinkers, wine drinkers, engage less often in binge drinking, are more likely to be social drinkers)?

Figure 1 A graphical representation of the relationship between alcohol consumption and health: The role of drinking pattern and psychosocial stressors



Chapter 3: Subjective health measures

Chapter 3 of this thesis concerns the description of the relationship between alcohol consumption and several objective and subjective health measures (see figure 1). Average alcohol intake is studied, as well as binge drinking or frequency of heavy drinking episodes. Does the same curvilinear relationship describe the relationship between alcohol and objective and subjective health outcomes? Does binge drinking increase the health risks for objective and subjective health outcomes?

If the same curvilinear pattern observed for mortality would be observed for subjective health, it would seem unlikely that this is explained by a specific biological mechanism, and this would suggest that some other mechanism also contributes to the health benefits associated with moderate drinking. On the contrary, if the same curvilinear pattern is not found, one may speculate that there is only some kind of biological mechanism underlying the effects of alcohol on health. Thus, the study of subjective aspects of health may provide further insight into the understanding of the underlying mechanisms explaining the U-shaped curve.

Chapter 4: The health risk of abstainers

As stated above, several researchers have argued that the health benefits observed for light-moderate drinkers compared to abstainers are due to selection of the group of abstainers. The main criticism that studies on the health benefits of alcohol consumption have received primarily concerns the composition of the group of abstainers. What is the proportion of former drinkers in the group of current abstainers? What proportion of abstainers and of former drinkers abstains from alcohol due to ill health (are 'sick-quitters')? What is the contribution of former drinkers to the health risk of abstainers? Do abstainers differ from drinkers in characteristics other than their abstinence from alcohol? Although in the group of abstainers, recent studies have been able to separate those who were former drinkers and those who abstain due to ill health, results are not conclusive. Furthermore, the main focus of such studies has been on objective health measures and nothing is known about the contribution of former drinkers or sick-quitters to the elevated risk observed among abstainers for more subjective health measures. What is the contribution of former drinkers to the elevated health risk observed among abstainers? What are the characteristics differentiating abstainers from drinkers? Chapter 4 addresses these issues.

Chapter 5: Occasional versus regular drinking

In addition to average intake, drinking pattern has been suggested to be important in the relationship between alcohol consumption and objective health (Camargo et al., 1989; McElduff & Dobson, 1997; Fillmore et al., 1998). Several researchers have pointed out that regular drinking of small amounts of alcohol does not have the same health

effects as does drinking large amounts occasionally (binge drinking). This is true at least for outcomes such as mortality, stroke, blood pressure, major coronary event or acute myocardial infarction (Kauhanen et al., 1997; Hendriks et al., 1994; McElduff & Dobson, 1997; Palomaki & Kaste, 1993). Possible biological explanations (such as differences in blood pressure by drinking pattern, for example) have been mentioned but the mechanisms are not yet clear (Kauhanen et al., 1997). Are regular drinkers also better off than occasional drinkers with regard to subjective health measures? Does it matter, in terms of health, whether one drinks a lot on a few days rather than a little everyday? Have occasional and/or regular drinking different effects for objective and subjective health? Chapter 5 describes the relationship between alcohol consumption and health for drinkers of similar average alcohol intakes and different drinking patterns.

Chapter 6: Type of beverage

The idea that red wine in particular protects against heart disease has been popularized as the 'French Paradox' — the finding that people in certain regions of France have relatively low rates of heart disease even though their diet is high in saturated fats (St.Leger et al., 1979; Renaud & de Lorgeril, 1992). Are wine drinkers better off than beer drinkers? Are the health effects related to the type of alcohol consumed (e.g., wine, beer or spirits)? Some studies favored wine against other beverages while some others found more benefits for beer and for spirits drinkers and some others found no differences between the beverages (Rimm et al., 1996). Results regarding the health effects of different beverage-types are contradictory (Doll, 1997). Components other than alcohol (antioxidants, phenolic compounds, tannins, flavonoids) have been suggested to be responsible for the health differences (Rimm et al., 1996; Klatsky & Armstrong, 1993; Grønbaek et al., 1995). In addition, drinking pattern and practices have been suggested to underlie the differences by type of beverage (Wannamethee & Shaper, 1999; Grønbaek et al., 1995). Corroborating or refuting previous studies in relation to objective outcomes (mortality) the superiority of one type of beverage over the others for more subjective health measures brings insight into the understanding of the possible mechanisms explaining these differences. Is the health of wine drinkers better than that of beer or spirits drinkers? Is the same pattern observed for the different health measures considered? Chapter 6 examines the role of type of beverage.

Part II: The role of psychosocial stressors and the stress-buffering effects of alcohol consumption

The main focus in the second part of this thesis is on the role of psychosocial stressors in the explanation of the U-shaped curve. We first studied the association between several stressors and alcohol

consumption and then we examined the stress-buffering effects of alcohol, or in other words, the role of alcohol consumption in the relationship between stressors and health.

Psychosocial characteristics differentiating abstainers and drinkers have been speculated to be responsible for their health differences (Eward et al., 1986; Baum-Baicker, 1985; Maclure, 1993; Fillmore et al., 1998; Skog, 1996). However, information regarding these psychosocial characteristics is not usually available in studies focusing on the health effects of alcohol. It has also been suggested that alcohol's stress-buffering effects could contribute to the explanation of the U-shaped curve (e.g., Jones et al., 1982) Are light and moderate drinkers in better health than abstainers and heavy drinkers because the effects of stress on health are buffered by light-moderate doses of alcohol?

Chapter 7: Stressful life events and chronic stressors in relation to alcohol consumption

Stressful life events and chronic stressors have been associated with alcoholism, alcohol abuse, alcohol dependence and problems in different populations (Linsky et al., 1985; Cole et al., 1990; Johnson & Pandina, 1993; Welte & Mirand, 1995). Psychosocial stress has also been associated with health. Our body reacts to stress by creating an alert situation. Stress affects our cardiovascular system by increasing our heart rate and blood pressure. It has also consequences for the immune system and affects our mental functioning. A deterioration of health is likely to occur in the presence of stress (Cohen & Herbert, 1996; Markovitz et al., 1993). Alcohol has been hypothesized to buffer and to serve as a coping mechanism against stress. It is commonly accepted that people drink alcohol in order to cope with the effects of stress (Allan and Cooke, 1985; Krause, 1991). The two ends of the U-shape, abstainers and heavy drinkers, are the focus of the study. Are abstainers and heavy drinkers more likely than light-moderate drinkers to report negative life-events and long-term stressors? And, does this explain their higher risk of health problems? In Chapter 7 we describe the association between life-events and long-term stressors in relation to alcohol consumption.

Chapter 8: Adverse working conditions and alcohol consumption

The relationship between work stressors and alcohol has also been studied. Work-related stress has been associated with alcohol abuse (Muntaner et al., 1995; Romelsjo et al., 1992; Crum et al., 1995), alcohol consumption (Romelsjo et al., 1992), and also alcohol-related problems (Kawakami et al., 1993; Cooper et al., 1990). Despite the number of studies that have been conducted in the field, results are often contradictory (Trice and Sonnenstuhl, 1990; Greenberg and Grunberg, 1995). Once again, abstainers and heavy drinkers were the main interest of the study. In the working population, are abstainers and heavy drinkers more likely than light-moderate drinkers to report adverse

working conditions? Chapter 8 explores the association between adverse working conditions and alcohol consumption.

Chapter 9: The role of psychosocial stressors in the U-shaped curve

Stress has been repeatedly reported to have an adverse affect on health. In the presence of stress, individuals are more vulnerable, which is often reflected in adverse health consequences (Markovitz et al., 1993; Cohen & Herbert, 1996). Alcohol, on the other hand, has been reported to have stress-buffering effects (Cappell & Greeley, 1987). If alcohol buffers the effects of stress on health, in the presence of stress, light-moderate drinkers are likely to benefit from the stress-buffering properties of alcohol and enjoy better health. Given the high prevalence of both light-moderate drinking and of stress in industrialized and modern societies, the stress-buffering effects of alcohol could be reflected in health benefits for light-moderate drinkers. In Chapter 9 we assess the role of alcohol consumption in the relationship between psychosocial stressors and health. More specifically we explore the possibility that the relationship between stress and health is different for the different levels of consumption. Abstainers are speculated to be more prone to suffer the effects of stress on health, while light-moderate drinkers may be better off, given the stress-buffering effects of alcohol.

Chapter 10: General discussion

The results are summarized and discussed in Chapter 10. The limitations of the study and its contribution to the scientific literature are stated. It furthermore provides suggestions for future research and a discussion of the implications of the findings for public health.

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CHAPTER 2

Data source

2 DATA SOURCE

For the present study, data from the GLOBE study was used. The GLOBE acronym refers to 'Gezondheid en LevensOmstandigheden Bevolking Eindhoven en omstreken' ('Health and Living Conditions of the Population of Eindhoven and Surroundings'). The GLOBE study is a longitudinal study conducted in the South East region of The Netherlands, aiming at investigating sociodemographic inequalities in health. For practical reasons, the GLOBE-study was carried out in a geographically restricted area, Eindhoven and seventeen surrounding municipalities. Eindhoven is an industrial city with a population of approximately 195,000 inhabitants (the fifth largest city of The Netherlands) and because of the inclusion of smaller municipalities the study area is mixed rural-urban (Mackenbach et al., 1994).

2.1 The baseline measurement

A random sample of approximately 27,000 persons, stratified by age, degree of urbanization and socioeconomic status was drawn from population registries. Individuals with Dutch nationality and in the age range 15-74 were eligible for the study. Older individuals as well as those in the lowest and highest socioeconomic groups were oversampled in order to increase the contrast to study socioeconomic inequalities in health, the main objective of the GLOBE study (described in detailed in Mackenbach et al., 1994). In March 1991 a postal questionnaire was sent and 18,973 persons responded (response rate of 70,1%). As shown in Table 2.1, the response rate was lower than average among younger people, those from urban areas and the never married and divorced, but the differences in response rates were small.

Respondents were inquired, among others, about their health status, health behavior and sociodemographic characteristics. In order to obtain a more complete assessment of several factors such as health status, financial situation, or psychological factors, a subsample of the respondents to the postal questionnaire was furthermore approached for personal interviews. Of the 3,529 respondents of the postal survey who were contacted, 2802 responded (response rate of 79,4%).

Table 2.1 Response rates to the postal questionnaire by socio-demographic characteristics

	<u>Numbers approached (a)</u>	<u>Numbers responding (b)</u>	<u>Response rate (%)</u>
Gender			
Men	13,583	9,207	67.8
Women	13,487	9,766	72.4
Age			
14-34	7,083	4,762	67.2
35-54	10,088	6,977	69.2
55-74	9,899	7,234	73.1
Marital status			
Married	17,736	12,568	70.9
Single	4,781	3,958	82.8
Separated/Divorced	2,218	1,152	51.9
Widowed	2,543	1,008	39.6

(a) net sample, i.e. total sample (n = 27,278) minus: questionnaires which were returned because the address was wrong (n=124); persons who had died (n=30); persons who were absent for a long time (n=18); nursing home residents (n=7); mentally handicapped (n=29).

(b) i.e. those who returned a completed questionnaire (N = 18,973)

2.1.1 Alcohol consumption

The baseline questionnaire included questions regarding the drinking behavior of the respondents. Information regarding frequency and amount consumed on a drinking occasion was available for our study. Respondents were also inquired about other aspects of the drinking pattern such as frequency of heavy drinking episodes and type of alcoholic beverage consumed. The alcohol questions used in the present study had been validated before in the Dutch population and are often used in alcohol studies (Garretsen, 1983).

The following questions were included in the questionnaire in order to measure alcohol consumption:

- 'Please indicate what type of alcoholic beverage do you usually consume when you drink?'

Respondents were asked to cross only one of the following response-alternatives: 'beer', 'wine', 'mixed drinks' (alcohol with softdrinks), 'strong beverages such as genever, whisky, cognac, etc.', 'it varies all the time', and 'I do not drink'. For the present study, respondents in the categories of mixed drinks and strong beverages were combined. Respondents who answered the question by saying 'I do not drink' were considered abstainers.

- 'Research showed that many people often drink more than six alcoholic beverages every day'
- 'Have you, in the last half-year consumed six or more glasses on one day?'

Respondents answered yes or no.

- 'If yes, in the last half-year, how often have you consumed six or more glasses?'
Response alternatives were: 'everyday', '5 to 6 times per week', '3 to 4 times per week', '1 to 2 times per week', '1 to 3 times per month', '3 to 5 times in the last six months' and '1 to 2 times in the last six months'
- 'On average, how many days per week do you drink alcoholic beverages?'
Response alternatives were: '7 days per week', '6 days per week', '5 days per week', '4 days per week', '3 days per week', '2 days per week', '1 day per week'.
- 'On a day in which you drink alcohol, how many glasses do you drink on average?'
Response alternatives given to this question were: '11 glasses or more', '7 to 10 glasses', '6 glasses', '4 to 5 glasses', '3 glasses', '2 glasses', and '1 glass'.

With this information at hand, we constructed two additional variables to describe in greater detail drinking pattern. Information regarding amount of alcohol consumed per drinking occasion (in glasses per day) was combined with information regarding frequency of the consumption (in number of days per week) to arrive at a measure of average intake (units per week). As explained in Chapter 1 (1.2.) the amount of alcohol contained in a glass of beer is equivalent to that contained in a glass of wine or spirits, and it is about 8-10 grs of pure ethanol (1 glass = 1 unit = 8-10 grams of ethanol). Drinkers were categorized according to average alcohol intake into: light (1-14 units/week), moderate (15-28 units/week) and excessive drinkers (≥ 29 units/week). For some of the analyses we reduced the number of categories even further and we used different cut-off points for heavy drinking for men and women. Among men we distinguished light-moderate drinkers (≤ 21 units/week) and heavy drinkers (> 21 units/week) and among women, similarly, we distinguished between those drinking ≤ 14 units/week and those drinking > 14 units/week. These cut-off points were chosen because drinking below these limits had been associated with health benefits in the literature (e.g. Jackson and Beaglehole, 1995).

In order to compare drinkers with comparable average intakes and different drinking pattern, we further classified drinkers (those drinking up to 6 glasses per day) into the following categories: 1-2 days/1-2 glasses, 3-5 days/1-2 glasses, 6-7 days/1-2 glasses, 1-2 days/3-5 glasses, 3-5 days/3-5 glasses, 6-7 days/3-5 glasses, 1-2 days/6 glasses, 3-5 days/6 glasses, 6-7 days/6 glasses.

2.1.2 Health status

Several questions were included in the questionnaire as well as the personal interviews to map as many dimensions of health status as possible. For the health measurements, instruments as developed and

validated by the Netherlands Health Interview Survey were used (Central Bureau of Statistics, 1988).

A single question was used to measure perceived general health: 'how do you rate your health, generally speaking?' Five response possibilities were given: very good, good, sometimes good-sometimes fair, fair and poor. For the present analyses, the responses given were dichotomized into: very good or good versus less than good.

A list of subjective health complaints was also included in the questionnaire (Dirken, 1967; Central Bureau of Statistics, 1988). The list included questions regarding chest pain, back pain, stomach complaints, feeling dizzy, etc. For this study we looked at the sum of these complaints. A dichotomized variable was constructed and respondents were categorized as reporting suffering from ≤ 3 of the complaints or reporting > 3 of the complaints.

The prevalence of specific chronic conditions was measured by administering a checklist of 23 frequent disorders (Central Bureau of Statistics, 1988). Respondents were classified according to whether or not they reported suffering from any of the conditions listed in the questionnaire.

For the subsample of respondents of the postal survey that was approached for the oral interview ($n = 2,802$), information from the Dutch version of the Nottingham Health Profile, with its different subscales: mobility, pain, sleeping complaints, social isolation, complaints of lack of energy and emotional complaints, was also collected (Hunt, McEwen & McKenna, 1986; Essink-Bot, van Agt & Bonse, 1992).

2.1.3 Vital status

Mortality data was obtained from the population registers. For the present study, virtually complete mortality information gathered until 1996, used for Chapter 3, (cumulative number of deaths = 760) and until 1998, used for Chapters 6 and 9, (cumulative number of deaths = 1,144) was used.

2.1.4 Psychosocial stressors

For the present study, various sources of psychosocial stress were considered: life-events, chronic stressors and adverse working conditions.

Respondents were asked about their experience of the following life events in the preceding twelve months: moving; important decrease in financial position; being a victim of a robbery, assault or rape; whether he/she had lost his/her own job; whether a partner or a family member had lost his/her job; whether a partner or another family member was seriously ill; whether their partner had died; whether a close relative or a close friend had died; or whether they had divorced or had broken up with their partner. Respondents answered yes or no to each of these

questions. A variable was constructed to determine whether more than each life-event separately, an accumulation of events was associated with drinking or drinking heavily. This variable had the following categories: none of the events listed, positive answer given to 1 of the events, and positive answers given to ≥ 2 events.

Reporting having financial difficulties at the time of data-collection (having difficulties affording food, housing, electricity, etc.), housing problems during the previous year (draft, cold and damp), and neighborhood problems during the previous year (unpleasant smells; noise from neighbors, noise from traffic and criminality) were considered as chronic stressors. Respondents were also asked about their marital and employment status in the questionnaire. Being single, separated or divorced and widowed, and being unemployed, receiving a disability pension and having retired early or being retired, were also considered chronic stressors.

Those respondents who reported being employed were also asked several questions in order to assess their working conditions (Central Bureau of Statistics, 1992). The questions were included in one of the following domains: hazardous physical working conditions (noise, dirt, dust, etc.), support at work (from co-workers and supervisors), job-control (monotonous work, breaks, development of own abilities, etc.) and job-demands (pace, time-pressure).

Information regarding socio-demographic characteristics was also available from the GLOBE questionnaire and from population registers. Characteristics such as age (date of birth), and sex, religious affiliation, marital status/living arrangement and level of urbanization were included. For the present study, educational level was used as a proxy for social class.

2.2 The follow-up measurement

In 1993, 1995 and 1997 the follow-up data collection took place. Questionnaires were sent to the respondents to the baseline oral interview ($n=2,802$). In this thesis only the follow-up measurement of 1997 is used. Following the questionnaire, the individuals were interviewed and the interviewers collected the questionnaires in their visits. For the present study, only data collected by questionnaire were used. The main aim of the follow-up was the measurement of change in health status.

Alcohol consumption was also measured in the 1997 follow-up. In addition to the questions included in the baseline questionnaire, respondents who reported not drinking alcohol were further asked about their reasons for abstaining. The question: 'What are the most important reasons for not drinking alcohol (or for no longer drinking alcohol)?' Response alternatives were: 'I do not like the taste', 'because others

suggested', 'because of medical advice', 'because of financial reasons' 'as a result of a TV-program, a spot, an advertisement', 'other reasons'. Measurement of health status was repeated with the same questionnaire used at baseline. Age and sex were included in the follow-up questionnaire in order to check if the person who participated was the same each time.

Table 2.2 Response rate in 1997 by socio-demographic factors, health, and alcohol consumption as measured in 1991

	1991 n=2,802	1997a n=2,148	response 1997 as % of 1991
Demographic factors 1991			
Gender			
Men	1,369	1,028	75.1
Women	1,433	1,12	78.2
Age			
14-29	539	399	74.0
30-44	529	437	82.6
45-59	985	803	81.5
≥60	755	509	67.4
Marital status			
Married	1,915	1,510	78.9
Single	585	431	73.7
Separated/Divorced	143	104	72.7
Widowed	128	82	64.1
Education			
Primary school only	548	372	67.9
Low vocational/low secondary	1,004	775	77.2
Intermediate vocational/high secondary	637	513	72.7
Higher vocational/university	555	445	64.1
Alcohol consumption in 1991			
Abstainers	632	446	70.6
Light drinkers	1,642	1,298	79.0
Moderate drinkers	285	217	76.1
Excessive drinkers	114	91	79.8
Health status in 1991			
Perceived general health			
Good or very good	1,978	1,575	79.6
Less than good	824	573	69.5
Health complaints			
≤3 complaints	1,821	1,435	78.8
>3 complaints	981	713	72.7
Chronic conditions			
0 chronic conditions	1,496	1,177	78.7
≥1 chronic conditions	1,293	965	74.6

a. The net sample in 1997 was formed by those respondents of the 1991 interview (n=2,802) (n=2,802) minus: persons who died (n=130), who had moved (n=25), who could not be traced (n=11) or who refused to participate after 1991 (n=68).

An adequate follow-up per mail required an updated database of addresses in order to minimize attrition. Population registries of the municipalities involved in the study (and other municipalities if cohort members had moved from the study area) tracked individuals with respect to place of residence, address, marital status and vital status. The net response rate in 1997 was 76,6 percent of the respondents of the 1991 questionnaire. In order to establish whether our follow-up was selective in terms of demographic factors, alcohol consumption or health status,

the response rate in 1997 was studied in relation to that of 1991 for each of these factors (see Table 2.2). Some differences in response rate with regard to socio-demographic characteristics, alcohol consumption and health status in 1991 between the baseline data-collection and the 1997 follow-up, were observed. In 1997, people in the younger and in the older age-categories, widowed, and those in the lower educational groups responded somewhat less than their respective counterparts. The response rate among abstainers was also lower than among drinkers. Further, response in the follow-up seemed to be higher among respondents in good health in 1991 (according to all three-health indicators). The implications of these differences in the response rates between 1991 and 1997 for the results of the present study will be discussed in Chapter 10.

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PART I

**ALCOHOL CONSUMPTION
AND HEALTH:
VARIOUS HEALTH MEASURES
AND ALCOHOL DRINKING
PATTERNS**

CHAPTER 3

The U-shaped curve: Various health measures and alcohol drinking patterns

3 THE U-SHAPED CURVE: Various health measures and alcohol drinking patterns

ABSTRACT

Objective: To determine whether the well-known U-shaped relationship between average alcohol intake and mortality also holds for other health measures and for aspects of drinking other than weekly average alcohol intake, such as frequency of heavy-drinking episodes. *Methods:* This study was carried out within the framework of a general population survey conducted in Eindhoven, the Netherlands (N=18,973). Apart from mortality the following health measures were considered: self-assessed health (based on perceived general health and the Nottingham health profile questionnaire), a list of chronic conditions, and a list of health complaints. Respondents were categorized as abstainers, light (1-14 units/week), moderate (15-28 units/week) and excessive drinkers (≥ 29 units/week). Information on the frequency with which heavy-drinking episodes occurred was also available. *Results:* Light or moderate drinkers not only had lower mortality but other health burdens were lower than for either abstainers or heavier drinkers. Frequent heavy-drinking episodes were observed to be directly related to increased mortality rates, although not significantly. A trend was observed for drinkers reporting seldom heavy-drinking episodes (once or twice in the previous 6 months) to report less health burdens and to have lower mortality rates than those reporting no heavy drinking episodes. *Conclusions:* A U-shaped pattern was observed for mortality as well as for several other health measures. Frequent heavy-drinking episodes were related to an increased likelihood of mortality (not significant but suggesting a J-shaped pattern) and were not related to other health measures.

3.1 Introduction

Many studies have focused on the explanation of the relationship between alcohol consumption and health. It is well known that (heavy) alcohol consumption is linked to adverse outcomes such as liver cirrhosis, road accidents and suicide (Gordon and Doyle, 1987). However, alcohol consumption is not only associated with adverse effects; the influence of alcohol on health is more complex. Many epidemiologic studies have suggested that there is a U-shaped relationship between alcohol consumption and such health outcomes as mortality, cardiovascular diseases and stroke (Marmot et al., 1981; Marques-Vidal et al., 1996; Stampfer et al., 1988). Subjective health has also been added only recently to the list of outcomes studied and the literature is limited (Poikolainen et al., 1996).

In order to gain more insight regarding the health impact of exposure to alcohol, other health measures should also be considered. Alcohol consumption has direct consequences for health through biological mechanisms, but has social and psychological consequences that may influence health as well. Different implications of drinking should be considered when studying the net effects of alcohol consumption on health.

The present study looks at mortality - one of the classic outcomes - and considers other health measures such as chronic conditions, health complaints and self-assessed health. To understand the relationship with other health measures is important in itself; it may also help us understand the mechanisms explaining a U-shaped curve for mortality. Most of the studies have investigated average weekly or daily alcohol intake. Other aspects of drinking patterns (e.g., what, when, how often and how much) have not been adequately studied. The net effect of drinking may, however, depend on drinking patterns, not only on average alcohol intake (Poikolainen, 1995; Stampfer et al., 1993). Someone who consumes one glass of wine each day is usually grouped together with someone who has heavy drinking episodes once a week and does not drink the rest of the days. As the drinking pattern and the health risks or benefits of these two persons may differ, various aspects of drinking behavior should be considered separately.

Although evidence supporting the curvilinear relationship between alcohol and health is large, the underlying mechanisms are not clearly understood. In this article we address the following questions: (1) Is there a U-shaped relationship between alcohol consumption and health measures other than mortality? (2) What is the role played by aspects of drinking such as frequency of heavy-drinking episodes?

3.2 Methods and materials

Baseline data from the 1991 GLOBE study (Eindhoven, The Netherlands) were used in this analysis. The GLOBE study involved a random sample of noninstitutionalized Dutch citizens aged 14-74, selected from 17 communities in the Eindhoven area (Mackenbach et al., 1994). The populations in the age range 45-74, as well as the population in the highest and lowest socioeconomic strata (identified by post-code) were oversampled. Data were collected via questionnaires, interviews and registries. A mailed questionnaire regarding health and life circumstances was sent to 27,000 people and approximately 70% (N = 18,973; valid data on alcohol consumption were available for 17,898) responded. Personal interviews were conducted with 3,750 postal questionnaire respondents in order to collect more detailed data on health as well as on personality characteristics; the response rate was approximately 80% (n = 2,802). Differences in response rates between

sociodemographic groups were small: women, elderly people, wealthier people and country dwellers responded more frequently than did their respective counterparts although the differences were not statistically significant. A separate interview survey among a sample of nonrespondents to the postal survey (response rate of approximately 30%) showed that respondents and nonrespondents did not differ in self-assessed health, chronic conditions and self-assessed health complaints. Nonresponse analysis regarding alcohol consumption showed that nonrespondents drink somewhat more than respondents and have more frequent heavy-drinking episodes.

3.2.1 Measurements

Several health indicators were used in these analyses. The first measure categorized 23 chronic conditions, some of certain severity (e.g., cancer or heart disease) and others of less severity (e.g., headaches or varicose veins). Respondents were classified according to whether they reported suffering from at least three of the conditions listed in the questionnaire. Reporting more than three chronic conditions were 2.7 % ($n = 247$) of the men and 4.2% ($n = 410$) of the women.

Health complaints were measured by means of a checklist containing 13 questions; respondents were asked whether they suffered from each of the complaints listed. This variable was dichotomized into suffering from ≤ 3 or >3 of the complaints in the list. Reporting more than three complaints were 29.4% ($n = 2,664$) of the men and 37.5% ($n = 3,565$) of the women.

Perceived general health was measured by a single question, "How do you rate your health in general?" The answer was dichotomized for the analysis into very good or good, and less than good (fair, sometimes good and sometimes bad, and bad). Of the men 27.7% ($n = 2,482$) perceived their health as less than good and of the women 27.6% ($n = 2,800$) did so.

All the health indicators described above are available for the total study population of 18,973 people. A subsample of respondents ($n = 2,802$) was also approached for an oral interview. Information from the Dutch version of the Nottingham Health Profile, with its different subscales (mobility, pain, sleeping complaints, social isolation, complaints of lack of energy and emotional complaints) was collected from this subsample as another indicator of self-assessed health (Erdman et al., 1994; Hunt et al., 1986).

The population registers of the municipalities involved in the study (and other municipalities if cohort members moved from the study area) were used to track the study population with respect to place of residence, marital status and vital status. Mortality follow-up was continued until July 1996. Information on causes-of-death was not available for the present analyses. By July 1996, 762 persons had died. Of those, 482 were men (5.2% of the male population) and 278 were women (2.8% of the

female population).

Respondents were asked about their drinking patterns. Amount of alcohol (in glasses) consumed on a typical occasion in the previous 6 months and frequency in which alcohol was used (number of drinking days per week) were combined to assess weekly average alcohol consumption. The following categories were derived: abstainers (those who responded "I do not drink" when they were asked about the type of alcoholic beverage they usually consume) and light (1-14 units/week), moderate (15-28 units/week), excessive (≥ 29 units a week) drinkers. Furthermore, respondents were asked whether they had consumed 6 glasses or more in one sitting in the previous 6 months. If they answered in the affirmative they were also asked about the frequency of these heavy-drinking episodes.

Several background variables are known to be associated with both health and alcohol consumption and may confound the relationship between them. The following confounding variables were, therefore, taken into account: age (in 5-year age groups), gender, marital status, education, religion and level of urbanization (categorized as in table 3.1).

3.2.2. Analysis

Several logistic regression models were developed to measure the relationship between weekly average alcohol intake and health, accounting for confounders. Each of the health measures under study was entered in a separate model as a dummy variable. The abstainer group was used as a reference category. Health measures of the respondents who reported having consumed six or more glasses on one occasion were analyzed separately after adjusting for average weekly alcohol intake and the influence of confounding variables. For this phase of the analysis the reference category included those drinkers who did not report heavy drinking episodes in the past 6 months. Results for men and for women are presented jointly as the interaction terms between alcohol consumption and gender were not significant for mortality, chronic conditions and perceived general health; the p-value of the interaction term for health complaints was exactly 0.05 and could be a result of multiple testing. Confidence intervals of 95% and standard errors were computed from the regression coefficients.

3.3. Results

Population characteristics according to alcohol consumption and potential confounders are shown in Table 3.1. Although the percentage of men and women in the category of light drinkers were comparable (60.9% of the men, 58.4% of the women), the remaining percentages were unevenly distributed. Women were more likely than men to be abstainers, and men tended to drink larger amounts of alcohol compared

with women. Abstainers were older than drinkers, more likely to be widowed, had a lower educational background, and were residents of rural neighborhoods. Excessive drinkers were more likely to be separated or divorced, and were residents of urban neighborhoods.

Table 3.1 Demographic characteristics, in percent, grouped by weekly average alcohol intake (units/week)

	Abstainers n=4,482	Light (1-14 u/w) n=10,659	Moderate (15-28 u/w) n=1,831	Excessive (≥29 u/w) n=923	Total N=17,898
Gender					
Men	15.0	60.9	15.6	8.5	49.0
Women	34.8	58.4	5.2	1.6	51.0
Age					
14-29	22.5	63.4	10.8	3.3	19.6
30-44	16.4	65.7	11.7	6.1	19.0
45-59	21.7	61.6	11.1	5.6	35.9
60-78	38.4	49.6	7.5	4.5	25.4
Marital status					
Married	23.7	61.0	10.0	5.2	67.0
Single	23.0	61.3	11.3	4.4	21.7
Separated-divorced	27.0	52.9	13.0	7.0	6.1
Widowed	46.4	45.7	4.8	3.1	5.2
Education					
Primary school only	44.0	45.2	6.2	4.7	20.2
Lower vocational	27.2	58.8	9.4	4.6	23.4
Medium general	22.2	61.7	10.8	5.2	14.7
Medium vocational	18.4	64.8	12.2	4.5	14.3
Secondary general	18.8	64.3	11.4	5.6	8.3
Higher vocational	11.6	69.5	13.7	5.3	13.7
University	7.7	71.7	13.9	6.7	5.4
Religion					
Roman Catholic	25.6	59.2	10.2	5.0	86.9
Protestant	22.0	63.6	9.5	4.9	11.8
Other	44.7	47.2	6.0	2.0	1.3
Level of urbanization					
Rural	29.9	55.6	11.1	3.5	0.8
Semi-rural	23.5	61.2	11.3	4.0	10.4
Small town	22.6	61.4	10.8	5.2	17.2
Medium city	25.3	59.0	11.4	4.3	13.3
Large city	26.0	59.0	9.6	5.3	58.2

Significant differences in the chi-square test statistic ($p < 0.001$)

Adjusted odds ratios for the categories of average weekly alcohol intake are presented in Figures 3.1 and 3.2. There is a curvilinear relationship between alcohol consumption and health measures. The shape of the curves varies from a U-shaped (for health measures such as the subscales of the Nottingham health profile of pain, emotion and complaints of lack of energy as shown in Figure 3.2), to J-shaped (for mortality), or inverse J-shaped (for perceived general health, health complaints, chronic conditions, or the Nottingham Health Profile subscales of mobility, sleeping and isolation, see Figure 3.2).

Compared with abstainers, all drinking categories were observed to be significantly less likely to report less than good perceived general health, more than three health complaints or more than three chronic conditions. For the subscales of the Nottingham Health Profile of mobility, isolation and complaints of lack of energy, statistically significant differences between abstainers and light and moderate drinkers were observed. No differences were shown, however, between abstainers and excessive drinkers. For the subscales of pain, sleeping and emotional complaints significant differences were observed between abstainers and light drinkers, but moderate or excessive drinkers did not seem to differ from abstainers. A J-shaped pattern was observed for mortality. The differences between abstainers and each of the categories of drinkers did not reach significance (see Figure 3.1).

Figure 3.1 Adjusted odds ratios (age, gender, marital status, education, religion, level of urbanization) and 95% confidence intervals for the relationship between average alcohol intake (units/week) and various health measures (N = 18,973)

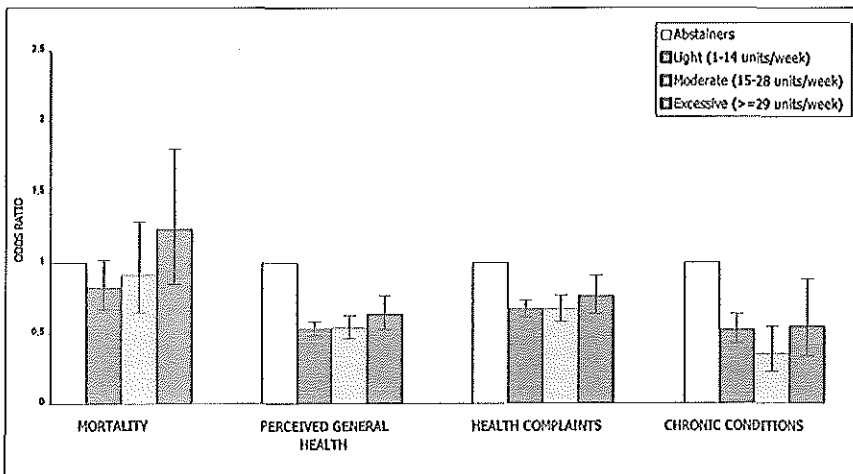


Figure 3.2 Adjusted odds ratio (age, gender, marital status, education, religion and level of urbanization) and 95% confidence intervals for the relationship between average alcohol intake (units/week) and Nottingham Health Profile (n = 2,802)

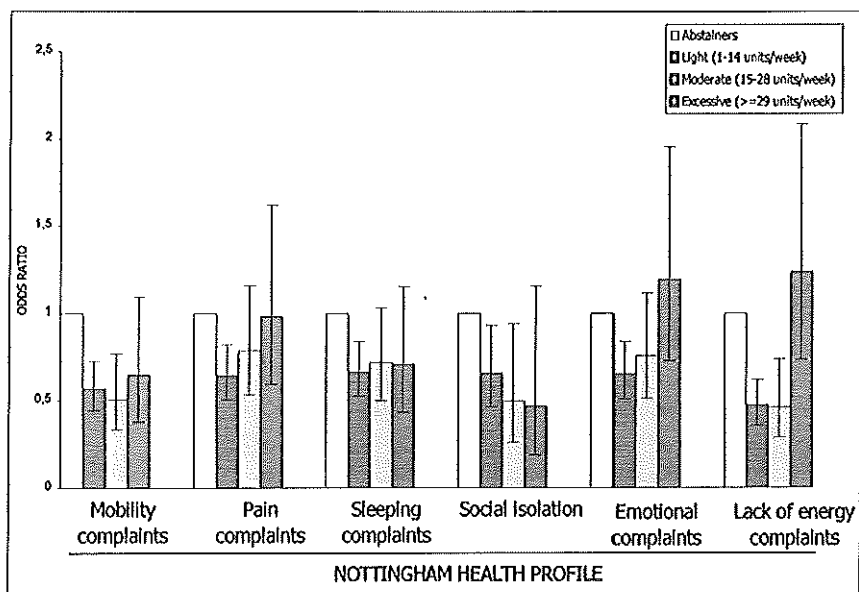


Table 3.2 presents adjusted odds ratios for the relationship between frequency of heavy drinking episodes (six or more glasses on one occasion, as described in the Methods section) and several health measures. Frequent heavy-drinking episodes (≥ 5 times per week) were associated with an increase in mortality rates (although not significantly), after controlling for weekly average intake (Table 3.2). Data presented here suggested a J-shaped pattern for the relationship between frequency of heavy-drinking episodes and mortality. Those reporting heavy-drinking episodes once or twice in the previous 6 months were significantly less likely than those not reporting them to perceive their health as less than good. The same pattern was observed for mortality and health complaints, although the results did not reach significance in the latter cases. Sleeping complaints (results not shown) were significantly less likely among drinkers reporting heavy-drinking episodes ≥ 5 times a week. Mobility complaints were significantly less likely among drinkers who reported drinking six or more glasses on one occasion with a frequency of 3-5 times in the defined time-frame. No significant differences were observed for any of the other categories.

Table 3.2 Adjusted odds ratios (OR) and 95% confidence intervals (CI) for the relationship between health measures and frequency of heavy-drinking episodes^a

	Mortality			Perceived general health			Health complaints			Chronic conditions		
	n	OR	95% C.I.	n	OR	95% C.I.	n	OR	95% C.I.	n	OR	95% C.I.
> 5x/week	37	1,51	(0,85-2,71)	127	0,85	(0,62-1,18)	153	0,91	(0,78-1,07)	9	1,06	(0,63-1,77)
3-4x/week	13	0,84	(0,42-1,68)	121	0,90	(0,67-1,21)	145	1,20	(0,86-1,66)	11	0,67	(0,25-1,84)
1-2x/week	36	0,82	(0,52-1,31)	381	0,95	(0,81-1,13)	522	0,99	(0,74-1,34)	30	0,96	(0,37-2,50)
1-3x/month	31	1,06	(0,66-1,69)	278	0,89	(0,75-1,07)	417	1,09	(0,90-1,33)	27	1,12	(0,58-2,15)
3-5x/6 months	17	0,69	(0,40-1,18)	242	0,91	(0,76-1,09)	303	1,07	(0,88-1,30)	15	1,16	(0,60-2,28)
1-2x/6 months	15	0,57	(0,32-1,02)	238	0,82	(0,69-0,99)	370	0,84	(0,68-1,03)	20	0,96	(0,47-1,94)
none/6 months	613	1,00	(reference)	3,895	1,00	(reference)	4,319	1,00	(reference)	545	1,00	(reference)

Note: Adjusted for the differences in weekly average alcohol intake (units/week), age, gender, marital status, education, religion and level of urbanization

^aHeavy drinking episodes = drinking six or more glasses of alcohol on one occasion.

3.4 Discussion

Our analysis shows a curvilinear pattern (U-, J- or inverse J-shaped) between alcohol consumption and each of the different health measures under study. Light and moderate drinkers have better health measures than either abstainers or heavy drinkers. Frequent heavy-drinking episodes are directly related to increased mortality rates. Seldom heavy-drinking episodes, on the contrary, were related to reduced health risks. Before interpreting these results, several methodological issues should be considered. Whether nonresponse may have influenced the results was examined. Nonresponse analysis showed that respondents of the postal survey and interview did not differ from nonrespondents with regard to age, gender, marital status, degree of urbanization and socioeconomic status (measured by post code). A brief oral interview among postal survey nonrespondents showed no differences with respect to health problems. Comparisons were made regarding drinking patterns; although nonrespondents seemed to drink somewhat more and were more likely than respondents to have frequent heavy-drinking episodes; the numbers were not large enough to allow for meaningful analysis of the relationship between alcohol and health among nonrespondents. As no differences were found between respondents and nonrespondents concerning their health measures, and differences with respect to drinking pattern were not large, nonresponse bias is not expected to have affected the results presented here.

The validity of self-reported data is also another methodological issue to consider. Misclassification among different alcohol categories could have influenced the results. Comparisons of survey reports of alcohol consumption with sales statistics in the Netherlands show that there is an underestimation of alcohol consumption of almost 50% in survey reports (Neve et al., 1993). If all drinkers underestimate their alcohol consumption, there could be a shift to the right in the cut-off point for heavy drinking. The real health burdens of heavy drinking would start

at higher consumption levels than the ones stated here according to self-reported data. Specification of a cut-off point is, however, beyond the scope of this study. Underestimation of alcohol consumption in a specific drinker category (e.g. underreporting among light and moderate drinkers is less than among heavy drinkers) might make the categories of light and moderate drinkers more like that of heavy drinkers and the possible differences in health more difficult to observe. However, several studies conducted in the Netherlands have not indicated that nonrespondents generally drink more, nor that alcohol misuse is more common in this group (Garretsen, 1983; Lemmens et al., 1988). Although underestimation of alcohol consumption has been reported to be a methodological problem, overestimation could also occur as very light drinkers and abstainers may want to give the impression of being more adapted to their social environment (Shaper, 1990; Skog, 1996). Overestimation of alcohol consumption has been reported to occur, especially when there are secondary benefits of doing so, (Midanik, 1989); for example, when subjects are about to enter a treatment center they tend to overestimate their consumption. This is unlikely to be the case in the present study as there are no obvious reasons for distorting reports of alcohol use and no secondary benefits for doing so.

As not only alcohol consumption but also health was self-reported, there is the possibility that factors such as personality characteristics (e.g., negative affect) could have influenced the way respondents rated their health and reported alcohol consumption. It could be that people more likely to complain are also more likely to under- or overreport heavy alcohol consumption. This explanation is not very plausible, as alcohol-drinking patterns are not usually seen as a form of complaint. The fact that the same curvilinear relationship (U-shaped curve) was observed for mortality also supports this hypothesis. Overall, in our study, if a measurement error occurred, underreport of consumption would have been the most likely case.

Light drinkers and moderate drinkers had lower risks for adverse health effects than abstainers. Excessive drinkers had comparable likelihoods to those of abstainers. Our findings corroborate other researchers' findings for mortality and self-assessed health (Marmot et al., 1981; Poikolainen et al., 1996) and add information about the effects of alcohol consumption on other health measures (self-assessed health, chronic conditions and health complaints).

Although abstainers and light or moderate drinkers differed in some of the health measures, their mortality rates did not differ significantly. In previous studies it has been argued that the category of abstainers may be contaminated by former drinkers and heavy drinkers whose health condition induced them to quit drinking (Marmot et al., 1981; Shaper, 1995). This may be the case in our study; the implication is that the difference between abstainers (possibly including former drinkers) and light drinkers could be even larger than the one found here. For the

present analysis we were not able to make a distinction between life-long abstainers and former drinkers, and the contamination of this group could partly explain the results found. The increased risk that abstainers showed for health measures other than mortality might also be explained if abstainers suffer from nonfatal conditions but not from conditions leading to death.

As several studies have found that self-assessed health is a strong predictor of mortality, (Kaplan and Camacho, 1983; Wannamethee and Shaper, 1991) and as self-assessed health has been found to be associated with alcohol intake (Poikolainen et al., 1996), the underlying mechanisms explaining the U-shaped relationship for mortality could be the same as the ones explaining the same pattern for other health measures.

The importance of studying different aspects of drinking behavior explaining the U-shaped curve has been suggested in the literature (Poikolainen, 1995; Stampfer, 1993). Frequency of heavy-drinking episodes and type of alcoholic beverage may be factors in the relationship between alcohol and health (Kauhanen et al., 1997); therefore, frequency of heavy-drinking episodes was studied. Frequent heavy-drinking episodes were directly related to increased mortality rates. As those who report frequent heavy-drinking episodes do not seem to be at an increased risk for health burdens other than mortality, one could argue that their increased risk for mortality is caused by specific conditions directly related to heavy-drinking episodes (e.g. road accidents or violence). Unfortunately, information on cause of death was not available for the present study so further research is needed to confirm or refute this hypothesis.

Drinkers who reported heavy-drinking episodes once or twice in the previous 6 months were significantly less likely to perceive their health as less than good than those not reporting heavy-drinking episodes. Their mortality risks, as well as their likelihood for reporting more than three health complaints, were also reduced (not significantly). Although no significant differences were observed for any of the other health measures, the possibility of those episodes to influence morbidity cannot be ruled out. However, the fact that the same pattern was shown for various health measures could be considered, by itself, an indication of the validity of self-assessed health measurements. A positive relationship between heavy-drinking episodes and mortality had been reported in the literature (Kauhanen et al., 1997) but in a study limited to beer drinkers.

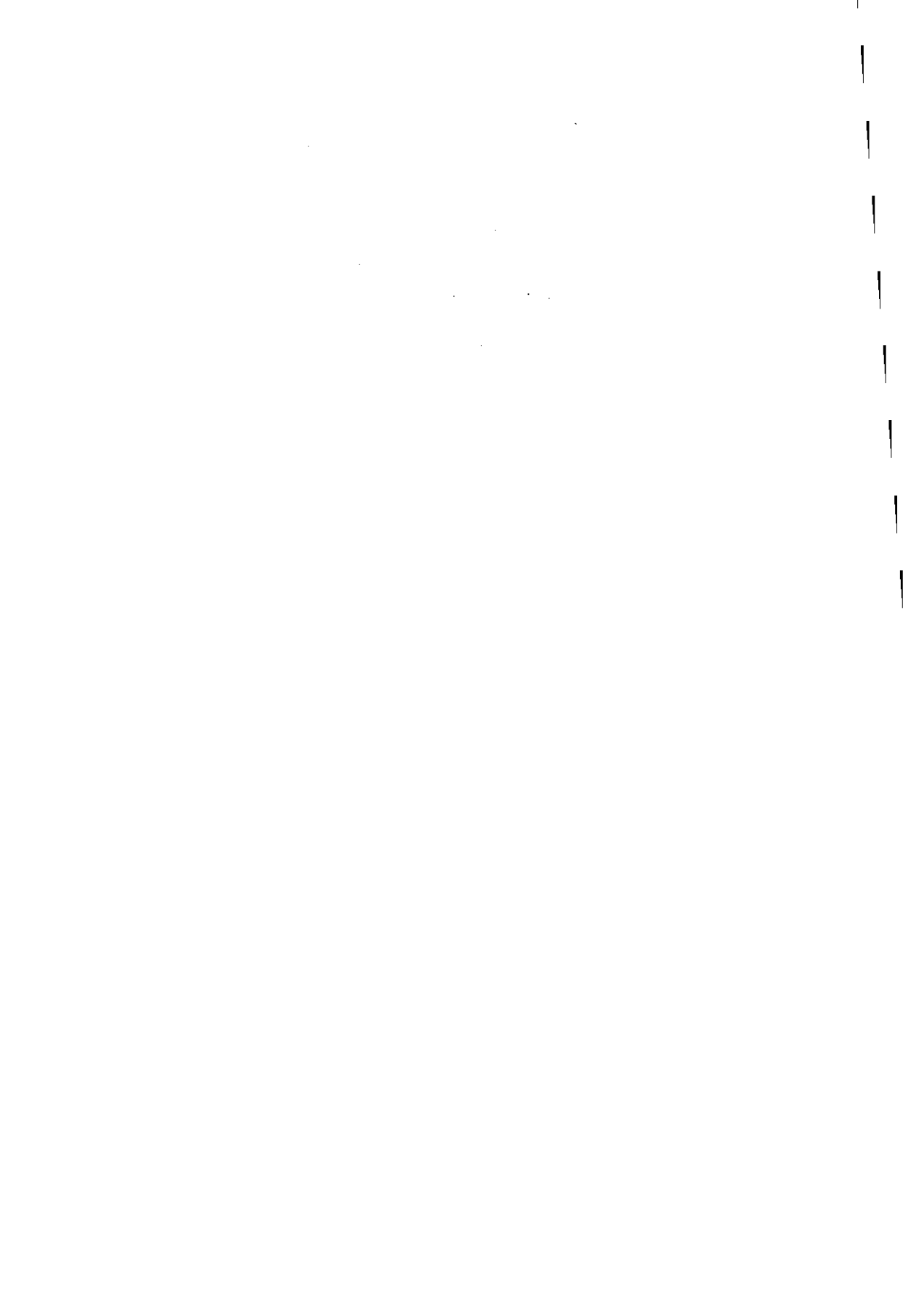
We observed the same U-shaped pattern for several health measures. We also studied the role of heavy-drinking episodes in relation to different health measures. However, several issues remain unresolved. First, from a cross-sectional study one cannot determine whether a particular drinking pattern leads to a particular health status or whether the health status conditions drinking behavior. Second, characteristics other than those related to drinking behavior could explain the differences found

between abstainers and drinkers. Drinking history, smoking, dietary factors, and social factors (e.g. social networks or measures of sociability) have been reported to be potential confounders of the relationship between alcohol consumption and morbidity and mortality (Marmot et al, 1981; Skog, 1996). The increased risk of abstainers and heavy drinkers may be due to characteristics other than weekly alcohol intake. Further research is needed to address issues such as personality characteristics and other features of drinking (e.g., drinking setting).

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CHAPTER 4

Drinking patterns and health outcomes: Occasional versus regular drinking

4 DRINKING PATTERNS AND HEALTH OUTCOMES: Occasional versus regular drinking

ABSTRACT

Objective: To compare the health of drinkers with different drinking patterns and particularly drinkers with comparable average intakes and different drinking frequency. *Methods:* General population survey conducted in Eindhoven, the Netherlands (N=18,973). Chronic conditions, perceived general health, and health complaints were the outcome measures. Drinking categories were constructed by taking into account the frequency and amount of alcohol consumption (up to six glasses per sitting). *Results:* Drinking 3-5 days per week/3-5 glasses per occasion and drinking 6-7 days/1-2 glasses were associated with lower likelihood for reporting health complaints and for perceiving one's health as less than good compared to those drinking 1-2 days/1-2 glasses (reference). Drinking 1-2 days/6 glasses was associated with being more likely to report chronic conditions, compared to the reference group. Those drinking 1-2 days/6 glasses were significantly more likely to report >3 health complaints than those drinking 6-7 days/1-2 glasses. Although no differences were observed for any of the other comparison groups, at high levels of consumption (18-35 units/week), occasional drinkers (3-5 days/6 glasses) seemed to have better health outcomes compared to their counterparts (6-7 days/3-5 glasses). *Conclusion:* Our results suggested that regular drinking is associated with larger health benefits than occasional drinking. In addition to average alcohol intake, drinking pattern is also related to health.

4.1 Introduction

A curvilinear relationship between alcohol intake and health measures has been reported repeatedly in the literature. Outcomes such as mortality, cardiovascular disease, myocardial infarction and even subjective health have been studied (Marmot et al., 1981; Stampfer et al., 1988; Marques-Vidal et al., 1996; Poikolainen et al., 1996). In most of the studies the drinkers were categorized according to their average alcohol intake. These categories were constructed taking into account the amount of alcohol consumed per drinking occasion and the frequency with which alcohol was consumed. The authors then arrived at categories of light, moderate, and excessive drinkers, or drinkers of a certain number or units of alcohol (or grams of ethanol) per day, week or month. These methods of categorizing individuals tend to group together drinkers with very different drinking patterns. Someone who

consumes 1-2 glasses of alcohol every day is grouped together with someone who drinks six glasses once or twice a week.

However, drinking pattern and not only average intake has been suggested to be important in the relationship between alcohol consumption and health (Camargo et al., 1989; McElduff and Dobson, 1997; Fillmore et al., 1998). Researchers looking at health outcomes such as mortality, stroke, blood pressure, major coronary event or acute myocardial infarction have suggested that regular drinking of small amounts of alcohol do not have the same health effects as does drinking large amounts occasionally (binge drinking). Regular drinkers have been reported to be better off than occasional drinkers (Palomaki and Kaste, 1993; Hendriks et al., 1994; Kauhanen et al., 1997; McElduff and Dobson, 1997). Possible biological explanations (such as differences in blood pressure by drinking pattern, for example) have been mentioned but the mechanisms are not yet clear (Kauhanen et al., 1997).

The present study looked at the association between drinking pattern and chronic conditions, perceived general health, and health complaints. The same U- or J-shaped pattern has been observed for objective and subjective health measures using an averaging measure for alcohol consumption (Poikolainen et al., 1996; San José et al., 1999). To our knowledge, nothing is known about the association between drinking pattern and more subjective health measures. Drinking patterns may have direct health effects through biological mechanisms, but also social and psychological consequences, which may, in turn, influence health. Special attention was paid to the comparison between drinkers with comparable average alcohol intakes and different drinking pattern.

4.2 Methods and materials

Data were obtained from the baseline data collection of the Longitudinal Study on Health and Life Circumstances of the inhabitants of the city of Eindhoven, The Netherlands, and its surroundings. A random sample of non-institutionalized individuals with Dutch nationality aged 15-74 was drawn from the mentioned area (Mackenbach et al., 1994). The population in the age group 45-74, as well as the population in the highest and lowest social economic strata (identified by post-code) was over-sampled. Questionnaires and personal interviews were used in 1991 for the baseline data collection. 27,000 people received a mailed questionnaire regarding their health and life circumstances. The response rate was approximately 70% (N = 18,973). Three thousand, seven hundred and fifty respondents of the postal questionnaire were contacted for personal interviews in order to gather more detailed information on health as well as on personality characteristics. The response rate was approximately 80% (n = 2,802).

There were no differences in response rates by gender, income or

urban/rural location. Non-respondents of the postal questionnaire were approached for a personal interview. The response rate was approximately 30% (N=71). Respondents and non-respondents did not differ in self-assessed health, chronic conditions or reported health complaints. Non-response analysis regarding alcohol consumption showed that non-respondents drank more glasses per occasion and more often than did respondents.

4.2.1 Measurements

Various health indicators were used for these analyses. The first measure consisted of a list of 23 chronic conditions of different severity, such as cancer, heart diseases or headaches (Central Bureau of Statistics, 1992). Respondents were classified according to whether or not they reported suffering from any of the conditions listed in the questionnaire. Almost half of the respondents reported at least one chronic condition.

Health complaints were measured through a checklist of 13 items concerning minor health problems, such as minor heart complaints, stomach complaints, etc (Dirken, 1967). This variable was then dichotomized and respondents were categorized as reporting suffering from ≤ 3 of the complaints or reporting suffering from >3 complaints. Among males, 29.4% reported four or more health complaints. Among females, the percentage was 37.5.

Perceived general health was another health outcome under study. It was measured by a single question: "How do you rate your health in general?" (Central Bureau of Statistics, 1992). The possible answers were: poor, fair, sometimes good sometimes fair, good and very good. For the present analyses, respondents were categorized as perceiving their health as good or very good or as perceiving their health as less than good. 27.7% of the males and 29.7% of the females reported perceiving their health as less than good.

Respondents were also asked about their drinking patterns. Abstainers were excluded from the analyses. Information on amount of alcohol (in standard glasses) consumed on a typical occasion in the previous 6 months, and frequency with which alcohol was used (number of drinking days per week) was available (Garretsen, 1983; Bongers et al., 1997). Respondents were given several response alternatives (from 1 to 7 days per week and for amount of alcohol, number of standard glasses consumed per sitting: 1, 2, 3, 4 to 5, 6, 7-10 and ≥ 11). In order to construct categories with comparable average intakes of alcohol, drinkers of ≥ 7 glasses per sitting were excluded from the analysis and several response alternatives were combined. This resulted in nine categories: (1) drinking 1-2 days/1-2 glasses (reference category); (2) drinking 3-5 days/1-2 glasses; (3) drinking 6-7 days/1-2 glasses; (4) drinking 1-2 days/3-5 glasses; (5) drinking 3-5 days/3-5 glasses; (6) drinking 6-7 days/3-5 glasses; (7) drinking 1-2 days/6 glasses; (8) drinking 3-5 days/6 glasses; (9) drinking 6-7 days/6 glasses.

Several background variables that were known to be associated with both health and alcohol consumption and that therefore may confound the relationship were accounted for in these analyses. These variables were: age (entered the model as continuous variable), gender, marital status (single, married, divorced or separated, and widowed), education (in seven categories, from primary education to university degree), religion (Roman catholic, Protestant and other), level of urbanization (five categories, from rural to highly urbanized), smoking (never smoker, ex-smoker, pipe-cigar smoker, smoking ≤ 20 cigarettes/day or > 20 cigarettes/day) and physical exercise (no exercise, little exercise, moderate exercise, a great deal of exercise).

4.2.2 Analysis

The relationship between alcohol and health outcomes was examined by using logistic regression models. The health variables were dichotomized (perceived general health good or very good vs. less than good; health complaints ≤ 3 vs. > 3 ; absence vs. presence of chronic conditions) and introduced as dependent variables in the models. Results presented here have been adjusted for the differences in age, gender, marital status, religion, education, level of urbanization, smoking and physical exercise. The 95% confidence intervals and their standard errors were computed from the regression coefficients.

4.3 Results

Tables 4.1 and 4.2 present the results for perceived general health and health complaints, respectively. In both cases, those drinking 6-7 days per week/1-2 glasses per occasion and those drinking 3-5 days/3-5 glasses were significantly less likely than the reference (1-2 days/1-2 glasses) to report health burdens. Table 4.3 shows results for chronic conditions. Those drinking 6-7 days/1-2 glasses did not differ significantly from the reference. Those drinking 1-2 days/6 glasses, however, were significantly more likely to report chronic conditions than those in the reference category. Results for the three health outcomes are, therefore, in the same direction and suggest better health outcomes for regular drinkers.

Table 4.1 Adjusted odds ratios* and 95% confidence intervals for the relationship between drinking pattern and perceived general health

	1-2 days/week	Perceived general health less than good	
		3-5 days/week	6-7 days/week
1-2 glasses per occasion	Reference	0.93 (0.79-1.10)	0.75 (0.63-0.89)
N	970	323	310
3-5 glasses per occasion	1.01 (0.87-1.18)	0.79 (0.65-0.96)	0.92 (0.77-1.09)
N	476	245	313
6 glasses per occasion	1.17 (0.89-1.32)	0.83 (0.51-1.34)	0.91 (0.61-1.36)
N	94	28	46

* All the results are adjusted for age, gender, marital status, religion, education, level of urbanization, smoking and physical exercise.

In Table 4.4 we studied whether frequency and amount of consumption were independently associated with better self-reported health, for a given overall level of alcohol consumption. Drinkers with different drinking frequencies were compared in terms of health after adjusting for the confounders and for average alcohol intake. Regular drinking was consistently and significantly associated with better health than occasional drinking after controlling for average alcohol intake (odds ratios for all frequencies different from 1-2 days/week and all health measures below unity). Number of glasses consumed per drinking occasion, on the contrary, did not seem to be associated with any of the health measures, after controlling for average alcohol intake. These results corroborate the findings presented in Tables 4.1-4.3, which suggested some benefits of regular drinking.

Table 4.2 Adjusted odds ratios* and 95% confidence intervals for the relationship between drinking pattern and health complaints

	1-2 days/week	Health complaints >3	
		3-5 days/week	6-7 days/week
1-2 glasses per occasion	Reference	0.98 (0.84-1.13)	0.77 (0.66-0.91)
N	1,268	424	355
3-5 glasses per occasion	1.07 (0.94-1.23)	0.78 (0.66-0.93)	0.86 (0.73-1.01)
N	655	300	361
6 glasses per occasion	1.21 (0.92-1.58)	0.75 (0.47-1.19)	0.76 (0.51-1.13)
N	128	30	45

* All the results are adjusted for age, gender, marital status, religion, education, level of urbanization, smoking and physical exercise.

Table 4.3 Adjusted odds ratios* and 95% confidence intervals for the relationship between drinking pattern and health complaints

	1-2 days/week	Chronic conditions ≥ 1	
		3-5 days/week	6-7 days/week
1-2 glasses per occasion	Reference	1,06 (0,93-1,21)	1,09 (0,95-1,26)
N	1,806	694	625
3-5 glasses per occasion	0,97 (0,86-1,10)	0,88 (0,76-1,03)	0,94 (0,81-1,09)
N	936	484	534
6 glasses per occasion	1,35 (1,05-1,73)	0,71 (0,48-1,07)	1,14 (0,80-1,63)
N	190	48	73

* All the results are adjusted for age, gender, marital status, religion, education, level of urbanization, smoking and physical exercise.

Information on other psychosocial variables was available for the subsample of respondents that were approached for oral interviews (n = 2,802). A separate analysis was conducted among these individuals taking into account these psychosocial variables. The role played by neuroticism, locus of control, emotional support, instrumental support, long lasting difficulties (relational, health and situational) and life events was then studied. The inclusion of these variables did not change the point estimates, suggesting little contribution to the models.

Table 4.4 Adjusted odds ratios* and 95% confidence intervals for the relationship between frequency of alcohol consumption and amount of alcohol consumed per occasion and several health outcomes

	Perceived general health		Health complaints		Chronic conditions	
	O.R.*	95% C. I.	O.R.*	95% C. I.	O.R.*	95% C. I.
Frequency of the consumption						
1-2 days/week	1,00	(reference)	1,00	(reference)	1,00	(reference)
3-5 days/week	0,91	(0,80-1,05)	0,84	(0,74-0,95)	0,84	(0,75-0,95)
6-7 days/week	0,83	(0,71-0,97)	0,76	(0,66-0,88)	0,91	(0,80-1,04)
Amount per occasion						
1-2 glasses	1,00	(reference)	1,00	(reference)	1,00	(reference)
3-5 glasses	1,04	(0,92-1,18)	1,08	(0,96-1,20)	1,01	(0,91-1,12)
6 glasses	1,12	(0,88-1,42)	1,15	(0,92-1,43)	0,95	(0,77-1,17)

* Adjusted for the differences in age, gender, marital status, religion, education, level of urbanization, smoking, physical exercise and average alcohol intake.

4.4 Discussion

Drinking patterns and not only total average intake had been reported to play a role in the relationship between alcohol consumption and health. Binge drinking has been studied in association with mortality, stroke, myocardial infarction or coronary heart disease. Kauhanen and colleagues reported that binge beer drinking was associated with an increased risk of death, independently of the total average consumption (Kauhanen et al., 1997). In a previous study of this same population, we also found an increased mortality risk when the frequency of binge drinking increased (San José et al., 1999). A change in blood pressure (Russell et al., 1991) has been mentioned as a possible explanation for the benefits of regular drinking compared to binge drinking. Hendriks and colleagues suggested that regular intake of small amounts of alcohol may prevent blood clot formation through an increase of tissue type plasminogen activator activity (Hendriks et al., 1994). Although several biological explanations have been given for the association between drinking pattern and health, the mechanisms are still not clear (Kauhanen et al., 1997).

Before interpreting these results, various methodological issues should be considered. Nonresponse may have influenced the results. Nonresponse analysis showed that respondents of the postal survey and interview did not differ from nonrespondents with regard to socio-demographic characteristics or with respect to health problems. Regarding drinking patterns, nonrespondents seemed to drink somewhat more. Several studies conducted in The Netherlands, however, have not indicated that nonrespondents drink generally more, nor that alcohol abuse is more common in this group (Garretsen, 1983; Lemmens et al., 1988;). Given the lack of differences in health and the size of the differences with regard to drinking pattern, and considering that we restricted the analysis to those drinking ≤ 6 glasses per occasion, nonresponse bias is not expected to have affected the results presented here.

Results presented here are in agreement with those reported in the literature, but we observed these results only for objective health measures such as chronic conditions, but also for more subjective health indicators, such as health complaints or perceived general health. One could think of mechanisms other than the purely biological ones for the health differences found between regular and occasional drinkers. The reasons why drinkers choose a specific drinking pattern could also be associated with health benefits. Social contact, for example, has been associated with health benefits and regular drinkers may be more likely to involve in social drinking. Psychosocial stressors have been suggested as possible mediators of the relationship between average alcohol consumption and health. Some characteristics, such as personality traits or stressors that affect drinking pattern on the one hand, and objective

health (through biological markers) and subjective health on the other hand, are other possible mechanisms explaining the relationships found here. Our findings (subjective health differences by drinking pattern) suggest that the role of psychosocial factors could also be different for different drinking patterns. Regular drinking may have, for example, more buffer effects than occasional drinking.

Information on several psychosocial factors was available for the subsample of respondents who were approached for personal interviews. A separate analysis in this subsample showed that psychosocial factors, when included into the logistic regression models changed the point estimates for the relationships between drinking pattern and health measures. These factors did not seem to explain the health differences observed by drinking pattern.

Health differences at baseline could be thought to explain, at least in part, the results found here. Drinkers could have adjusted their drinking patterns to their own health condition. It could also be that people who feel better may indulge in regular drinking of small amounts or belong to a group of society who offers them the opportunity to drink regularly, due for example to their type of job, etc. Further research should explore these possibilities in more detail. Furthermore, respondents were asked about their drinking pattern over the last 6 months; however, nothing is known about their drinking history and this could result in differences on health as well as on drinking pattern.

In our research, we restricted ourselves to a very specific group of drinkers, drinking up to six glasses per drinking occasion. Therefore, for high levels of alcohol intake the relationships may differ from the ones described here.

A U-shaped curve between average alcohol consumption and health has been reported repeatedly. Drinking pattern may, however, play an important role in this association. Aspects of drinking, such as setting, or type of beverage, or the influence of changes in the consumption over time, should be considered in further research in order to clarify the role of drinking pattern on a variety of health outcomes. A logical next step would be to look at this same relationship from a longitudinal perspective because from a cross-sectional one we cannot know whether drinking patterns led to specific health conditions or whether health condition determined drinking pattern. Our results also suggested the need for further research to look into the differential health effects of several drinking patterns. The findings presented here, if replicated, would suggest the need to include some indication about the drinking pattern in the recommendations for safe drinking.

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CHAPTER 5

Health differences among drinkers: The role of type of beverage

5 HEALTH DIFFERENCES AMONG DRINKERS: The role of type of beverage

ABSTRACT

Objective: To explore health differences between drinkers of various types of alcoholic beverages. *Methods:* Cross-sectional study (general population sample) from the Southeast region of The Netherlands. Baseline self-reported data from 1991 provided information on alcohol consumption, perceived general health, health complaints and chronic conditions. Mortality data was collected through registers. 18,973 men and women aged 15-74, who filled in a questionnaire regarding their health and life circumstances were the study participants. *Results:* Among men, beer and mixed drinks/spirits drinkers seemed to have higher mortality rates than wine drinkers; among women, beer and mixed drinks/spirits drinkers were more likely than wine drinkers to report less than good perceived general health, to report >3 health complaints and ≥ 1 chronic conditions (only mixed drinks/spirits drinkers). Although drinking pattern (level of alcohol consumption, binge drinking or regularity of consumption) did not seem to contribute to the explanation of the results, life-style factors such as smoking and physical exercise did. *Conclusions:* Health differences observed among drinkers of diverse beverage types may be partly explained by behavioral characteristics associated with both, choice of beverage and health.

5.1 Introduction

The literature regarding the relationship between alcohol and health is large. Health benefits for light-moderate drinkers compared to abstainers or heavy drinkers (U or J-shaped curves) have been described for outcomes such as mortality, cardiovascular diseases, stroke, and subjective health (Marmot et al., 1981; Marques-Vidal et al., 1996; Stampfer et al., 1988; Poikolainen et al., 1996; San José et al., 1999). Most of these studies, however, looked at total volume of alcohol consumed (average alcohol intake measured in either grams/day, units/week or any other equivalent measure), disregarding other aspects of drinking pattern, such as binge drinking, drinking settings or type of beverage consumed. Recently, a number of scientific efforts have been directed to the study of these other aspects of drinking (Bondy, 1996; Rehm et al., 1996). Binge drinking or frequent heavy drinking episodes has been associated with mortality, stroke, and coronary heart disease (Kauhanen et al., 1997; Palomaki and Kaste, 1993; McElduff and Dobson, 1997). Furthermore, regular drinking has been suggested to carry along additional benefits for objective as well as subjective health measures

compared to occasional drinking, even if the average alcohol intake is equivalent (Kauhanen et al., 1997; Wannamethee and Shaper, 1999; San José et al., 2000).

A number of studies looked at yet another aspect of drinking pattern: type of beverage. Results, however, are not consistent. Some studies favored wine against other beverages while some others found more benefits for beer and for spirits drinkers and some others found no differences between the beverages (Rimm et al., 1996). Components other than alcohol (antioxidants, phenolic compounds, tannins, flavonoids) have been suggested to be responsible for the health differences (Rimm et al., 1996; Klatsky and Armstrong, 1993; Gronbaek et al., 1995); the evidence, however, is not conclusive. Drinking pattern and practices could also underlie the differences by type of beverage. Although wine has been nominated as 'the drink of moderation', in some populations, spirits are consumed on daily bases (Wannamethee and Shaper, 1999; Gronbaek et al., 1995). Furthermore, lifestyle factors have also been reported to intermediate in the relationship between type of beverage and health, although many studies failed to address lifestyle adequately (Wannamethee and Shaper, 1999; Rimm et al., 1996; Gronbaek et al., 1995; Doll, 1997; Chou et al., 1998).

In our study we focused on the health differences of drinkers of different types of beverages. We examined the association between type of alcoholic beverage and mortality—one of the classic health outcomes—and we also consider other health measures such as self-assessed health, chronic conditions, and health complaints, separately for men and women.

We analyze the role of drinking pattern (level of alcohol consumption, frequency of heavy drinking episodes and regularity of the consumption) as well as behavioral factors, such as smoking or physical exercise.

The research questions that we attempted to answer were:

- (1) Are there any health differences between drinkers of different types of beverages?
- (2) If so, does drinking pattern or lifestyle explain these differences?

5.2 Materials and methods

This study has been conducted within the framework of a large longitudinal population study, the GLOBE study (Eindhoven, The Netherlands). Baseline data (collected in 1991) and mortality follow-up (until 1998) were used for the present analyses. A random sample of non-institutionalised Dutch citizens in the age range 15-74 was drawn from a region in the south of Holland (Eindhoven and surroundings). Those over 45 years of age, as well as those in the highest and lowest socio-economic strata (identified by postal code) were over-sampled. Of the ca.

27,000 persons who received the questionnaire, 18,973 responded (Mackenbach et al., 1994).

5.2.1 Measurements

Several health indicators were used in these analyses. Perceived general health was measured by a single question: 'How do you rate your health in general?' Respondents were asked to choose between the following answers: very good, good, fair, sometimes good-sometimes bad, and bad. The answers given to this question were dichotomized for this study into 'very good or good' and 'less than good'. Of the men 27.7% (n=2,482) perceived their health as less than good and of the women 27.6% (n=2,800) did so.

Health complaints were measured by means of a checklist containing 13 questions on minor heart, stomach complaints, etc. Respondents were asked whether they in general suffer from each of these complaints. This variable was dichotomized into suffering from ≤ 3 of the complaints or suffering from >3 complaints in the list. 29.3% of the male and 36.6% of the female population reported >3 health complaints.

A list of 23 chronic conditions was also included in the questionnaire. Some of the conditions were of certain severity, such as cancer or heart diseases and some others were less severe, such as headaches or varicose veins. Respondents were classified according to whether or not they reported to be suffering from any of the conditions listed in the questionnaire. 46% of males and the same proportion of female respondents reported at least one chronic condition.

The population registers of the municipalities involved in the study (and other municipalities if cohort members moved from the study area) were used to track the study population with respect to place of residence, marital status, and vital status. Mortality follow-up was completed until 1998. 719 men (7,8%) and 425 women (4,4%) died during the follow-up time.

Respondents were also asked about their drinking patterns. Information on the type of alcoholic beverage was covered by one question: 'what alcoholic beverage do you usually consume when you drink?' Beer, wine, mixed drinks, spirits (such as gin, whisky, cognac) and 'it varies all the time' were the alternative responses. The categories of spirits and of mixed drinks consumers were combined for the present study. Wine drinkers were used as a reference category.

Amount of alcohol consumed on a typical occasion (in glasses) in the previous six months, and frequency in which alcohol was used (number of drinking days per week) were combined to arrive to a measure of weekly average alcohol consumption. This was computed as number of units of alcohol per week. The following categories were derived: abstainers (those who responded 'I do not drink' when they were asked about the type of alcoholic beverage they usually consume), light (1-14 units/week), moderate (15-28 units/week) and excessive drinkers (≥ 29

units/week).

Study subjects were moreover asked whether they had ever consumed six or more glasses on one occasion and if so, with what frequency (frequency of binge drinking). This information was used to test the hypothesis of whether the health differences by beverage type were explained by drinking pattern.

Socio-demographic characteristics known to be associated with health as well as with alcohol consumption were also included in the analyses. These variables were age (in 5 age-groups), marital status, religion, educational level and level of urbanization (categorized as shown in Table 5.2).

Smoking, non-smokers (ever smoker and ex-smoker) vs. current smokers (pipe-cigar smoker, smoking ≤ 20 cigarettes/day or > 20 cigarettes/day) and physical exercise (no exercise, vs. little exercise, moderate exercise, a lot of exercise) were also examined in the present study as they may confound the relationship between type of beverage and health.

5.2.2 Analyses

Logistic regression techniques were used to examine the health differences of drinkers of several types of alcoholic beverages (Hosmer and Lemeshow, 1989). 95% confidence intervals and their standard errors were computed from the regression coefficients.

Type of beverage was first examined in relation to several health measures, accounting for socio-demographic differences. The contribution of level of alcohol consumption, drinking pattern, binge drinking and regularity of the consumption was also explored. Finally, lifestyle characteristics were incorporated to the regression models.

5.3 Results

Table 5.1 presents the description of the population according to alcohol consumption. The proportion of abstainers was twice as large among women than among men (33,3% vs. 14,4%). Within drinkers, men seemed to be mainly beer drinkers whereas women seemed to consume mainly wine.

Table 5.1 Distribution of the population by alcohol consumption and gender (n and %)

	%	n
Males		
Abstainers	14,4	1309
Drinkers	85,6	7774
Wine	11,7	1063
Beer	45,5	4135
Mixed drinks/spirits	12,8	1160
Vary	15,6	1416
Females		
Abstainers	33,3	3173
Drinkers	66,7	6342
Wine	35,9	3416
Beer	8,4	802
Mixed drinks/spirits	10,2	970
Vary	12,1	1154

Table 5.2 shows the distribution of type of alcoholic beverage by socio-demographic characteristics. The proportion of beer drinkers in the younger age groups was higher than that of wine drinkers. Among men, mixed drinks/spirits drinkers seemed to be concentrated in the older age groups, whereas among women, only small differences were found in the consumption of mixed drinks/spirits by age. Most of the drinkers of all beverage types reported being married. However, almost 30 percent of beer drinkers among men, and almost 40 percent among women were single. Among men, most of wine drinkers seemed to be in the highest educational groups, whereas among women, they were concentrated in the lowest ones. The prevalence of beer drinking, as well as mixed drinks/spirits drinking was highest in low educational groups, in both men and women.

Table 5.2 Type of alcoholic beverage consumed by socio-demographic variables among men and women (n and %)

		Wine %	Beer %	Mixed/spirits %	Vary %	n
Males						
Age*	14-29	5,1	27,5	8,6	16,2	1522
	30-44	19,0	24,6	9,4	17,4	1574
	45-59	42,6	34,4	33,7	42,0	2862
	60-78	33,3	13,5	48,3	24,3	1816
Marital status*	Married	80,9	64,1	77,8	72,3	5362
	Single	11,4	29,9	11,9	20,6	1763
	Separated/divorced	5,7	4,9	6,2	4,6	394
	Widowed	2,0	1,2	4,2	2,5	151
Education*	Primary school only	7,9	17,6	23,3	10,7	1199
	Lower vocational	9,4	25,2	21,0	18,2	1595
	Medium general	12,9	10,3	10,5	10,2	805
	Medium vocational	14,8	17,3	17,5	18,3	1297
	Secondary general	7,8	6,5	7,3	9,2	550
	Higher vocational	28,4	15,3	15,2	22,9	1395
University		18,7	8,0	5,2	10,6	719
Religion*	Roman Catholic	79,3	90,8	86,3	83,4	5746
	Protestant	20,7	9,2	13,7	16,6	845
Level of urbanization*	Rural	0,8	0,8	0,8	0,4	54
	Semi-rural	8,9	12,3	11,1	10,7	883
	Small town	18,9	16,6	16,6	19,2	1347
	Medium-sized city	12,8	14,4	13,8	12,0	1059
	Large city	58,6	56,0	57,8	57,8	4418
Females						
Age*	14-29	10,5	39,3	33,6	23,7	1272
	30-44	23,9	25,6	13,2	20,5	1384
	45-59	43,8	29,1	29,9	38,6	2465
	60-78	21,9	6,1	23,3	17,2	1221
Marital status*	Married	74,5	48,9	55,5	64,0	4171
	Single	12,2	38,0	31,3	23,8	1283
	Separated/divorced	6,8	8,1	6,7	7,2	440
	Widowed	6,5	5,0	6,5	5,0	379
Education*	Primary school only	14,3	20,8	19,7	15,7	1006
	Lower vocational	24,3	23,9	29,8	25,8	1577
	Medium general	22,9	15,1	19,3	18,0	1275
	Medium vocational	11,9	13,5	13,8	15,3	808
	Secondary general	10,3	10,9	11,6	10,1	656
	Higher vocational	13,3	12,7	4,9	12,3	732
University		2,9	3,1	0,8	2,7	160
Religion*	Roman Catholic	84,8	93,5	90,1	88,7	4743
	Protestant	15,2	6,5	9,9	11,3	689
Level of urbanization*	Rural	0,9	1,0	0,2	1,6	59
	Semi-rural	9,6	11,8	8,2	9,5	610
	Small town	19,3	15,5	16,0	19,8	1166
	Medium-sized city	11,9	11,0	16,0	14,3	813
	Large city	58,3	60,7	59,6	54,8	3676

* Significant differences in the Chi-Square test statistic ($p < 0,0001$)

In Table 5.3 the distribution of lifestyle characteristics by type of beverage is presented. Although most of the drinkers, in each of the beverage-type categories were light drinkers, a large proportion of beer drinkers was found to be moderate drinkers (15-28 units/week), especially among men (21,2%). More than half of the men, and about 75 percent of the women drinkers of wine, mixed drinks/spirits and those who vary their beverage consumed, reported not having consumed six or more glasses on one occasion in the previous six months. Among beer drinkers this proportion was much lower (22,8% for men and 35,7% for women), suggesting that beer drinkers are more likely to binge drink than drinkers of other beverages. Current smoking was found more prevalent among beer and mixed drinks/spirits drinkers than among wine drinkers or among those who vary their beverage consumed. Finally, it should be noted that the proportion of physically inactive people was highest among drinkers of mixed drinks/spirits for men as well as for women.

Table 5.3 Type of alcoholic beverage consumed by drinking pattern and lifestyle characteristics among men and women (n and %)

		Wine %	Beer %	Mixed/spirits %	Vary %	n
Males						
Average alcohol intake*	1-14 units/week	80,0	65,1	77,4	78,1	5320
	15-28 units/week	14,1	21,2	16,1	14,4	1361
	≥29 units/week	5,9	13,7	6,5	7,5	778
Heavy drinking episodes*	none/6 months	62,0	22,8	65,3	47,7	2993
	≤5x/6mo	17,1	20,7	14,2	22,0	1495
	1-2/mo	8,2	17,8	7,1	12,3	1065
	1-2/w	7,5	25,4	7,8	11,2	1361
	≥3x/w	5,2	13,2	5,6	6,7	753
Smoking*	Current smokers	29,8	44,5	44,6	38,2	3190
Physical exercise*	No exercise	2,9	5,0	5,4	4,4	354
Females						
Average alcohol intake*	1-14 units/week	90,2	81,0	92,4	91,7	5306
	15-28 units/week	7,9	13,4	5,6	6,2	469
	≥29 units/week	1,9	5,6	2,0	2,1	145
Heavy drinking episodes*	none/6 months	79,3	35,7	74,9	68,3	4462
	≤5x/6mo	12,1	21,5	15,7	17,2	926
	1-2/mo	3,9	15,4	4,6	7,6	384
	1-2/w	3,2	21,9	4,0	5,6	383
	≥3x/w	1,5	5,6	0,8	1,2	117
Smoking*	Current smokers	28,6	57,4	38,7	33,8	2182
Physical exercise*	No exercise	3,0	3,2	5,5	2,6	206

* Significant differences in the Chi-Square test statistic ($p < 0,0001$)

Table 5.4 Adjusted odds ratios and 95% confidence intervals for the relationship between type of alcoholic beverage consumed and several health measures, for men and women.

	Model1	Model 2	Model 3	n
Males				
Mortality				
Wine	1,00 (reference)	1,00 (reference)	1,00 (reference)	69
Beer	1,53 (1,08-2,19)	1,46 (1,02-2,09)	1,28 (0,89-1,85)	203
Mixed/spirits	1,94 (1,37-2,77)	1,93 (1,36-2,75)	1,64 (1,14-2,35)	177
Vary	1,15 (0,78-1,71)	1,14 (0,77-1,69)	1,10 (0,74-1,64)	80
<good perceived general health				
Wine	1,00 (reference)	1,00 (reference)	1,00 (reference)	252
Beer	1,08 (0,89-1,32)	1,05 (0,86-1,28)	1,03 (0,85-1,26)	996
Mixed/spirits	1,19 (0,95-1,49)	1,19 (0,95-1,48)	1,12 (0,89-1,40)	404
Vary	1,20 (0,97-1,50)	1,20 (0,96-1,49)	1,20 (0,97-1,50)	391
>3 health complaints				
Wine	1,00 (reference)	1,00 (reference)	1,00 (reference)	266
Beer	1,04 (0,86-1,25)	1,01 (0,84-1,22)	1,00 (0,82-1,21)	1119
Mixed/spirits	1,15 (0,93-1,43)	1,15 (0,93-1,43)	1,09 (0,87-1,35)	378
Vary	1,22 (0,99-1,50)	1,21 (0,98-1,49)	1,22 (0,99-1,51)	414
≥1 chronic conditions				
Wine	1,00 (reference)	1,00 (reference)	1,00 (reference)	446
Beer	1,10 (0,94-1,30)	1,11 (0,94-1,31)	1,13 (0,96-1,33)	1811
Mixed/spirits	1,11 (0,92-1,35)	1,11 (0,92-1,35)	1,13 (0,93-1,37)	540
Vary	1,23 (1,02-1,47)	1,23 (1,02-1,47)	1,24 (1,03-1,49)	663
Females				
Mortality				
Wine	1,00 (reference)	1,00 (reference)	1,00 (reference)	109
Beer	1,39 (0,76-2,56)	1,35 (0,73-2,49)	1,24 (0,65-2,38)	17
Mixed/spirits	1,39 (0,89-2,17)	1,39 (0,89-2,16)	1,22 (0,77-1,94)	37
Vary	1,26 (0,81-1,97)	1,25 (0,80-1,96)	1,27 (0,80-2,01)	34
<good perceived general health				
Wine	1,00 (reference)	1,00 (reference)	1,00 (reference)	788
Beer	1,55 (1,24-1,93)	1,55 (1,24-1,94)	1,35 (1,07-1,70)	224
Mixed/spirits	1,43 (1,18-1,74)	1,43 (1,18-1,74)	1,35 (1,11-1,65)	304
Vary	1,11 (0,92-1,34)	1,11 (0,92-1,34)	1,08 (0,89-1,30)	284
>3 health complaints				
Wine	1,00 (reference)	1,00 (reference)	1,00 (reference)	1115
Beer	1,27 (1,04-1,55)	1,28 (1,04-1,56)	1,17 (0,95-1,43)	293
Mixed/spirits	1,23 (1,03-1,47)	1,23 (1,03-1,47)	1,18 (0,99-1,42)	375
Vary	1,16 (0,99-1,37)	1,16 (0,99-1,36)	1,17 (0,99-1,38)	425
≥1 chronic conditions				
Wine	1,00 (reference)	1,00 (reference)	1,00 (reference)	1498
Beer	1,05 (0,86-1,27)	1,07 (0,88-1,29)	1,08 (0,89-1,31)	356
Mixed/spirits	1,19 (1,01-1,42)	1,20 (1,01-1,42)	1,20 (1,01-1,43)	453
Vary	0,97 (0,83-1,13)	0,97 (0,83-1,13)	0,96 (0,82-1,12)	500

Model 1: Adjusted for age, marital status, religion, educational level, level of urbanization.

Model 2: Model 1 adjusted also for level of alcohol consumption.

Model 3: Model 2 adjusted also for smoking and physical exercise.

In order to assess whether beverage type was associated with health measures, logistic regression models were constructed. Each of the models contained health as dependent dichotomous variables (as described in the methods section) and a set of independent variables formed by socio-demographic characteristics (age, gender, marital status, religion, educational level and level of urbanization). Abstainers were excluded (see model 1). Wine drinkers formed the reference category. Results are presented in Table 5.4. Among men, beer drinking and mixed drinks/spirits drinking were positively associated with higher mortality risks. Among women, beer drinking and mixed drinks/spirits drinking, were positively associated with reporting less than good perceived general health, >3 health complaints and ≥ 1 chronic condition.

By adding average alcohol intake to the logistic regression models (containing also socio-demographic characteristics) we assessed the role of level of alcohol consumption in the relationship between type of beverage and health (model 2, Table 5.4). When average alcohol intake was incorporated to the models, the odds ratio for mortality for beer drinkers was reduced. Further adjustment for drinking pattern (frequency of heavy drinking episodes or regularity of the consumption) did not produce any change in the point estimates (results not shown). Other behavioral characteristics related to both choice of beverage and health, have been suggested as possible explanations for the relationships found between beverage type and health (Rimm et al., 1996). We looked at the relationships between type of beverage and health accounting also for the differences in smoking status and physical exercise (model 3, Table 5.4). For males, the excess mortality risk for beer drinkers (compared to wine drinkers) was no longer statistically significant. Although the mortality risk for those drinking mixed drinks/spirits was reduced after including behavioral characteristics in the models, the risk in this group remained statistically significantly higher compared to that of wine drinkers.

Behavioral characteristics also altered the results for women. The likelihood for reporting less than good perceived general health remained significantly higher for beer and mixed drinks/spirits drinkers compared to wine drinkers, although the values of the odds ratios were lower in this model than in the previous ones. For health complaints, differences by type of alcoholic beverage were no longer statistically significant when behavioral characteristics were accounted for. Results for chronic conditions did not seem to be influenced by behavioral characteristics since the changes in the point estimates (men and women) were very small.

5.4 Discussion

Before interpreting the findings presented here, several limitations of our study should be considered. Misclassification of subjects has been mentioned to be one of the methodological pit falls of studies looking at type of beverage (Wannamethee and Shaper, 1999; Klatsky et al., 1997). In our study we asked respondents which was their most frequently consumed beverage. Although respondents reporting drinking one beverage type may also consume on occasions another type of beverage, most of the respondents consuming more than one type of beverage were expected to have answered the question by saying 'it varies all the time'. Data on self-reported health measures and on alcohol consumption were collected at the same time. The directionality of these relationships could therefore, not be assessed. Mortality data, nevertheless, was collected during the follow-up and associated with alcohol consumption at baseline. Although one could argue that respondents might change from one type of beverage to another during the follow-up, other researchers found that changes in beverage preference during the follow-up time were small (Klatsky et al., 1997).

Among the strengths of our study we should emphasize the sample size, the variety of health measures used (varying in degree of objectivity, from mortality to perceived general health), as well as the availability of information on drinking and other lifestyle characteristics of the respondents.

In agreement with results presented by other researchers, we found some health benefits associated with wine drinking and some detrimental effects of mixed drinks or spirits drinking (Gronbaek et al., 1995; Klatsky et al., 1997). This finding was observed for objective health measures, such as mortality, as well as for self-reported health. Several authors have argued that differences observed by type of beverage are more likely to be due to underlying differences in drinking patterns and practices than to the beverage itself (Rimm et al., 1996; Gronbaek et al., 1995; Chou et al., 1998; Hennekens et al., 1979). If differences were observed by type of beverage, these differences could be due to differential drinking pattern associated with each beverage. We explored the possibility that level of alcohol intake, binge drinking and regularity of the consumption was responsible for the findings of our study and we found no evidence to support the hypothesis that differences by type of beverage are due to differences in drinking pattern across beverages. Adjusting for level of alcohol consumption, frequency of heavy drinking episodes or regularity of the consumption did not result in changes in the relationships.

Lifestyle and behavioral characteristics associated with choice of beverage and with health have also been suggested as contributing to the explanation of differences by type of beverage (Wannamethee and Shaper, 1999; Gronbaek et al., 1995; Poikolainen and Vartiainen, 1999; Hennekens et al., 1979). Wine drinkers have been reported to have

healthier lifestyle and some other favorable characteristics than drinkers of other beverages (Wannamethee and Shaper, 1999; Klatsky et al., 1997). Our results are consistent with those reported by other researchers (Tables 5.2 and 5.3). In our study we observed that a large proportion of drinkers of beverages other than wine (beer and/or mixed drinks/spirits drinkers) were single, and of low educational level, more likely to be moderate drinkers, to report heavy drinking episodes, to smoke and to be physically inactive. Most of the studies concerned with differences by beverage, however, fail to adequately control for the possible influence of these factors (Wannamethee and Shaper, 1999; Klatsky and Armstrong, 1993; Chou et al., 1998). A recent study on the relationship between wine and subjective health showed a reduction in the values of the odds ratios after adjustment for several lifestyle factors. The authors concluded that good health among wine drinkers was not related only to their lifestyle, because results were still significant (Poikolainen and Vartiainen, 1999). Results presented here are in agreement with those presented by Poikolainen and colleagues. In our study, although a reduction in the odds ratio was observed after accounting for smoking and physical exercise, the health differences remained statistically significant. It should be noted that accounting for smoking and physical exercise reduced the odds ratios for mortality and perceived general health among male beer and mixed drinks/spirits drinkers by about 30 percent $\{(O.R. \text{ model } 2 - O.R. \text{ model } 3) / (O.R. \text{ model } 2 - 1)\}$, and also resulted in reduction in the odds ratios for mortality, perceived general health and health complaints among women. Wine drinkers remained better off for all health measures compared to beer drinkers. We concluded, that good health among wine drinkers was partly explained by behavioral factors. From a public health perspective, in the light of these results, intervention and prevention strategies should consider lifestyle factors in order to maximize the health of populations.

Non-ethanol components of different beverages (antioxidants, phenolic compounds, flavonoids and tannins) have been suggested to be responsible for additional benefits of wine drinkers compared to beer drinkers (Gronbaek et al., 1995; Chou et al., 1998; Klatsky et al., 1997). The study of such components could bring light into the remaining health benefits found for wine drinkers. Characteristics of drinking context (social drinking vs. drinking with meals, for example) should also be taken into account in future research. Other behavioral factors, such as diet, could also contribute to the explanation of the health benefits observed for wine drinkers. Information on dietary habits was not available in our study. Exploring these factors in further research would bring light into the underlying mechanisms explaining the health benefits observed for wine drinkers.

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CHAPTER 6

Explaining the U-shaped curve: The health risk of abstainers

6 EXPLAINING THE U-SHAPED CURVE: The health risk of abstainers

ABSTRACT

Objective: To investigate two possible reasons for the elevated health risk observed among abstainers compared to light drinkers: (1) the effect of former drinkers and sick-quitters on the group of abstainers, and (2) the role of socio-demographic and behavioral factors differentiating abstainers and drinkers. *Methods:* The study was conducted within the framework of a large-scale longitudinal population survey conducted in The Netherlands. The risks of reporting less than good perceived general health, >3 health complaints, and ≥ 1 chronic condition were assessed (N = 2,148). Respondents were categorized as abstainers and drinkers according to their alcohol consumption levels in 1997. Using data collected in 1991, abstainers were further classified as long-term abstainers and former drinkers. Former drinkers reporting ill health in 1991 were considered sick-quitters. Socio-demographic and behavioral characteristics (age, gender, marital status, education, smoking, physical exercise) measured in 1991 were used as covariates. *Results:* The exclusion of former drinkers and sick-quitters from the group of abstainers resulted in a reduction of the health risk of abstainers. Abstainers also differed from drinkers in socio-demographic and behavioral characteristics. These differences explained part of their elevated health risk. *Conclusion:* Sick-quitters accounted for a proportion of the excess health risk observed among abstainers. Long-term abstainers, however, remained at higher health risk than light drinkers after removing former drinkers and sick-quitters from the group of abstainers and after accounting for socio-demographic and behavioral factors.

6.1 Introduction

A curvilinear (U- or J-shaped) curve has been repeatedly used to describe the relationship between average alcohol intake and several health measures. Studies suggest that light and moderate drinkers have lower all-cause mortality rates, lower risk of coronary heart disease, stroke, myocardial infarction, and better self-reported health than either abstainers or heavy drinkers (Marmot et al., 1981; Marques-Vidal, 1996; Stampfer et al., 1988; Poikolainen et al., 1996; San José et al., 1999). The interpretation of these findings, however, is controversial.

One question that remains unanswered concerns the composition of the group of abstainers. Several hypotheses have been proposed to support the elevated health risk of abstainers.

(1) In the presence of disease, subjects are likely to abstain from drinking. Individuals who stop drinking because of ill health would provoke an artificial elevation in the health risk among abstainers. These individuals are often referred to as “sick-quitters” (Shaper, Wannamethee & Walker, 1988; Shaper, 1990). Former heavy drinkers who stop drinking due to problems related to (heavy) drinking would also artificially increase the health risk in the abstainers’ group (Andreasson, 1998; Thorogood et al., 1993). Heavy drinkers (originally at the right end of the U-shaped curves), who stop drinking would carry along their already elevated health risk when they move into the abstainers category. Furthermore, individuals who never started drinking due to their vulnerability could also be included in the group of current abstainers and contribute to their high health risk (susceptibility bias) (Vaillant, 1983; Foets and van Baar, 1993).

(2) Abstainers may differ from light-moderate drinkers in characteristics other than their alcohol consumption. These characteristics, rather than their abstinence could account for the health differences observed between abstainers and drinkers (Hart et al., 1999; Fillmore et al., 1998; Skog, 1996; Mertens et al., 1996). Socio-demographic and life-style factors related both to alcohol consumption and health (confounders) could affect the relationship.

Several researchers have attempted to solve these issues by distinguishing between life-long abstainers and former drinkers. While some authors reported that the results remained unchanged and that abstainers still seemed to have higher health risks than light-moderate drinkers, after removing former drinkers or persons with pre-existing disease, the opposite has also been stated (Serdula et al., 1995; Beaglehole and Jackson, 1993; Thorogood et al., 1993; Shaper, 1990).

Most of these studies had objective health measures as end-points (e.g., mortality or cardiovascular disease). Although the same curvilinear relationship has described the relationship between alcohol consumption and more subjective health measures (self-reported health, health complaints, etc.), little is known about the contribution of former drinkers, or of sick-quitters. Likewise, other characteristics differentiating abstainers and drinkers may explain a part of the increased risk observed among abstainers for the more subjective health measures.

The present study was designed to expand on or confirm these earlier findings by asking the following questions:

1. What is the proportion of abstainers who are former drinkers, and more specifically, sick-quitters? Is the elevated health risk of abstainers explained by the presence of former drinkers, particularly sick-quitters in the group of abstainers?

2. Do abstainers (former drinkers and long-term abstainers) and drinkers

differ in socio-demographic and behavioral characteristics other than their alcohol consumption? Do these factors explain their observed health differences?

6.2 Methods and materials

The present study was conducted within the framework of a large-scale longitudinal study on health and life circumstances (GLOBE study) in the city of Eindhoven and its surroundings (The Netherlands). A random sample of non-institutionalized individuals of Dutch nationality aged 15-74 was selected as previously described (Mackenbach, van de Mheen & Stronks, 1994). People aged 45-74 and in the highest and lowest social economic strata (identified by post-code) were over sampled in order to increase the contrast to study socio-economic inequalities in health, the main objective of the GLOBE study. Questionnaires and personal interviews were used in 1991 for the baseline data collection. Of the 27,000 people who received a mailed questionnaire, 18,973 responded. 3,500 respondents of the baseline questionnaire were contacted for personal interviews in order to collect more detailed information regarding their health and psychosocial characteristics. 2,802 responded. In 1997 the respondents of the personal interview were contacted again ($n = 2,802$), and 2,148 individuals responded. Respondents were inquired to fill in a questionnaire, followed by an interview. For the present study only information collected by questionnaires was used.

6.2.1 Measurements

Questions on three health indicators were included in both measurements (1991 and 1997). Perceived general health was measured by a single question: 'How do you rate your health in general?' (Central Bureau of Statistics, 1992). The response alternatives were: poor, fair, sometimes good/sometimes fair, good, and very good. For the present analyses, respondents were categorized as perceiving their health as good or very good or as less than good. 22,6 percent of the males and 25,1 percent of the females reported less than good perceived general health in 1997.

Health complaints were measured through a checklist of 13 items concerning minor health problems such as minor heart complaints, stomach complaints, etc (Dirken, 1967; Central Bureau of Statistics, 1988). This variable was dichotomized and respondents were categorized as reporting suffering from ≤ 3 of the complaints listed versus reporting >3 . 23 percent of the males and 36,8 percent of the females reported more than 3 health complaints in 1997.

Chronic conditions were measured by means of a list of 23 chronic conditions of different severity, such as cancer, heart diseases or headaches (Central Bureau of Statistics, 1992). Respondents were

classified according to whether or not they reported suffering from any of the conditions listed in the questionnaire. 51,5 percent of the males and 59,8 percent of the females reported suffering from ≥ 1 chronic condition in 1997.

Respondents were classified according to their alcohol consumption in 1997. Information on amount of alcohol (in standard glasses) consumed on a typical occasion, and frequency with which alcohol was used (number of drinking days per week) was combined to arrive at an average number of drinking units/week. The following categories were then constructed: abstainers, light drinkers (1-14 units/week), moderate drinkers (15-28 units per week) and excessive drinkers (≥ 29 units/week). Alcohol consumption at baseline, in 1991 was used to differentiate the group of abstainers from those who were former drinkers (reported drinking ≥ 1 units/week in 1991 and reporting abstaining in 1997), those who were long-term abstainers (abstainers in 1991 and in 1997) and also those who continued drinking (drinkers in 1991 and in 1997). In 1997, respondents who reported no alcohol consumption were asked about their reasons for abstaining. For the present analyses we distinguished between medical and non-medical reasons for abstaining.

A number of socio-demographic and behavioural characteristics were used to describe the population and to assess differences by alcohol consumption category. Age, gender, marital status and educational level were the socio-demographic factors studied. Smoking and physical exercise were the behavioural factors. Since these socio-demographic variables were related to alcohol consumption and are also known to be associated to health status, they were included as confounders in the logistic regression models exploring the relationship between alcohol consumption and health.

6.2.2 Analyses

In order to explore the contribution of the presence of former drinkers and of sick-quitters to the explanation of the elevated health risk observed among abstainers, several logistic regression models were constructed, using a different definition of 'abstainer'. A first model was constructed in which the risk of abstainers was assessed without distinguishing between long-term abstainers and former drinkers. In a second model, former drinkers were excluded from the group of abstainers; yet a third model was constructed in order to assess the contribution of sick-quitters to the health risk of abstainers. Abstainers were then defined as 'long-term abstainers and former drinkers who were healthy at baseline' (reported good or very good perceived general health, or ≤ 3 health complaints or no-chronic conditions in 1991). In other words, only sick-quitters were excluded. Light drinkers were used as a reference category. The risk differences between the models were estimated using the following formula: $(\text{O.R. Model}_x - \text{O.R. Model}_{x+1}) / (\text{O.R. Model}_x - 1)$.

As explained above, the health risk of abstainers could be partly explained through the contamination of the group of abstainers with the presence of former drinkers, who have been speculated to have higher health risks than long-term abstainers. In order to check this possibility, we compared the health risk both, in 1997 and in 1991 of long-term abstainers and of former drinkers with that of those who continued drinking (reference category), accounting for socio-demographic and behavioral differences.

Finally, step-forward logistic regression models were constructed in order to determine which socio-demographic and behavioral characteristics contributed most to the explanation of the relationship between alcohol consumption and health. Since socio-demographic characteristics contributed most to the models, they were included first in our analyses. Age, gender, marital status, education, smoking and physical exercise were entered progressively in the logistic regression models. Comparing each logistic regression model with the previous one, by using this formula $(O.R. Model_x - O.R. Model_{x+1}) / (O.R. Model_x - 1)$, we assessed the contribution of each of the variables.

6.3 Results

6.3.1 What is the proportion of abstainers who are former drinkers, and more specifically sick quitters?

A description of the population by alcohol consumption and health at baseline is shown in Table 6.1. 21,8 percent of those who reported abstaining in 1997, reported drinking in 1991 (former drinkers, n=91). For all three-health measures under study, the proportion of respondents reporting adverse health condition in 1991 was largest among long-term abstainers, followed by former drinkers. 45,1 percent of long-term abstainers reported less than good perceived general health, 48,2 percent reported >3 health complaints and 55,2 percent reported ≥ 1 chronic conditions, versus 38,5, 33,0 and 53,8 percent among former drinkers. The proportion of respondents reporting adverse health condition at baseline was lowest among those who continued drinking. The corresponding percentages were 19,8, 28,5 and 41,9.

Table 6.1 Description of the population by alcohol consumption in 1997 and health at baseline, in 1991

		Abstainers		Drinkers
		Long-term ^a n= 326	Former drinkers ^b n= 91	Continued drinking ^c n= 1425
< good perceived general health in 1991*	%	45,1	38,5	19,8
	n	147	35	282
>3 health complaints in 1991*	%	48,2	33,0	28,5
	n	157	30	406
≥1 chronic condition in 1991*	%	55,2	53,8	41,9
	n	179	49	597

^a Abstainers in 1991-Abstainers in 1997

^b Drinkers in 1991-Abstainers in 1997

^c Drinkers in 1991-Drinkers in 1997

* Significant differences at level 0,05 (chi-square test-statistic).

Is the health risk of abstainers elevated by the presence of former drinkers and of sick-quitters in the group of abstainers?

As observed in Table 6.2, for all three-health measures under study, abstainers (long-term abstainers and former drinkers combined) were at significantly higher health risk than light drinkers (reference category). The exclusion of former drinkers resulted in a slight reduction in the odds ratios for abstainers. Long-term abstainers (abstainers as defined in model 2) were more likely to report less than good perceived general health, >3 health complaints and ≥1 chronic conditions than their light-drinking counterparts. When sick-quitters were further excluded from the group of abstainers a reduction in the risk of 18,9 percent for perceived general health, of 37,5 percent for health complaints and of 27,8 percent for chronic conditions was observed. When comparing directly models 2 and 3 we observed that the health risk of abstainers decreased slightly when only sick-quitters were excluded, suggesting that non-sick-quitters were healthier than long-term abstainers.

Table 6.2 Differences in health in 1997 by alcohol consumption in 1997 (Odds ratios* and 95% Confidence Intervals)

	Model 1			Model 2			Model 3		
	O.R.*	95% C.I.	n	O.R.*	95% C.I.	n	O.R.*	95% C.I.	n
<good perceived general health in 1997									
Abstainers	1,90	(1,41-2,56)	157	1,83	(1,31-2,54)	125	1,73	(1,27-2,36)	138
Light	1,00	(reference)	207	1,00	(reference)	207	1,00	(reference)	207
Moderate	0,69	(0,44-1,06)	37	0,69	(0,44-1,06)	37	0,69	(0,45-1,07)	37
Excessive	1,69	(0,86-3,31)	25	1,70	(0,87-3,34)	25	1,71	(0,87-3,36)	25
>3 health complaints in 1997									
Abstainers	1,40	(1,07-1,83)	175	1,35	(1,00-1,81)	138	1,25	(0,95-1,65)	152
Light	1,00	(reference)	313	1,00	(reference)	313	1,00	(reference)	313
Moderate	0,69	(0,48-1,00)	47	0,69	(0,48-1,00)	47	0,69	(0,48-1,01)	47
Excessive	0,57	(0,26-1,25)	38	0,58	(0,27-1,27)	38	0,58	(0,27-1,27)	38
≥1 chronic condition in 1997									
Abstainers	1,54	(1,17-2,02)	284	1,46	(1,08-1,98)	223	1,39	(1,05-1,85)	245
Light	1,00	(reference)	616	1,00	(reference)	616	1,00	(reference)	616
Moderate	0,75	(0,55-1,02)	116	0,76	(0,55-1,03)	116	0,76	(0,55-1,03)	116
Excessive	1,12	(0,62-2,03)	53	1,14	(0,63-2,05)	53	1,14	(0,63-2,05)	53

O.R.* Adjusted for age, gender, marital status, educational level, smoking and physical exercise.

Model 1: Abstainers = long-term abstainers + former drinkers.

Model 2: Abstainers = long-term abstainers.

Model 3: Abstainers = long-term abstainers + former drinkers who were healthy at baseline1 (excluding sick-quitters).

Healthy at baseline1: for perceived general health, healthy at baseline=good or very good perceived general health in 1991; for health complaints, ≤3 health complaints in 1991; for chronic conditions, = 0 chronic conditions in 1991.

As shown in Table 6.3, long-term abstainers were significantly more likely than those who continued drinking to report less than good perceived general health, >3 health complaints and ≥1 chronic conditions, both in 1991 and in 1997. Although former drinkers were also more likely to report higher health risks in 1997 than those who continued drinking, their health risk in 1991 was only significantly higher for perceived general health. The values of the odds ratios for 1997 were higher for former drinkers than for long-term abstainers; differences between former drinkers and long-term abstainers, however, were not statistically significant (overlapping confidence intervals). Long-term abstainers and former drinkers were directly compared accounting additionally for differences in reasons for abstaining (medical versus non-medical). In our study, adjusting for reasons for abstaining did not result in any change in the point estimates (results not shown).

Table 6.3 Health differences in 1991 and in 1997 between drinkers who continued drinking, long-term abstainers and former drinkers in 1997 (Odds ratios* and 95% confidence intervals)

	1991		1997	
	O.R.*	95% C.I.	O.R.*	95% C.I.
Less than good perceived general health				
Continued drinking	1,00	(reference)	1,00	(reference)
Long-term abstainers	2,40	(1,77-3,25)	1,90	(1,38-2,64)
Former drinker	2,07	(1,27-3,38)	2,20	(1,31-3,68)
>3 health complaints				
Continued drinking	1,00	(reference)	1,00	(reference)
Long-term abstainers	1,71	(1,28-2,27)	1,42	(1,06-1,91)
Former drinker	1,06	(0,65-1,72)	1,71	(1,07-2,74)
≥1 chronic condition				
Continued drinking	1,00	(reference)	1,00	(reference)
Long-term abstainers	1,55	(1,17-2,07)	1,54	(1,14-2,07)
Former drinker	1,57	(0,98-2,49)	1,93	(1,17-3,20)

O.R.* Adjusted for age, gender, marital status, educational level, smoking and physical exercise.

6.3.2 Do abstainers (former drinkers and long-term abstainers) and drinkers differ in socio-demographic and behavioural characteristics other than their alcohol consumption? Do these characteristics explain their health differences?

A description of the population according to alcohol consumption in 1997 and socio-demographic and behavioral characteristics at baseline (1991) is provided in Table 6.4. Long-term abstainers were more likely to be older, of female gender, widowed, and less educated than former drinkers. The proportion of never smokers was larger among long-term abstainers than among former drinkers, and so was the proportion of respondents reporting doing no or little physical exercise. Although former drinkers were more likely than long-term abstainers to report abstaining for medical reasons, the differences were not statistically significant. Long-term abstainers also differed from drinkers who continued drinking in several socio-demographic and behavioral characteristics; long-term abstainers were older, more likely to be female, widowed, less educated, never smokers and to practice no or little exercise. Former drinkers were more similar to drinkers who continued drinking. The proportion of females and of low educated people was higher among former drinkers than among people who continued drinking, but these two groups showed only small differences in other characteristics.

As shown in Table 6.4, abstainers and drinkers differed in a number of socio-demographic and behavioral characteristics. The contribution of these characteristics to the explanation of their health differences was explored in Table 6.5. The likelihood of reporting less than good

perceived general health was 2.92 times higher among abstainers than among light drinkers. Including age in the model resulted in a reduction in the likelihood of about 29,2 percent (O.R. from 2,92 to 2,36). Further adjustment for gender and marital status resulted in small changes in the point estimates, however, when education was added to the model, a 32,9 percent reduction in the likelihood was observed (O.R. from 2,36 to 1,91). Smoking and physical exercise did not seem to contribute further to the explanation of the relationship between alcohol consumption and perceived general health, after accounting for other socio-demographic differences.

Table 6.4 Description of the population by alcohol consumption in 1997 and socio-demographic and behavioral characteristics at baseline, in 1991 (%)

	Abstainers		Drinkers
	Long-term n=326	Former drinker n=91	Continued drinking n=1,425
Age*			
14-29	12,9	19,8	20,6
30-44	11,3	13,2	23,7
45-59	38,0	35,2	36,8
60-78	37,7	31,9	18,9
Gender*			
Male	25,2	37,4	55,2
Female	74,8	62,6	44,8
Marital status*			
Married	69,3	69,2	70,7
Single	17,1	22,0	21,7
Separated / Divorced	4,7	4,4	5,1
Widowed	9,0	4,4	2,5
Education*			
Primary school only	37,5	24,1	10,5
Low vocational/low secondary	39,7	43,7	35,6
Intermediate vocational/high secondary	13,8	21,8	27,5
Higher vocational/university	9,0	10,3	26,4
Smoking*			
Never smoker	53,2	31,9	27,6
Former smoker	18,2	33,0	36,2
Current smoker	28,6	35,2	36,1
Physical exercise*			
No/little physical exercise	21,9	15,1	12,0
Moderate/a lot exercise	78,1	84,9	88,0
Reasons for abstaining			
Medical	7,7	12,1	N/A
Other	92,3	87,9	N/A

N/A = Not applicable.

* P-value $\leq 0,05$

The likelihood of reporting more than three health complaints was 1,94 times higher among abstainers than among light-drinkers. The O.R. was reduced when age, gender and marital status differences were accounted for (to O.R.=1,78 and 1,58 respectively). Including education reduced the likelihood by about 32,8 percent (from 1,58 to 1,39). No further decrease in the O.R. was observed when both smoking and physical exercise were accounted for.

Abstainers were twice as likely to report ≥ 1 chronic condition as light drinkers. 34,8 percent of the variance, however, was explained by the age differences. This likelihood was reduced even further when differences in gender and marital status were considered (O.R. from 1,65 to 1,54). As it was the case for perceived general health and for health complaints, educational differences also explained part of the health differences between abstainers and drinkers (O.R. from 1,54 to 1,44) and further adjustment for smoking and physical exercise resulted in a slight increase in the odds ratios.

Table 6.5 The contribution of socio-demographic and behavioral differences in 1991 between abstainers and drinkers to the explanation of the health differences in 1997 (OR and 95% Confidence Intervals)

	Model 1		Model 2		Model 3		Model 4		Model 5	
	O.R.	95% C.I.	O.R.	95% C.I.	O.R.	95% C.I.	O.R.	95% C.I.	O.R.	95% C.I.
<i><good perceived general health in 1997</i>										
Abstainers	2,92	(2,27-3,76)	2,36	(1,82-3,07)	2,39	(1,82-3,15)	1,91	(1,43-2,56)	1,89	(1,40-2,56)
Light	1,00	(reference)	1,00	(reference)	1,00	(reference)	1,00	(reference)	1,00	(reference)
Moderate	0,84	(0,56-1,25)	0,76	(0,50-1,15)	0,77	(0,51-1,16)	0,77	(0,51-1,18)	0,70	(0,45-1,08)
Excessive	1,73	(0,92-3,26)	1,57	(0,81-3,01)	1,51	(0,78-2,93)	1,68	(0,86-3,29)	1,63	(0,82-3,21)
<i>>3 health complaints in 1997</i>										
Abstainers	1,94	(1,53-2,44)	1,78	(1,40-2,25)	1,58	(1,24-2,03)	1,39	(1,07-1,80)	1,41	(1,07-1,84)
Light	1,00	(reference)	1,00	(reference)	1,00	(reference)	1,00	(reference)	1,00	(reference)
Moderate	0,69	(0,484-0,98)	0,67	(0,47-0,95)	0,75	(0,52-1,08)	0,77	(0,53-1,11)	0,70	(0,48-1,02)
Excessive	0,49	(0,23-1,05)	0,46	(0,22-1,00)	0,57	(0,26-1,24)	0,60	(0,27-1,30)	0,56	(0,26-1,24)
<i>≥ 1 chronic condition in 1997</i>										
Abstainers	2,00	(1,58-2,53)	1,65	(1,29-2,11)	1,54	(1,20-1,98)	1,44	(1,11-1,88)	1,57	(1,19-2,06)
Light	1,00	(reference)	1,00	(reference)	1,00	(reference)	1,00	(reference)	1,00	(reference)
Moderate	0,79	(0,59-1,06)	0,72	(0,53-0,97)	0,76	(0,56-1,03)	0,77	(0,56-1,05)	0,74	(0,54-1,02)
Excessive	1,17	(0,67-2,04)	1,05	(0,59-1,87)	1,16	(0,65-2,08)	1,13	(0,63-2,04)	1,12	(0,62-2,01)

Model 1: Only the constant

Model 2: Model 1 + age.

Model 3: Model 2 + gender + marital status.

Model 4: Model 3 + education.

Model 5: Model 4 + smoking + physical exercise.

Overall, after adjustment for socio-demographic and behavioral characteristics, the health risk of abstainers for less than good perceived general health, >3 health complaints and ≥ 1 chronic condition was reduced by 53,4, 56,6 and 43,5 percent respectively. After accounting for these differences, however, abstainers still remained at higher health risk for all three health measures, compared to light drinkers.

6.4 Discussion

In the literature, a U-shaped curve has been used to describe the relationship between alcohol consumption and health. Objective and subjective health measures have been studied and results are in the same direction: the health risk of abstainers and heavy drinkers seemed to be higher than that of light and moderate drinkers (U-shaped relationship) (Marmot et al., 1981; Marques-Vidal, 1996; Stampfer et al., 1988; Poikolainen et al., 1996; San José et al., 1999). Heavy drinking (the right end of the U-shaped curves) has been repeatedly associated with adverse

medical consequences (liver cirrhosis, for example) but also with adverse social and psychological consequences (i.e. work-related problems, family disruption, violence), which may in turn influence health (Anderson, 1995; Midanik, 1995). The interpretation of the elevated risk observed among abstainers, however, is still an issue of discussion. Why is the health risk of abstainers higher than that of light-moderate drinkers? One of the interpretations suggested concerns the composition of the group of abstainers (Shaper, 1990; Marmot and Brunner, 1991; Andreason, 1998). The group of abstainers has been speculated to be heterogeneous, formed by individuals who are life-long abstainers and others who have stopped drinking at some point during their lives. The health risk of abstainers could be explained by the presence of former drinkers, especially by those individuals who quit drinking due to ill health (Shaper, 1990; Shaper et al., 1988). Furthermore, and specially in countries where drinking is a norm, abstainers have been speculated to differ from light and moderate drinkers in a number of characteristics, not only with regard to their alcohol consumption (Fillmore et al., 1998; Stampfer et al., 1988; Wannamethee and Shaper, 1988). Socio-demographic, behavioural, life-style or personality characteristics have been proposed as possible explanations for the health differences observed between abstainers and light-drinkers, and it could be argued that these characteristics, rather than their abstinence from alcohol, may put them at increased risk for health burdens (Hart et al., 1999; Skog, 1996; Mertens et al., 1996; Jones et al., 1982). We explored the contribution of both former drinkers and sick-quitters to the health risk of abstainers and also investigated the contribution of socio-demographic and behavioural factors differentiating abstainers from drinkers to the explanation of their health differences.

Before discussing our findings, several limitations of our study should be noted. Firstly, we compared long-term abstainers with former drinkers and with light drinkers. Long-term abstainers were defined as respondents who reported abstaining both in 1991 and in 1997; former drinkers were those who reported drinking in 1991 and reported abstaining in 1997. Our data did not allow us to differentiate within long-term abstainers those who were life-long abstainers and those who had quit drinking before the beginning of our study (1991). Individuals who never started drinking (because they were weak), and those who stopped drinking at young ages, (because they suffered from a serious disease during childhood, for example) could also be part of the group of long-term abstainers in our study. We had no information regarding past drinking habits and therefore do not know what proportion of long-term abstainers were life-long abstainers. Further, we defined sick-quitters as those former drinkers who were unhealthy in 1991; however, it is likely that a proportion of former drinkers were healthy in 1991 but became unhealthy before 1997 and these may account for the excess risk contributed by former drinkers. Since we found that former drinkers,

explained part of the health risk of abstainers especially by sick-quitters, we speculate that the contribution of these two sub-populations would be even greater in a natural setting. This is especially true since a proportion of those we considered long-term abstainers is likely to include former drinkers and sick-quitters.

Let us examine the possibility that the group of abstainers may be contaminated by the presence of former drinkers. In the first place, former drinkers could be thought to be former heavy drinkers. Heavy drinkers who stop drinking, would artificially increase the risk of abstainers because of their high health risk (originally at the right end of the U-shaped curves). Since none of the former drinkers in our sample had been categorized as excessive drinkers when drinking (in 1991) and only 7 of them were moderate drinkers, we concluded that former heavy drinkers did not contribute to the health risk among abstainers. Future research should look into the drinking level of former drinkers since they may contribute in a different way to the risk curves.

Former drinkers have been reported to have higher health risk than life-long abstainers (Leino et al., 1998; Wannamethee and Shaper, 1996). And our study found that former drinkers seemed to contribute partly to the excess risk observed among abstainers, in agreement with results presented by other researchers (Serdula et al., 1995; Boffetta and Garfinkel, 1990; Klatsky et al., 1990; Rimm et al., 1991). However, the excess risk of abstainers was not fully explained by former drinkers. After excluding former drinkers, long-term abstainers still remained at increased risk. Several authors pointed out the possibility that abstainers refrain from consuming alcohol for different reasons and that these reasons could also be reflected in health differences (Goddard, 1994; Klatsky et al., 1990; Criqui, 1996). We collected information regarding the reasons for abstaining. 12,1 percent of former drinkers and 7,7 percent of long-term abstainers reported abstaining for medical reasons (see Table 6.4). Although accounting for reasons for abstaining did not result in any change in the point estimates, results should be interpreted carefully, since the number of respondents in each of the categories was small. Future studies should consider accounting for reasons for abstaining since long-term abstainers and former drinkers may differ in this respect. We also found that non-sick-quitters had lower health risks than long-term abstainers. It could be speculated that this result is an indication for abstainers whose abstinence is not related to their health condition (i.e., they are not at higher health risk than their light- drinking counterparts). Further research should be conducted to determine the health risk of those abstainers whose abstinence is not related to their health condition. As has been suggested before, the health risk of abstainers could also be elevated by the presence of some occasional, light or moderate drinkers who stop drinking due to ill health (Shaper, 1990; Shaper et al., 1988). We assessed the contribution of sick-quitters to the explanation of the health differences between abstainers and light drinkers. Our results showed

that sick-quitters accounted for a proportion of the excess health risk observed among abstainers. Long-term abstainers, however, were still at higher health risk than light drinkers after removing former drinkers and sick-quitters from the group of abstainers. Further, we were able to compare long-term abstainers, former drinkers and drinkers who continued drinking with regard to health in 1991 as well as in 1997. Long-term abstainers were observed to have higher health risks both in 1991 and in 1997 (for all three-health measures under study) than drinkers who continued drinking. We also observed that former drinkers were more likely to report health problems in 1991 and in 1997 than those who continued drinking. These results suggest that drinkers may stop drinking because of deterioration in their health condition.

Why are long-term abstainers at higher health risk than light drinkers even after excluding former drinkers and sick-quitters? Do abstainers and drinkers differ in characteristics other than their drinking which may explain their differential health risk? We found that long-term abstainers and light drinkers differed in a number of socio-demographic and behavioral factors. We also found some differences between long-term abstainers and former drinkers. Compared to former drinkers, long-term abstainers tended to be older, were more likely to be female, widowed, less-educated, never-smokers, and were less likely to report moderate to high levels of physical exercise. These results are consistent with those reported by other researchers (Thorogood et al, 1993; Thun et al., 1997; Fillmore, et al., 1998; Goddard, 1994). These differences highlighted the possibility that characteristics other than alcohol consumption that differ between long term abstainers and former drinkers could be responsible, at least partly to the excess health burden observed among abstainers. These characteristics, indeed, contributed to the explanation of the high risk observed among abstainers. However, even after accounting for socio-demographic and behavioral factors, abstainers were still observed to be at higher health risk than light drinkers. Other unmeasured aspects such as diet or personality characteristics, or social integration, have been related to health and were not available in our study. These factors have been mentioned as possible confounders of the relationship between alcohol consumption and health (Skog, 1996; Huijbregts, et al., 1997) and should be taken into consideration in future studies.

Three possible mechanisms have been suggested in order to explain the health benefits observed for light and moderate drinkers compared to abstainers:

Causation: light-moderate alcohol consumption causes good health.

Selection: the health risk of abstainers is explained by the contamination of this group with the presence of former drinkers and sick-quitters.

Confounding: other characteristics associated with both, alcohol consumption and health, are responsible for the health differences observed.

Results presented here suggest that selection counts at least for part of the elevated risk observed among abstainers: The exclusion of former drinkers from the group of abstainers, and especially the exclusion of sick-quitters, resulted in a reduction in their health risk. We also found some evidence to support that abstainers and light drinkers differ in characteristics other than their alcohol consumption and that these characteristics contribute to the explanation of their health differences.

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PART II

**THE ROLE OF PSYCHOSOCIAL
STRESSORS AND
THE STRESS-BUFFERING
EFFECTS OF ALCOHOL
CONSUMPTION**

CHAPTER 7

Stressors and alcohol consumption

7 STRESSORS AND ALCOHOL CONSUMPTION

ABSTRACT

Objective: To examine the relationship between negative life-events and chronic stressors and drinking behavior. *Results:* Data suggested that some life events (getting divorced) and some chronic stressors (financial difficulties, being single and receiving a disability pension or being retired or having retired early) were positively related to abstinence among men and women. Furthermore, some life events (being a victim of a crime, decrease in financial position, divorce or reporting two or more life events) were positively associated to heavy drinking among men. Chronic stressors, such as being separated or divorced among men and women and being single or being unemployed among men were also related to heavy drinking among both men and women. *Conclusion:* Results presented here suggest that people under stressful conditions are more likely to either abstain or drink heavily rather than to drink light-moderately.

7.1 Introduction

Alcohol has been hypothesized to buffer and to serve as a coping mechanism against stress (Cappell and Greeley, 1987). It is commonly accepted that people drink alcohol in order to cope with the effects of stress (Allan and Cooke, 1985; Krause, 1991). Stressful life-events and chronic stressors have been correlated with alcoholism (Linsky et al., 1985), alcohol abuse (Cole et al., 1990) heavy drinking (Wilsnack et al., 1991), and alcohol dependence and problems (Johnson and Pandina, 1993; Welte and Mirand, 1995) in different populations. However, while some studies have reported positive associations, some others found negative associations (Temple et al, 1991; Romelsjo et al, 1991). With regard to the relationship between stress and abstinence, some authors have reported that abstainers have more adverse life-context (Mertens et al., 1996), but the opposite has also been reported (Cole et al., 1990; Neff and Husaini, 1982). After years of research, the relationship between stress and alcohol consumption remains inconclusive (Temple et al., 1991; Pohorecky, 1991; Pierce et al., 1994).

Although some researchers have found stronger relationships between stressful conditions and alcohol consumption among men than among women (e.g. Romelsjo, et al., 1991), the opposite has also been reported (e.g. Allan and Cooke, 1985). In the present study we examined the relationship between stressors and alcohol consumption separately for men and women, and using different cut-off points for heavy drinking for each of the gender groups. Also, in order to assess the relationship between stressors and alcohol consumption, several types of events as

well as the total number of events reported (Neff and Husaini, 1982) have been considered. Negative life events (and a sum of those events) and chronic stressors were assessed simultaneously in relation to alcohol consumption. We considered stressful situations as possible predictors of both, abstinence and heavy drinking.

7.2 Methods and materials

This study has been conducted within the framework of a large population study, the GLOBE study (Eindhoven, The Netherlands). For this study, a random sample of 27,000 non-institutionalized Dutch citizens in the age range 15-74 was drawn from a region in the south of Holland (Eindhoven and surroundings). Those over 45 years of age, as well as those in the highest and lowest socio-economic strata (identified by postal code) were over-sampled. A questionnaire was mailed to these individuals and 18,973 responded. Personal interviews were conducted with some of the respondents of the postal questionnaire (N=3,750) in order to collect more detailed data on health as well as on personality characteristics. The response rate was approximately 80% (N=2,802). Differences in response rates between different socio-demographic groups were small, women, elderly people, the wealthier and the country dwellers responded more frequently than their counterparts, although the differences were not statistically significant (Mackenbach et al., 1994).

Respondents were asked about their experience of the following *life events* in the preceding twelve months: moving; important decrease in financial position; being a victim of a robbery, assault or rape; whether he/she had lost his/her own job; whether a partner or a family member had lost his/her job; whether a partner or another family member was seriously ill; whether their partner had died; whether a close relative or a close friend had died; or whether they had divorced or had broken up with their partner. Respondents answered yes or no to each of these questions. A variable was constructed to determine whether an accumulation of events was associated with drinking or drinking heavily. This variable had the following categories: none of the events listed; positive answer given to one of the events; positive answers given to two or more events.

Respondents were also asked whether they had, at the time of data-collection financial difficulties (difficulties affording food, housing, electricity, etc.), about their marital status (married, single, separated or divorced, and widowed) and their employment status (being employed, unemployed, receiving a disability pension, being retired or having retired early, being a housewife, student or in the army). Furthermore, participants were asked whether in the year prior to the data-collection they had had housing problems (draft, cold and damp), and

neighbourhood problems (unpleasant smells in the neighbourhood, noise from neighbours, noise from traffic and criminality). Reporting financial difficulties, being single, separated or divorced, or widowed; being unemployed, receiving a disability pension or being retired or having retired early; reporting housing problems; and reporting neighbourhood problems were considered as chronic stressors. Respondents not having financial difficulties, being married, employed, reporting no housing problems and reporting no neighbourhood problems, on the other hand, were categorized as being 'not stressed' (reference categories).

Alcohol consumption was measured as average alcohol intake (Units/week). Questions about the amount (no. of glasses) of alcohol consumed per occasion as well as the frequency of the consumption (drinking days/week) were combined to arrive at a measure of average alcohol intake. Abstainers (0 U/week) were compared to light-moderate drinkers (drinking ≤ 21 U/week for men; drinking ≤ 14 U/week for women); heavy drinkers (drinking above these limits) were also compared to light-moderate drinkers (reference category). These cut-off points (>21 U/week for men and >14 U/week for women) were chosen, because drinking below these limits has been repeatedly associated with health benefits (Jackson and Beaglehole, 1995). Furthermore, an even higher cut-off point was chosen (>29 U/week for men and >21 U/week for women) in order to check for possible associations at higher levels of consumption.

Several variables that are known to be associated with both alcohol consumption and stress were included in the logistic regression models. These potential *confounders* were age, educational level and level of urbanization.

Several logistic regression models were constructed to assess the relationship between stressors and alcohol consumption. The outcome variable for all the models constructed was alcohol consumption. This variable had been dichotomized into abstainers vs. light-moderate drinkers (reference category) and heavy drinkers vs. light-moderate drinkers (reference category). These models contained also the confounders mentioned above. Analyses were done multivariately.

Some of the acute events have their chronic counterparts; these include losing a job in the previous twelve months and being unemployed; getting divorced in the previous twelve months and being divorced; death of a partner in the previous twelve months and being widowed. In the models looking at the acute event, we did not adjust for the corresponding chronic stressor (or vice versa). For example, in a model looking at the effect of having lost a job in the previous twelve months, employment status was excluded. Although decrease in financial position and having financial difficulties could be thought of as the acute and the chronic version of the same thing, they were measured in very different ways, since having financial difficulties referred to having

difficulties affording to pay for basic needs. A decrease in financial position may not lead to financial difficulties. The model looking at a decrease in financial position was adjusted for financial difficulties (or vice versa).

7.3 Results

The associations of life-events or chronic stressors with drinking or abstinence levels for men and women are shown in Table 7.1. Getting divorced was positively associated with abstinence among men and negatively among women. Among women, reporting having moved was positively related to abstinence from alcohol. A large number of chronic stressors proved to be statistically significantly related to abstinence among men and women. Financial difficulties, being single and being separated or divorced (only among men) and receiving a disability pension, or having retired early or being retired were positively related to abstinence in men and women.

Table 7.1 Adjusted odds ratios (O.R.*) and 95% confidence intervals (CI) for the relationship between stressors and abstinence

	Males		Females	
	O.R.*	95 % C.I.	O.R.*	95 % C.I.
Life-events				
Moved	0,81	(0,63-1,04)	1,25	(1,04-1,51)
Victim of crime/assault	0,82	(0,60-1,10)	0,86	(0,68-1,09)
Partner lost job	0,91	(0,60-1,38)	1,15	(0,91-1,47)
Sick partner/family member	0,99	(0,80-1,21)	1,01	(0,87-1,17)
Death of close relative/friend	0,98	(0,82-1,17)	0,92	(0,81-1,05)
Decrease financial position	1,03	(0,82-1,29)	0,94	(0,78-1,13)
Divorce/break-up (A)	1,54	(1,06-2,23)	0,66	(0,48-0,92)
Death of partner (A)	0,73	(0,31-1,70)	1,44	(0,91-2,28)
Lost job (B)	1,01	(0,76-1,35)	0,95	(0,72-1,26)
Count of life-events				
1 life event	0,93	(0,79-1,08)	0,98	(0,87-1,10)
≥2 life-events	0,91	(0,75-1,09)	0,98	(0,85-1,12)
Chronic strains				
Financial difficulties	1,28	(1,08-1,52)	1,30	(1,14-1,48)
Marital status (A)				
Single	1,73	(1,37-2,19)	1,25	(1,04-1,51)
Separated/divorced	1,52	(1,13-2,03)	1,00	(0,81-1,25)
Widowed	1,25	(0,83-1,87)	1,18	(0,96-1,43)
Employment status (B)				
Unemployed	1,31	(0,91-1,89)	0,97	(0,66-1,41)
Disability pension	2,50	(1,96-3,19)	1,97	(1,54-2,53)
Retired or early retired	1,93	(1,50-2,49)	1,91	(1,49-2,45)
Housing problems	1,15	(0,98-1,35)	1,10	(0,98-1,24)
Neighborhood problems	0,99	(0,85-1,14)	0,94	(0,84-1,05)

Males: >21 U/week vs. ≤21 U/week (reference). Females: >14 U/week vs. ≤14 U/week (reference).
* Adjusted for age, education and level of urbanization.

(A) In the model with divorce and death of a partner, marital status was excluded (or vice versa)

(B) In the model with lost job employment status was excluded (or vice versa).

As shown in Table 7.2, respondents reporting life events and chronic stressors were also compared with regard to their likelihood of heavy drinking (>21 U/week for males; >14 U/week for females). Being a victim of a crime, getting divorced or breaking up, decreasing financial position, and reporting one or more life events were positively related to heavy drinking among men. Among men, being single, separated or divorced, and being unemployed were the chronic stressors positively related to heavy drinking. Among women, reporting death of a close friend or relative was inversely related to heavy drinking. Being separated or divorced was positively related to heavy drinking whereas having retired early or being retired was inversely related to heavy drinking.

Table 7.2 Adjusted odds ratio (O.R.*) and 95% confidence interval (CI) for the relationship between stressors and heavy drinking

	Males		Females	
	O.R.*	95% C.I.	O.R.*	95% C.I.
Life-events				
Moved	0,85	(0,67-1,08)	1,14	(0,83-1,58)
Victim of crime/assault	1,46	(1,15-1,87)	1,15	(0,81-1,63)
Partner lost job	0,83	(0,55-1,25)	1,24	(0,81-1,89)
Sick partner/family member	0,94	(0,77-1,16)	1,23	(0,97-1,57)
Death of close relative/friend	1,10	(0,92-1,31)	0,78	(0,62-0,99)
Decrease financial position	1,30	(1,04-1,64)	0,96	(0,69-1,33)
Divorce/break-up (A)	1,91	(1,40-2,62)	1,19	(0,75-1,89)
Death of partner (A)	0,64	(0,22-1,86)	1,65	(0,74-3,67)
Lost job (B)	1,04	(0,78-1,38)	1,44	(0,94-2,21)
Count of life-events				
1 life event	1,18	(1,02-1,38)	1,20	(0,98-1,46)
≥2 life-events	1,20	(1,00-1,44)	1,17	(0,92-1,49)
Chronic strains				
Financial difficulties	1,03	(0,86-1,23)	1,14	(0,90-1,45)
Marital status (A)				
Single	1,39	(1,12-1,73)	0,77	(0,56-1,05)
Separated/divorced	1,80	(1,37-2,35)	1,41	(1,01-1,95)
Widowed	0,99	(0,58-1,71)	0,80	(0,53-1,23)
Employment status (B)				
Unemployed	1,47	(1,08-2,01)	0,98	(0,57-1,67)
Disability pension	1,03	(0,78-1,36)	0,62	(0,37-1,05)
Retired early or retired	0,94	(0,73-1,21)	0,61	(0,38-0,98)
Housing problems	1,01	(0,86-1,19)	1,05	(0,85-1,30)
Neighborhood problems	0,94	(0,81-1,09)	1,05	(0,87-1,27)

Males: >21 U/week vs. ≤21 U/week (reference). Females: >14 U/week vs. ≤14 U/week (reference).

* Adjusted for age, education and level of urbanization.

(A) In the model with divorce and death of a partner, marital status was excluded (or vice versa).

(B) In the model with lost job employment status was excluded (or vice versa).

A higher cut-off point (>29 units/week for men; >21 units/week for women) was then chosen to check whether the relationships were more pronounced at higher alcohol consumption levels. The relationships observed when using this higher cut-off point were all in the same direction as those using the traditional cut-off points (results not shown).

7.4 Discussion

Although previous studies have examined the relationship between stress and drinking behavior, results presented in the literature are often contradictory and the need for further research has been suggested (e.g. Pohorecky, 1991).

Before interpreting our results, several limitations of our study should be noted. Firstly, information on stressors was self-reported. Although respondents reported life events, they may not have perceived them as a source of stress and as something to cope with. Although we lack information on the way the respondents experienced these events, several researchers have argued that, rather than talking about positive or negative events, one could talk about events that require adaptation for the individual (e.g. Rabkin and Streuning, 1976). Since information on life events was collected by means of a questionnaire, limitations of such methodology should be considered (Brown, 1981; Paykel, 1983; Cooke, 1985). By using a checklist of events, the definition of the event and its interpretation is left to the individual and may vary (e.g. 'being a victim of a crime' may range from being raped to minor robberies). In both cases, respondents could have answered in the affirmative. It should be noted, however, that most of the life events considered in our study are objective and leave little room for personal interpretation. The differences in reports of life events become more relevant when they are related to the outcome under study, in this case alcohol consumption. If heavy alcohol users were more likely to respond in the affirmative even in the case of minor events (may be because alcohol use provokes a negative life perception) than light-moderate drinkers, the results presented here could be partly due to this differential reporting. We did not collect data on the magnitude of the event.

Secondly, information on alcohol consumption was also based on self-reports. It is well known that respondents tend to underreport their alcohol intake. If that would be the case in our study, the cut-off points of 21 or 29 and 14 or 21 U/week would have to be raised, since people would drink somewhat more than they report. The directionality and strength of the relationships would, however, remain as described here. Our study is also limited from its cross-sectional nature. High alcohol consumption may increase the probability that the individual experiences stress and problems rather than the individual drinking in order to cope with the problems (Allan and Cooke, 1985; Cole et al., 1990). In our study, for example, heavy drinking could be thought to increase the likelihood of the individual to be a victim of a crime, rather than drinking heavily to cope with the stress of a crime or assault (Table 7.2). Future research should consider the topic from a longitudinal perspective since some drinking patterns may lead to stressful situations (divorce, financial difficulties, unemployment, etc.) rather than the other way round.

Although the relationship between stress and alcohol consumption has been studied extensively, results are often contradictory (Temple et al., 1991; Pohorecky, 1991; Pierce et al., 1994). For example, while some authors report that unemployment is related to alcohol consumption in men and women (Janlert and Hammerstrom, 1992), others found no relationship between unemployment and quantity of alcohol consumed (Cooke and Allan, 1983; Seeman and Seeman, 1992). It has been suggested that acute rather than chronic financial difficulties may be related to alcohol consumption (Pierce et al., 1994). We were able to distinguish between acute changes in marital and employment status (recent divorce or death of a partner; job loss) and chronic status (being divorced or widowed; unemployed).

The relationship between marital status and alcohol consumption has also been reported. For example, Romelsjo et al. (1991) observed an increase in alcohol consumption among men and among women who were divorced compared to those who were not. Wilsnack et al. (1991), by contrast, found a negative association between being divorced and heavy drinking among women, and Hanna et al. (1993) suggested that changes in marital status were more important than marital status in relation to drinking behaviour. In our study, we were able to assess marital status as well as changes in marital status. Although getting divorced was positively related with abstinence among men, the opposite was observed among women. Being divorced, the chronic counterpart of getting divorced was also positively related with abstinence among men and not related to abstinence among women. With regard to heavy drinking, both getting divorced and being divorced were positively related to heavy drinking among men whereas only the latter was associated to heavy drinking among women.

Divorce and death of a partner have been studied together in the literature since they represent a change in marital status to 'not-married' and a consequent change in the individuals' roles (Temple et al., 1991; Hajema and Knibbe, 1998). The authors of these studies found that becoming 'unmarried' was associated with heavy drinking. In our study we distinguished between becoming separated or divorced and becoming widowed. Since we found a relationship between being/getting divorced and alcohol consumption but no relationship between death of a partner/being widowed, we suggest that these two ways of 'becoming unmarried' should be analysed separately in the future.

Financial stress and unemployment in relation to alcohol consumption have been studied. Some authors found no association between financial stress and alcohol (Moos et al., 1989), whereas others found economic strain to be related to drinking problems, both positively and negatively (Seeman and Seeman, 1992; Pierce et al., 1994). The same holds for unemployment; Janlert and Hammerstrom (1992) found a positive association suggesting that unemployment causes financial stress and

that people drink alcohol in order to cope with stress, although other authors did not (Cooke and Allan, 1983; Seeman and Seeman, 1992). The authors who found a negative association, on the contrary, attribute their findings to the fact that alcohol becomes less affordable with the decrease in income (Pierce et al., 1994). In our study we had information on employment status as well as on financial stressors (acute and chronic) so we were able to simultaneously assess the relationship between unemployment, financial stressors and alcohol consumption.

Chronic financial stress (financial difficulties) was positively associated with abstinence among men and women whereas acute financial stress (decrease in financial position) was positively associated with heavy drinking among men. Being unemployed was positively associated with heavy drinking among men. These relationships were observed simultaneously, so our data suggest that the relationships described in earlier studies between unemployment and financial position are independent.

Furthermore, our data allowed us to distinguish between acute and chronic financial stressors. Whereas a decrease in financial position was associated with heavy drinking among men, reporting financial difficulties was associated to abstinence. A possible explanation could be that, as a result of financial difficulties alcohol becomes unaffordable whereas a decrease in financial position may not necessarily result in financial difficulties. In the case of chronic financial stressors, alcohol consumption may be perceived as an aggravating factor, and therefore, as contraindicated.

Contradictory results regarding the relationship between employment status and alcohol consumption have been reported in the literature. Although heavy drinking is thought to be incompatible with some jobs, being employed may create more drinking opportunities for the individual (drinking with colleagues, etc.). Hajema and Knibbe (1998) suggested that becoming unemployed could be interpreted as a loss of role in a person's life, and according to their role theory, it is likely to be associated with high alcohol consumption. We found unemployment to be related to heavy drinking only among men. Losing one's own job in the preceding twelve months, on the contrary, did not seem to be associated with either abstaining or heavy drinking. Our study corroborates results by other researchers that long-term unemployment is related to heavy drinking. The fact that the situation has become chronic or that a role loss has resulted from the job loss could be alternative explanations for the finding.

In our study abstinence was associated with getting divorced or breaking up with a partner, being single, separated or divorced, receiving a disability pension and having retired early or being retired. Although these conditions could be thought to be stressful conditions to the individual, they could also be circumstances that simply limit the individuals' drinking possibilities, resulting in an increased likelihood for abstinence.

We furthermore observed that stressors that were related to abstinence were also related to heavy drinking. Personality characteristics (unavailable for our population) could explain why one individual facing a stressor will abstain while another individual facing the same stressor will drink heavily. Future research should explore these characteristics.

Several authors have hypothesized that accumulation of events may have a greater effect in alcohol consumption than each of the events considered separately (Neff and Husaini, 1982; Neff, 1984; Romelsjo et al., 1991). In our study, reporting more than one life events was positively associated with heavy drinking among men, but since the low limits of the confidence intervals were very close to unity, we concluded that our study provided little support for this hypothesis.

Characteristics other than the ones studied here could also be related to both, susceptibility of stress and alcohol consumption, for example type A personality behavior (Pohorecky, 1991; Brown, 1998). Unfortunately we did not have information on personality for our study. Future studies should investigate this relationship.

The relationship between alcohol consumption and health measures such as mortality, cardiovascular diseases or stroke (Marmot et al., 1981; Marques-Vidal et al., 1996; Stampfer et al., 1988), and even subjective health (Poikolainen and Vartiainen, 1996; San José et al., 1999) has been reported to be U- or J-shaped. Light and moderate drinkers have been suggested to have better health than either abstainers or heavy drinkers. The underlying mechanisms of this curvilinear relationship are not yet well understood. Biological mechanisms such as cholesterol levels or blood pressure changes have been suggested. However, these mechanisms do not fully explain the relationship for objective health outcomes. The mechanisms underlying a curvilinear relationship for more subjective health outcomes are less clear. Characteristics of the abstainers and heavy drinkers other than their drinking habits have been mentioned. Results presented here suggested that people under stressful conditions were more likely to either abstain or drink heavily. These results support the hypothesis that more than their drinking patterns, other characteristics of abstainers and heavy drinkers put them at increased risk for developing health burdens.

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CHAPTER 8

Adverse working conditions and alcohol use in men and women

8 ADVERSE WORKING CONDITIONS AND ALCOHOL USE IN MEN AND WOMEN

ABSTRACT

Objective: This study examines the association between adverse working conditions and abstinence and heavy drinking. *Methods:* Cross-sectional study within the framework of a general population survey conducted in Eindhoven, The Netherlands (N = 7,533). Working conditions were classified in four domains: hazardous physical working conditions, demands at work, level of control over one's job, and support from coworkers and supervisors. Abstainers were compared with drinkers; within drinkers, heavy drinkers were compared to light-moderate drinkers and those reporting binge drinking were compared to those who did not report binge drinking. *Results:* Respondents who reported adverse working conditions were as likely to be abstainers as to be drinkers. Within drinkers, males and females who reported high hazardous physical working conditions were more likely to drink heavily than to drink light-moderate amounts and to report binge drinking (males only). Respondents who reported high demands were also more likely to be heavy drinkers than to be light-moderate drinkers. *Conclusion:* Stressful circumstances, such as adverse working conditions were associated with high levels of alcohol intake among drinking men and women.

8.1 Introduction

Since the 1940s, when Bales and Horton first speculated about the relationship between stress and alcohol consumption, several theories have been suggested to explain this relationship (Cappell and Greeley, 1987; Pohorecky, 1991). The first model proposed was based on the tension-reduction hypothesis (people drink to reduce tension), and several researchers conducted studies in order to support or rather refute this model. Those scientific efforts lead to further developments in the theoretical framework and the proposition of models for the relationship between stress and alcohol. The efforts resulted in the incorporation of new possible components to a relationship between stress and health and in the specification of the theories (Blane and Leonard, 1987; Greenlund et al., 1995). The roles of expectations, personality characteristics, social support, and coping style, or type of stressors (acute versus chronic, life-events, etc.), were studied. Stress has been correlated with alcoholism (Linsky et al., 1985), alcohol abuse (Cole et al., 1990), heavy drinking (Wilsnack et al., 1991), and alcohol dependence and problems (Johnson and Pandina, 1993; Welte and Mirand, 1995). Results of such studies are,

however, contradictory. Some report positive associations whereas others report negative or no associations (Romelsjo et al., 1991; Temple, et al., 1991). After years of research, the relationship between stress and alcohol consumption remains inconclusive (Pierce et al., 1994; Pohorecky, 1991).

More specifically, the relationship between work stressors and alcohol has been studied in the field of occupational epidemiology. Specifications of the general stress-alcohol theories were developed. Within the tension-reduction hypothesis, the spill-over model speculates that adverse working conditions are associated with excessive or problematic alcohol use, because the stressful conditions extend outside the work-life of the individual (Greenberg and Grunberg, 1995; Grunberg et al., 1998; Trice and Sonnenstuhl, 1988). Work-related stress has been associated with alcohol abuse (Crum et al., 1995; Muntaner et al., 1995; Romelsjo et al., 1992), alcohol consumption (Romelsjo et al., 1992), and alcohol-related problems (Cooper et al., 1990; Kawakami, et al., 1993). Despite the number of studies that have been conducted in the field, results are often contradictory (Greenberg and Grunberg, 1995; Trice and Sonnenstuhl, 1990). Recent publications point out the possibility that the relationship between work stress and alcohol is an indirect one, one through intermediate variables. Variables such as reasons for drinking, beliefs about the effects of alcohol and its tension-reduction properties, or job satisfaction have been proposed (Greenberg and Grunberg, 1995; Harris and Fennel, 1988; Trice and Sonnenstuhl, 1990).

In the present study we looked at the relationship between adverse working conditions and alcohol consumption separately for men and women (using different cut-off points for heavy drinking for men and women). The association between adverse working conditions and behavioural pattern has been reported to be different for men and for women (Allan and Cooke, 1985; Ames and Rebhun, 1996; Niedhammer et al., 1998; Wilsnack and Wilsnack, 1992). Although some characteristics of the working environment (e.g., future job ambiguity) have been associated with drinking among females but not among males (Crum et al., 1995; Kawakami et al., 1993), most of the studies overlook these differences (Kawakami et al., 1993).

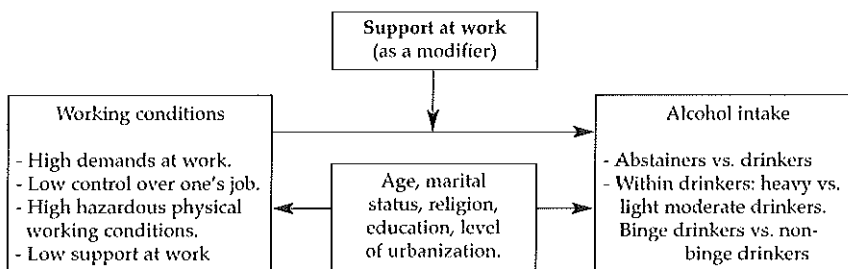
To assess the relationship between work stressors and alcohol consumption, we considered several possible work-related stressors, such as hazardous physical working conditions, demands at work, control over one's job and support from coworkers and supervisors. These working conditions have been associated to adverse health outcomes such as physical and mental health problems (Karasek and Theorell, 1990). Because some stressors may be related to abstinence (e.g. Krause, 1991) rather than induce heavy drinking, we considered adverse working conditions as possible predictors of both, abstinence and heavy drinking. We also looked at the association between work-related stressors and binge drinking because work-related stressors could be associated with specific drinking patterns.

In their studies of the relationship between work stress and health Karasek and Theorell (1990) incorporated the concept of support as an important factor ameliorating stress in the work environment (Karasek and Theorell, 1990). On the one hand, in the relationship between work-related stress and alcohol, support from coworkers and supervisors may result in an increased number of drinking occasions, but lack of support could promote drinking as a mean of coping. Thus, both result in an increased likelihood for heavy drinking. Furthermore, support at work could have an indirect effect in the relationship between stress at work and alcohol consumption because it may mediate in the relationship between other working conditions and alcohol consumption, thus acting as an effect modifier.

The questions that we aimed to answer with our research were:

1. Are adverse working conditions associated with abstinence, heavy drinking or binge drinking?
2. Is support at work a modifier of the relationship between adverse working conditions and alcohol consumption (top box in the diagram model)?

We propose the following model:



8.2 Methods and materials

This study was conducted within the framework of a large population study, the GLOBE study (Eindhoven, The Netherlands). The GLOBE study involved a random sample of noninstitutionalized Dutch citizens between the ages of 15-74 who were selected from 17 communities in the Eindhoven area (Mackenbach et al., 1994). The population in the age range 45-74 and those in the highest and lowest social-economic strata (identified by postcode) were oversampled to increase the power of the

study. Data were collected via questionnaires and registries. A total of 27,000 people received questionnaire, sent by mail, regarding their health and life circumstances. The response rate was approximately 70% (N = 18,973). Differences in response rates between different socio-demographic groups were small and not statistically significant. For these analyses only respondents who were working in 1991 at the time of the data collection were included (N = 7,533).

8.2.1 Measurements

Several questions were asked to cover the domain of working conditions to which the respondents answered yes or no (Central Bureau of Statistics, 1992; Schrijvers et al., 1998).

The four domains established were:

(a) *Hazardous physical working conditions* (6 items) for which the number of affirmative answers was counted. The questions included in the questionnaire regarding hazardous physical working conditions were: (1) Do you often work in a noisy environment? (2) Do you often perform dirty work, meaning work, which results in dirty hands, hair or which makes you inhale dust? (3) Is your work physically demanding? (4) Do you work for long periods in the same posture? (5) Are there often unpleasant smells or fumes in your work environment? (6) Do you perform dangerous work once in a while? The two highest categories (5 and 6) were combined for males; scoring ≥ 3 was considered the highest category for females.

(b) *Support at work* (3 items). The questions included to measure this dimension were: (1) Can you, if necessary, get support from one or more colleagues? (2) Do you get enough support concerning your work from your direct supervisor(s)? (3) Do you consider the atmosphere at work to be generally good?

(c) *Job control* (5 items) for which the number of negative answers given by respondents to questions 1,2,3 and 5, as well as the positive answer given to question number 4 were counted. The questions included in this domain were: (1) Can you interrupt your work when you find it necessary? (2) Can you organize your own activities at work? (3) Can you determine the beginning and end of your workday, and the timing of taking breaks? (4) Do you have a monotonous work? (5) Can you develop your abilities by working? The two highest categories were combined (scoring 4 or 5).

(d) *Job demands* (3 items) for which the number of positive answers given to these questions was summed. Respondents were asked to answer these questions: (1) Do you often work in a high pace environment? (2) Do you often not have enough time to get the job done? (3) Is your work psychologically demanding?

Respondents were also categorized according to their alcohol consumption: abstainers or drinkers and, within drinkers heavy drinkers were compared to light-moderate drinkers. We defined light-moderate

drinkers and heavy drinking based on their weekly average alcohol intake. Light-moderate drinkers were those drinking ≤ 21 units/week for men and ≤ 14 units/week for women. These cut-off points (21 units/week for men and 14 units/week for women) were chosen because drinking below these limits has been repeatedly associated with health benefits (e.g. Jackson & Beaglehole, 1995). Units/week were computed from the combination of information on the number of drinking days per week and on the amount of alcohol (in glasses) consumed per drinking occasion. Furthermore, respondents were asked whether they had consumed ≥ 6 glasses in any one occasion in the preceding 6 months (binge drinking).

Socio-demographic variables such as age, marital status, religion, and place of residence (urban, suburban, rural) were associated with adverse working conditions as well as with alcohol consumption. Because adverse work characteristics are unevenly distributed across socioeconomic strata and socioeconomic class was related to alcohol consumption, we adjusted for educational level in the analyses. The variables (age, marital status, religion, place of residence and educational level) were therefore entered in the logistic regression models as covariates.

8.2.2. Analyses

Adverse working conditions were studied in relation to abstinence, heavy drinking, and binge drinking among men and women. Results are presented in Tables 8.2, 8.3 and 8.4 respectively. For these analyses, all adverse working conditions were entered simultaneously in the logistic regression models (multivariate analyses).

Although in our research we used the conservative cut-off points of 21 units/week for men and 14 units/week for women, other cut-off points were also tested. More conservative cut-off points (≤ 14 units/week for men and ≤ 9 units/week for women) were tested and outcomes led to similar results. Yet, another cut-off point for even heavier drinking (≤ 29 units/week) was tested for men (the number of heavy drinkers among women was not large enough to allow for meaningful analyses). Results of these analyses showed no differences between drinking above and drinking below this limit. Therefore, results presented here are those using the traditional cut-off points (≤ 21 units/week for men and ≤ 14 units/week for women).

8.3 Results

The distribution of the population by working conditions is presented in Table 8.1. The proportion of respondents in the adverse working condition categories varied considerably. Results showed that 24,8% of the males (6,5% of who scored 5 or 6) and 11,3% of the women reported high hazardous physical working conditions (score ≥ 3); 30,2% of the men and 20,9% of the women reported having high demands at work; 7% of the men and 11,3% of the women reported low job control and 3,5% of the men and 2,4% of the women reported low support from coworkers and supervisors.

Multivariate logistic regression analyses were conducted to answer the question of whether adverse working conditions were associated with abstinence in men and women. Results are presented in Table 8.2. Respondents who reported adverse working conditions were as likely to abstain as to drink (all confidence intervals except one, include the number one). It should be noted, however, that most of the values for the odds ratios presented in Table 8.2 are above unity, which suggests a tendency to abstain from drinking in the presence of adverse working conditions. Although not statistically significant, differences were found; results for job demands among women seemed to be the opposite.

Table 8.1 Adverse working conditions by gender

	Men		Women	
	%	n	%	n
Hazardous physical working conditions				
0 (low)	38,0	1864	37,6	895
1	24,4	1196	34,0	891
2	12,9	635	17,2	450
3	10,0	490		
3 to 6 (high) ^a			11,3	297
4	8,3	408		
5 or 6 (high)	6,5	317		
Job demands				
0 (low)	22,3	1097	31,7	832
1	24,1	1182	24,9	653
2	23,4	1147	22,5	590
3 (high)	30,2	1484	20,9	548
Job control				
0 (high)	35,4	1712	21,5	554
1	27,5	1331	24,7	638
2	18,0	871	22,9	590
3	12,0	581	19,6	504
4 or 5 (low)	7,0	338	11,3	292
Support at work				
0 (high)	61,3	3011	63,3	1661
1	24,6	1208	25,4	666
2	10,6	519	8,8	232
3 (low)	3,5	172	2,4	64

^aWomen only.

The association between adverse working conditions and heavy alcohol consumption was assessed. Results are presented in Table 8.3. After exclusion of abstainers, heavy drinkers (>21 units/week for men; >14 units/week for women) were compared to light-moderate drinkers (drinking below these limits). Those reporting high hazardous physical working conditions were significantly more likely to drink heavily than those reporting low hazardous physical working conditions (O.R. of 1,46 for males and 1,97 for females). High demands at work were also related to a significantly higher likelihood to report heavy drinking among women (O.R. of 2,30). Although results did not reach significance among men for the highest category, they point in the same direction: increased likelihood for heavy drinking in the categories of highest job demands. The values of the odds ratios for demand and hazardous physical working conditions were higher for females than for males suggesting a stronger relationship among women.

Table 8.2 Association between number of adverse working conditions and abstaining from alcohol (OR^a and 95% CI), men and women

	Men		Women	
	O.R.*	95% C.I	O.R.*	95% C.I
Hazardous physical working conditions				
0 (low)	1,00	(reference)	1,00	(reference)
1	1,09	(0,79-1,48)	0,99	(0,76-1,30)
2	1,46	(1,02-2,08)	1,10	(0,79-1,54)
3	1,28	(0,85-1,93)		
3 to 6 (high) ^b			1,07	(0,73-1,58)
4	1,13	(0,72-1,77)		
5 or 6 (high)	1,29	(0,80-2,10)		
Job demands				
0 (low)	1,00	(reference)	1,00	(reference)
1	1,20	(0,87-1,66)	0,94	(0,70-1,26)
2	1,19	(0,85-1,67)	0,88	(0,64-1,21)
3 (high)	0,91	(0,64-1,28)	0,81	(0,57-1,15)
Job control				
0 (high)	1,00	(reference)	1,00	(reference)
1	1,20	(0,88-1,63)	1,06	(0,75-1,49)
2	1,39	(0,98-1,96)	1,13	(0,80-1,60)
3	1,28	(0,86-1,90)	1,00	(0,69-1,44)
4 or 5 (low)	1,56	(0,99-2,46)	1,16	(0,76-1,77)
Support at work				
0 (high)	1,00	(reference)	1,00	(reference)
1	1,03	(0,78-1,34)	1,01	(0,78-1,31)
2	1,17	(0,83-1,67)	1,06	(0,71-1,59)
3 (low)	0,76	(0,40-1,45)	1,67	(0,87-3,23)

CI, confidence interval.

*OR, odds ratio, adjusted for age, marital status, religious affiliation, education and place of residence.

^bWomen only.

Table 8.3 Association between number of adverse working conditions and drinking >21 units/week for men and >14 units/week for women (OR^a and 95% CI), drinkers only

	Men		Women	
	O.R ^a	95% C.I	O.R ^a	95% C.I
Hazardous physical working conditions				
0 (low)	1,00	(reference)	1,00	(reference)
1	0,99	(0,77-1,26)	0,93	(0,63-1,38)
2	0,67	(0,48-0,95)	0,85	(0,51-1,43)
3	1,19	(0,85-1,66)		
3 to 6 (high) ^b			1,97	(1,17-3,33)
4	0,80	(0,54-1,18)		
5 or 6 (high)	1,46	(1,00-2,13)		
Job demands				
0 (low)	1,00	(reference)	1,00	(reference)
1	1,13	(0,85-1,51)	1,35	(0,84-2,18)
2	1,34	(1,00-1,78)	1,45	(0,89-2,36)
3 (high)	1,26	(0,95-1,67)	2,30	(1,41-3,74)
Job control				
0 (high)	1,00	(reference)	1,00	(reference)
1	1,14	(0,90-1,45)	0,86	(0,53-1,39)
2	0,95	(0,71-1,27)	1,13	(0,70-1,83)
3	1,17	(0,84-1,61)	1,20	(0,73-1,95)
4 or 5 (low)	0,87	(0,57-1,32)	0,89	(0,46-1,70)
Support at work				
0 (high)	1,00	(reference)	1,00	(reference)
1	0,92	(0,73-1,15)	0,86	(0,58-1,26)
2	0,98	(0,72-1,35)	1,04	(0,59-1,83)
3 (low)	1,14	(0,68-1,89)	0,70	(0,20-2,38)

CI, confidence interval.

a OR, odds ratio, adjusted for age, marital status, religious affiliation, education and place of residence.

b Women only.

The association between adverse working conditions and binge drinking (report drinking ≥ 6 glasses in one occasion in the preceding 6 months) was explored. Results are presented in Table 8.4. High hazardous physical working conditions among men were positively associated with binge drinking (OR of 1.68 and 1.62 for the highest categories). Reporting low support, on the contrary, was inversely related to binge drinking among men. Adverse working conditions among women did not seem to relate to binge drinking.

Table 8.4 Association between number of adverse working conditions and drinking ≥ 6 glasses in one occasion in the past 6 months (OR^a and 95% CI), men and women, drinkers only

	Men		Women	
	O.R.*	95% C.I	O.R.*	95% C.I
Hazardous physical working conditions				
0 (low)	1,00	(reference)	1,00	(reference)
1	0,89	(0,73-1,10)	1,04	(0,80-1,36)
2	1,08	(0,82-1,42)	0,96	(0,68-1,35)
3	1,01	(0,73-1,39)		
3 to 6 (high) ^b			0,95	(0,62-1,44)
4	1,68	(1,16-2,43)		
5 or 6 (high)	1,62	(1,05-2,48)		
Job demands				
0 (low)	1,00	(reference)	1,00	(reference)
1	1,07	(0,84-1,37)	1,07	(0,78-1,47)
2	1,22	(0,94-1,58)	1,01	(0,73-1,40)
3 (high)	1,25	(0,97-1,59)	1,29	(0,92-1,82)
Job control				
0 (high)	1,00	(reference)	1,00	(reference)
1	0,82	(0,67-1,01)	1,16	(0,84-1,61)
2	0,82	(0,63-1,05)	1,08	(0,77-1,51)
3	0,84	(0,62-1,13)	1,00	(0,70-1,41)
4 or 5 (low)	0,74	(0,52-1,07)	1,01	(0,65-1,56)
Support at work				
0 (high)	1,00	(reference)	1,00	(reference)
1	0,89	(0,73-1,08)	0,88	(0,67-1,15)
2	0,92	(0,70-1,20)	1,28	(0,85-1,92)
3 (low)	0,60	(0,39-0,94)	0,72	(0,32-1,62)

CI, confidence interval.

*OR, odds ratio adjusted for age, marital status, religious affiliation, education, place of residence, and

^bWomen only.

The role of support, from coworkers and supervisors at work, as a modifier of the relationships between other adverse working conditions and alcohol was also explored. To do so, the interaction terms between support at work and each of the other conditions was added to the logistic regression models. None of the interaction terms resulted significant so we concluded that support at work was not an effect-modifier of the relationship between adverse working conditions and alcohol use for either men or women (results not shown).

8.4 Discussion

Although adverse working conditions did not seem to be related to abstinence, they seemed to be associated with heavy drinking. Reporting high hazardous physical working conditions was positively associated with heavy and binge drinking; high demands at work and the combination of some working conditions were also associated with high levels of alcohol intake in both men and women.

Before discussing our results and contrasting them with those of other studies, a few limitations of our study should be considered. Our research relates adverse working conditions and alcohol consumption. Information on perceived stress that results from these adverse conditions was not available. Therefore, although respondents reported adverse working environment, they may not perceive it a source of stress, or as something with which to cope. The length of the period in which the individual had been exposed to adverse working conditions was unknown to us and also could have affected the perception of the situation as stressful; its chronicity could have had different effects on health behavior, as has been suggested before (Hellerstedt and Jefferey, 1997).

Furthermore, information on alcohol consumption was self-reported. It is well known that respondents tend to underreport their alcohol intake. If that were the case in our study, the cut-off points used here should be shifted to higher cut-off points, because people who reported drinking 14 units/week, for example, would have drunk somewhat more. In our study we observed an association between high hazardous physical working conditions and binge drinking, especially among men. Future research should consider aspects of the drinking pattern such as drinking setting, when the alcohol was consumed (immediately after work, during the weekends, etc.), whether it was consumed in a social context, or the reasons for drinking alcohol.

Information on working conditions was also self-reported. Results presented here could be partly a result of bias in the reports of these conditions. Many of the results found in our research correspond to hazardous physical working conditions, the most objective measure of working conditions available for our study. Respondents who drink heavily might have been more likely to report, or to perceive, their working conditions (control, support) as more favorable, but they might have been more likely to report more objectively their hazardous physical conditions. This possibility has been suggested before (Muntaner et al., 1995).

Several intermediate variables (such as expectancies towards the effects of alcohol and its buffering properties, job satisfaction, reasons for drinking, etc.) have been mentioned as possible mediators of the relationship between stress and alcohol (Grunberg et al., 1998; Martin and Roman, 1996). Information regarding these factors, however, was not available for our research.

Our study was also limited from its cross-sectional design. A longitudinal design would be needed to assess the directionality of the relationships.

The first question we posed was whether adverse working conditions were related to abstinence. We found that respondents who had adverse working conditions were not more likely to abstain compared to those without adverse working conditions. The lack of association found here could be explained by a selection mechanism: those abstainers who have worse health condition may have difficulties finding a job that accommodates their vulnerability (Grunberg et al., 1998). Those abstainers who, on the contrary, have better health occupy more desirable positions. Those with worse health conditions, who because of their health are out of the working market, were not included in our study. Although this possibility cannot be ruled out, it seems more likely that adverse working conditions lead to alcohol intake as a way of coping, and not the other way round. Although in our study we were able to distinguish life-long abstainers from former drinkers, the number of respondents who indicated they were abstainers was not large enough to allow us to study the relationship between adverse working conditions and abstinence in the two subpopulations separately. Future research should consider the possibility that adverse working conditions are related to life-long abstinence or to former drinking, because this could shed some light into the understanding of the apparent lack of association observed in our study.

Those with adverse working conditions were more likely to drink heavily rather than light-moderately. Results were only significant for those who reported hazardous physical working conditions and those with high demands at work. In agreement with the results presented by Roxburgh, we found that the relationship between high demands at work and heavy drinking was stronger for women than for men (Roxburgh, 1998). For women, the experience of high demands at work may be associated with higher levels of stress than among men and they could choose to cope with the demands at work by increasing their alcohol consumption (Allan and Cooke, 1985). The experience of women who have high demands at work also could be combined with high demands experienced by women who work, who have to combined with the high demands experienced with other roles working women assume, such as the role of mother, which would results in a greater experience of stress than it would be for men (Collins et al., 1997).

We also found that both men and women in high physically hazardous working environments were more likely to drink heavily than light-moderately. Heavy drinking could be speculated to affect the perception of working conditions (as explained above) but it could also be that heavier drinkers have difficulties finding jobs and they tend to occupy "low-standard jobs", often characterized by hazardous physical conditions, or jobs with low structure and supervision that may allow

them to camouflage the drinking (Parker and Farmer, 1998). Another possible explanation is through what has been referred to as "occupational culture". Members of certain occupations share their own structure, vocabulary, organization and some of their behaviors. Some professions characterized by the high levels of physical hazards (e.g. construction workers) may share their drinking habits as part of their occupational culture; they can drink during lunch, before or after work, etc. Some authors have even suggested that the influence of occupational culture may be even more important than the influence of other variables such as family background or ethnicity (Ames and Rebhun, 1996). The association found between high hazardous physical working conditions and binge drinking among men also supports this hypothesis. Women in jobs that have high hazardous physical working conditions, on the other hand, may be a minority and therefore, they may not partake into the drinking culture of the majority (men). This hypothesis may help explain why high hazardous physical working conditions were not associated with binge drinking among women (Roxburgh, 1996). Future studies should consider the possibility that adverse working conditions may be more related to specific drinking patterns than to certain levels of average alcohol intake.

Although some researchers have reported an association between support from coworkers and alcohol consumption (McQueen and Celentano, 1982; DeFrank, Jenkins and Rose, 1987), our study did not find support from coworkers and supervisors related to alcohol consumption nor moderate the relationship between other working conditions and alcohol consumption. Availability of other alternative sources of support could attenuate the effects of adverse working conditions on the workers' behavior.

In agreement with results reported by other researchers, we also found a stronger relationship between adverse working conditions and alcohol consumption among women than among men (Kawakami et al., 1993; Wilsnack and Wilsnack, 1992). Being involved in typically male or typically female jobs could explain partly a number of associations found for women. Furthermore, and as we mentioned above, a combination of adverse working conditions among women could be especially stressful because of their multiple role responsibility (Roxburgh, 1998; Collins et al., 1997).

The definition of adverse working conditions differs across studies, and that could account for part of the differences between our results and results presented by other researchers with regard to the role of support from others at work. There could also be cultural differences in the perception of working conditions and the distribution of working conditions among the population. If the majority of the population works in jobs with low levels of control, individuals with low levels of control would not be likely to turn to drinking as a way of coping with the low control. However, when most of the population works in jobs

with high levels of control, someone occupying a job with low control may perceive the situation differently and turn to maladaptive ways of coping.

In addition to general prevention programs directed to the general population, those programs aiming specifically at the working population and at reducing high alcohol consumption or adverse drinking patterns (binge drinking) should target workers in specific jobs, such as those characterized by high hazardous physical conditions. In these types of circumstances, the health of men may be doubly at risk; by the physical conditions and by their unhealthy behavior (i.e., drinking). Furthermore, prevention and intervention programs at the worksite should pay attention to gender differences with regard to the effects of stress. Some of the associations described in our study were stronger for women than for men, so the acquisition of appropriate coping techniques, or stress-reduction alternatives directed at teaching, for example, how to cope with multiple roles, should also be different for both gender groups (Collins et al., 1997).

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CHAPTER 9

**The stress-buffering effects of
alcohol:
An explanation for the U-shaped
curve?**

9 THE STRESS-BUFFERING EFFECTS OF ALCOHOL: An explanation for the U-shaped curve?

ABSTRACT

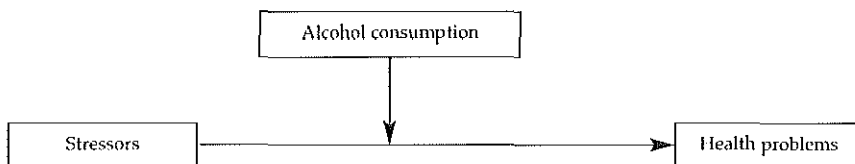
Objective: To study the role of alcohol consumption in the relationship between psychosocial stressors and health. We tested the hypothesis that the stress-buffering effects of alcohol consumption, by lowering the effects of stressors on health among light-moderate drinkers, would partly explain the U-shaped relationship between alcohol and health. *Methods:* The study was conducted within the framework of a large-scale longitudinal population survey conducted in The Netherlands (N=18,973). The relationship between psychosocial stressors (negative life-events, chronic stressors and adverse working conditions) and health (perceived general health and chronic conditions) was explored separately for the different levels of alcohol consumption (abstainers, light-moderate drinkers and heavy drinkers). *Results:* We found evidence to support buffering effects of light-moderate drinking only for some of the associations studied (e.g. for the relationship between financial difficulties, ≥ 2 life-events, neighborhood problems and health). Similarly, in the working population we only found evidence to support stress-buffering effects of alcohol on health for some adverse working conditions. However, for the rest of the associations, light-moderate drinking did not seem to buffer the effect of stressors on health. *Conclusion:* We found only little evidence to support that light-moderate drinking buffers the effect of stressors on health.

9.1 Introduction

Stress has been repeatedly reported to affect health adversely. In the presence of stress, individuals are more vulnerable, which is often reflected in adverse health consequences. Stressful life-events, life circumstances and also work-related stressors have been negatively associated with various health measures (Lindquist et al., 1997; Brown, 1981; Bosma et al., 1998). Stress has also been correlated with alcoholism (Linsky et al., 1985), alcohol abuse (Cole et al., 1990; Muntaner et al., 1995; Romelsjo et al., 1992; Crum et al., 1995) and heavy drinking (Wilsnack et al., 1991) in different populations. The tension-reduction-hypothesis postulates that alcohol has stress-buffering effects (Cappell & Greeley, 1987). Although there is evidence to support that in the presence of stress individuals turn to alcohol as means for coping, it has also been suggested that individuals may reduce their consumption or even abstain from drinking (e.g., Mertens et al., 1996).

The relationship between alcohol consumption and health has also been widely studied. Health benefits for light-moderate drinkers compared to abstainers or heavy drinkers (U or J-shaped curves) have been described for outcomes such as mortality, cardiovascular diseases, stroke, and subjective health (Marmot et al., 1981; Marques-Vidal, 1996; Stampfer et al., 1988; Poikolainen et al., 1996). The mechanisms underlying these U-shaped curves are not well understood. There is evidence for a plausible biological mechanism for the explanation of the health benefits observed for light-moderate drinkers for mortality or cardiovascular diseases (Maclure, 1993). Alcohol increases HDL cholesterol levels, decreases the risk of thrombosis by increasing blood-clotting activity, decreases platelet aggregation and fibrinogen, insulin resistance, and decreases blood pressure (Wannamethee & Shaper, 1991; Langer et al., 1992; Hendriks et al., 1994). But would a purely biological mechanism also explain the better subjective health observed for light-moderate drinkers? As explained below, some other alternative mechanisms (psychological mechanisms, for example) are also possible. In the framework of the tension-reduction-hypothesis, if light-moderate drinking buffers the effects of stress on health, in the presence of stress, light-moderate drinkers are likely to benefit from the stress-buffering properties of alcohol and enjoy better health (Jones, et al., 1982). Abstainers, on the contrary, are hypothesized to be more prone to suffer the effects of stress on health. At high levels of consumption, alcohol would no longer provide buffering effects but aggravate the stressful situation (Cappell & Greeley, 1987). Given the high prevalence of both, light-moderate drinking and of stress in industrialized societies (where the benefits of light-moderate drinking have been reported), if light-moderate drinking buffers the effects of stressors on health, health benefits are likely to be observed among light-moderate drinkers.

Following the tension-reduction hypothesis, we propose the following model for the explanation of the U-shaped curve:



In this chapter we assess the role played by alcohol consumption in the relationship between psychosocial stressors and health. More specifically we explore the possibility that the relationship between stressors and health would differ across alcohol consumption levels. We hypothesized that, if light-moderate drinking buffers the effects of stressors on health, stressors would be more strongly related to adverse health measures for both abstainers and heavy drinkers, than for light-moderate users of alcohol.

9.2 Methods and materials

The present study was conducted within the framework of a large-scale longitudinal study on health and life circumstances (GLOBE study) in the city of Eindhoven and its surroundings (The Netherlands). A random sample of non-institutionalized individuals of Dutch nationality aged 15-74 was selected as previously described (Mackenbach et al., 1994). People aged 45-74 and in the highest and lowest social economic strata (identified by post-code) were over sampled in order to increase the contrast to study socio-economic inequalities in health, the main objective of the GLOBE study. Questionnaires were used in 1991 for the baseline data collection. Of the 27,000 people who received a mailed questionnaire, 18,973 responded (response rate 70.1 %)

9.2.1 Measurements

For the present study, information regarding several psychosocial stressors was available. Three potential sources of stress were considered: adverse life-events, chronic stressors and adverse working conditions.

Respondents were asked about their experience of the following life-events in the preceding twelve months: moving; important decrease in financial position; being a victim of a robbery, assault or rape; whether he/she had lost his/her own job; whether a partner or a family member had lost his/her job; whether a partner or another family member was seriously ill; whether their partner had died; whether a close relative or a close friend had died; or whether they had divorced or had broken up with their partner. Respondents answered yes or no to each of these questions. For the present study, a sum-score-variable was constructed and individuals were categorized as having experienced none of the events listed (reference category), 1 of the events, or ≥ 2 events. For the sake of clarity, in the tables regarding the association between reporting life-events and health, only results for ≥ 2 life-events are presented.

Respondents were also asked whether they had, at the time of data-collection financial difficulties (difficulties affording food, housing, electricity, etc.), about their marital status (married, single, separated or divorced, and widowed) and their employment status (being employed, unemployed, receiving a disability pension, being retired or having retired early, being a housewife, student or in the army). For the study of the stress-buffering effects of alcohol, we present information on those categories that were considered as most stressful, namely being separated or divorced and being unemployed. Being married and being employed were used as reference category respectively. Furthermore, participants were asked whether in the year prior to the data-collection they had had housing problems (draft, cold and damp), and neighbourhood problems (unpleasant smells in the neighbourhood, noise from neighbours, noise from traffic and criminality). Reporting

financial difficulties, being separated or divorced, being unemployed, reporting housing or neighbourhood problems were considered as chronic stressors. Respondents not having financial difficulties, being married, employed, reporting no housing problems and reporting no neighbourhood problems, on the other hand, were categorized as being 'not stressed' (reference categories).

For those individuals who reported being employed at the time of the data collection, information regarding their working conditions was collected. Several questions were asked to cover the domain of working conditions to which the respondents answered yes or no (Central Bureau of Statistics, 1992; Schrijvers et al., 1998). The four domains established were: hazardous physical working conditions (noisy, dirty, stinky, smoky working place, physical demands, etc.) support at work (possibility to get support from coworkers and supervisors), job control (own organization of working time and duties, monotony, possibility to develop own abilities, etc.) and job demand (time pressure, psychological demands, etc.). Respondents reporting adverse working conditions (scoring 0 for control over one's job and for support at work; reporting ≥ 1 for hazardous physical working conditions and demands at work) were opposed to those reporting no adverse working conditions (reference category).

Alcohol consumption was measured as average alcohol intake (units/week). Questions about the amount of alcohol consumed per occasion (number of glasses) as well as the frequency of the consumption (drinking days per week) were combined to arrive at a measure of average alcohol intake: abstainers (0 units/week), light-moderate drinkers (drinking ≤ 21 units/week for men; drinking ≤ 14 units/week for women) and heavy drinkers (drinking above these limits). These cut-off points (>21 units/week for men and >14 units/week for women) were chosen because drinking below these limits has been repeatedly associated with health benefits (e.g. Jackson and Beaglehole, 1995). A description of the population by psychosocial stressors and alcohol consumption is provided in Table 9.1.

Perceived general health was measured by a single question: "How do you rate your health in general?" (Central Bureau of Statistics, 1992). The possible answers were: poor, fair, sometimes good sometimes fair, good and very good. For the present analyses, respondents were categorized as perceiving their health as good or very good or as perceiving their health as less than good. 27.7% of the males and 27.6% of the females reported perceiving their health as less than good.

Another health measure consisted of a list of 23 chronic conditions of different severity, such as cancer, heart diseases or headaches (Central Bureau of Statistics, 1992). Respondents were classified according to whether or not they reported suffering from any of the conditions listed in the questionnaire. 42.9 percent of the males and 48.8 percent of the females reported at least one chronic condition.

9.2.2 Analyses

Several logistic regression models were constructed, including age, education and level of urbanization as possible confounders. Life-events and chronic stressors (simultaneously) were related to perceived general health and chronic conditions by entering them simultaneously in the logistic regression models. In the model studying the relationship between being separated or divorced and health, those life-events relative to marital status, namely 'death of one's partner' and 'divorce/break up', were excluded. For the models measuring the effects of unemployment, 'loosing one's job' was removed from the list of life-events. For the present study, due to small number of respondents in some of the categories for the occurrence of certain life-events, we present results on a sum-score of life-events.

Similarly, within the working population, the relationship between adverse working conditions and health was studied including all four dimensions of working conditions simultaneously in the corresponding regression models.

Table 9.1 Description of the population by psychosocial stressors and alcohol (n and %)

	MEN		WOMEN	
	n	%	n	%
Life-events				
0 life-events	4699	51,9	4896	51,7
1 life event	2648	29,2	2779	29,4
≥2 life-events	1712	18,9	1792	18,9
Chronic stressors				
Financial difficultie				
no difficulties	7037	78,4	7171	75,8
difficulties	1939	21,6	2287	24,2
Marital status				
married	6250	68,9	6318	65,7
single	2128	23,5	1830	19,0
separated/divorced	488	5,4	664	6,9
widowed	201	2,2	807	8,4
Employment status				
employed	4910	54,3	2623	27,7
unemployed	355	4,3	221	2,3
disability pension	852	9,4	474	5,0
(early) retired	2067	22,9	666	7,0
Housing problems				
no problems	6878	76,0	7010	73,9
some problems	2170	24,0	2470	26,1
Neighborhood problems				
no problems	6028	66,6	6352	66,9
some problems	3023	33,4	3140	33,1
Adverse working conditions*				
Hazardous physical conditions				
0	1784	36,9	931	36,2
>1	3046	63,1	1638	63,8
Job demands				
0	1012	21,0	778	30,3
≥1	3813	79,0	1791	69,7
Job control				
≥1	1709	35,4	549	21,3
0	3121	64,6	2024	78,7
Support at work				
≥1	2925	60,6	1606	62,5
0	1899	39,4	962	37,5
Alcohol consumption				
abstainers	1309	14,9	3173	34,8
light-moderate drinkers	6351	72,7	5329	58,4
heavy drinkers	1090	12,4	616	6,8

Adverse working conditions*: only those respondents who were employed at the time of data-collection were included.

In order to test the study hypothesis, the interaction terms between each of the stressors and alcohol consumption were tested. Furthermore, analyses were conducted stratified by alcohol consumption, using the categorization described above. The relationship between stressors and health was assessed separately for abstainers, light-moderate drinkers and heavy drinkers, using different cut-off points for men and for women.

9.3 Results

In order to answer the question whether alcohol consumption modified the relationship between stressors and health, the interaction between stressors and health was tested. None of the interaction terms was statistically significant at level 0.05, so the effects of stressors on health did not seem to present variation by level of alcohol consumption (results not shown). Furthermore, we analyzed the relationship between stressors and health for each of the levels of consumption (Tables 9.2-9.4). In Table 9.2 the association between life-events and chronic stressors and the likelihood of reporting less than good perceived general health (for men and women separately) is presented. Among men, contrary to what we expected, we found that some of the stressors considered in our study were statistically significantly related to less than good perceived general health among light-moderate drinkers but not among abstainers or heavy drinkers. Only the relationship between financial difficulties and less than good perceived general health was stronger among abstainers than among drinkers (both, light-moderate and heavy drinkers), suggesting some buffering effects of alcohol consumption. Similarly, the value of the odds ratio for the relationship between unemployment and less than good perceived general health was higher among abstainers than among drinkers; differences between those unemployed and those employed were, however, not statistically significant at any of the levels of consumption.

Table 9.2 Adjusted odds ratios (O.R.*) and 95% confidence intervals (CI) for the relationship between life events and chronic stressors, and less than good perceived health

	Abstainers			Light-moderate drinkers ^a			Heavy drinkers ^b		
	OR*	95% CI	n	OR*	95% CI	n	OR*	95% CI	n
Males									
Count of life-events									
≥2 life-events	1,09	(0,73-1,63)	141	1,32	(1,10-1,59)	348	1,77	(1,18-2,66)	97
Financial difficulties	1,89	(1,32-2,71)	232	1,68	(1,41-2,00)	466	1,01	(0,67-1,53)	94
Being separated/divorced ¹	1,69	(0,93-3,07)	55	1,61	(1,19-2,19)	121	1,15	(0,65-2,03)	36
Being unemployed ²	2,03	(0,96-4,29)	27	1,25	(0,88-1,78)	77	1,40	(0,75-2,63)	26
Housing problems	1,22	(0,87-1,71)	181	1,35	(1,14-1,58)	413	1,63	(1,12-2,38)	89
Neighborhood problems	1,06	(0,78-1,45)	201	1,38	(1,20-1,60)	601	1,41	(1,01-1,96)	130
Females									
Count of life-events									
≥2 life-events	1,59	(1,25-2,02)	286	1,21	(0,99-1,47)	267	1,57	(0,90-2,75)	35
Financial difficulties	1,62	(1,31-2,00)	466	1,77	(1,47-2,13)	390	1,38	(0,79-2,40)	43
Being separated/divorced ¹	0,95	(0,66-1,36)	114	1,70	(1,27-2,28)	127	0,79	(0,35-1,77)	19
Being unemployed ²	1,26	(0,62-2,55)	23	1,44	(0,91-2,27)	37	4,06	(1,24-13,27)	10
Housing problems	1,39	(1,13-1,71)	384	1,38	(1,16-1,64)	364	1,55	(0,93-2,59)	49
Neighborhood problems	1,26	(1,04-1,52)	457	1,34	(1,14-1,56)	472	1,34	(0,83-2,15)	54

* Adjusted for age, education and level of urbanization.

^aLight-moderate drinkers: ≤21 units/week among men; ≤14 units/week among women.

^bHeavy drinkers: >21 units/week among men; >14 units/week among women.

¹In the model with being separated/divorced the life-events 'divorce or break up' and death of a partner were excluded.

²In the model with unemployment, the life-event 'losing one's job' was excluded.

Among women, we found evidence to support stress-buffering effects of light-moderate drinking only for those reporting ≥2 life-events. The value of the odds ratio among women in this case, was higher among abstainers (not statistically significant) and heavy drinkers and lowest (statistically significant) among light-moderate drinkers. For the relationship between financial difficulties and less than good perceived general health, we found evidence to suggest buffering effects at higher levels of consumption among heavy drinkers (lowest value of the odds ratio, although non-significant).

Table 9.3 Adjusted odds ratios (O.R.*) and 95% confidence intervals (CI) for the relationship between life events and chronic stressors and one or more chronic conditions

	Abstainers			Light-moderate drinkers ^a			Heavy drinkers ^b		
	OR*	95% CI	n	OR*	95% CI	n	OR*	95% CI	n
Males									
Count of life-events									
≥2 life-events	1,38	(0,95-2,00)	162	1,29	(1,11-1,51)	550	1,54	(1,06-2,23)	115
Financial difficulties	1,07	(0,77-1,49)	235	1,31	(1,12-1,53)	592	0,95	(0,66-1,37)	118
Being separated/divorced ^c	1,45	(0,81-2,61)	59	0,98	(0,75-1,29)	142	0,74	(0,44-1,26)	41
Being unemployed ^d	1,48	(0,73-3,00)	28	1,19	(0,87-1,62)	101	1,30	(0,72-2,35)	33
Housing problems	1,06	(0,78-1,43)	205	1,20	(1,05-1,37)	643	1,34	(0,96-1,88)	120
Neighborhood problems	1,23	(0,92-1,62)	246	1,24	(1,10-1,39)	969	1,21	(0,90-1,63)	171
Females									
Count of life-events									
≥2 life-events	1,29	(1,03-1,62)	331	1,36	(1,15-1,59)	512	1,47	(0,91-2,39)	60
Financial difficulties	0,95	(0,77-1,16)	491	1,22	(1,04-1,43)	571	0,83	(0,51-1,34)	63
Being separated/divorced ^c	1,04	(0,73-1,48)	125	1,10	(0,85-1,42)	188	1,18	(0,61-2,29)	35
Being unemployed ^d	1,19	(0,61-2,32)	27	0,98	(0,67-1,43)	67	2,65	(0,83-8,47)	12
Housing problems	1,08	(0,89-1,31)	441	1,23	(1,07-1,42)	679	0,82	(0,53-1,27)	78
Neighborhood problems	1,29	(1,08-1,55)	568	1,26	(1,11-1,43)	915	1,27	(0,87-1,87)	117

* Adjusted for age, education and level of urbanization

^aLight-moderate drinkers: ≤21 units/week among men; ≤14 units/week among women.

^bHeavy drinkers: >21 units/week among men; >14 units/week among women.

^cIn the model with being separated/divorced the life-events 'divorce or break up' and 'death of a partner' were excluded.

^dIn the model with unemployment, the life-event 'losing one's job' was excluded.

The relationship between life-events and chronic stressors and the likelihood of reporting one or more chronic conditions is presented in Table 9.3. Among men, only the relationship between ≥2 life-events and chronic conditions was statistically significantly lower among light-moderate drinkers than among abstainers or heavy drinkers, suggesting a stress-buffering effect. For all other stressors no such an effect was found.

Among women, similar to what we observed among men, for most of stressors no stress-buffering effects were found at light-moderate levels of consumption (statistically significant).

In Table 9.4, we present the results of the association between adverse working conditions and health (perceived general health and chronic conditions) in the working population. Among men, adverse working conditions were in general significantly related with adverse health (less than good perceived general health and one or more chronic conditions) among light and moderate drinkers, but not among abstainers or heavy drinkers. The relationships between high demands at work and perceived general health and between low support at work and ≥1 chronic conditions provided some support to the study hypothesis. Among men, no support for the study hypothesis was found with respect to the other relationships between stressors at work and health outcomes.

Table 9.4 Adjusted odds ratios (O.R.*) and 95% confidence intervals (CI) for the relationship between adverse working conditions and health in the working population

	Abstainers			Light-moderate drinkers ^a			Heavy drinkers ^b		
	OR*	95% CI	n	OR*	95% CI	n	OR*	95% CI	n
Males									
< Good perceived general health									
>1 hazardous physical conditions									
≥1 demands at work	1,00	(0,56-1,77)	96	1,39	(1,12-1,72)	416	1,58	(0,97-2,59)	98
0 job control	1,24	(0,69-2,22)	99	1,09	(0,86-1,38)	459	1,48	(0,86-2,54)	109
0 support at work	1,76	(0,97-3,19)	103	1,63	(1,31-2,02)	441	1,48	(0,92-2,40)	101
≥1 Chronic conditions	1,67	(1,05-2,68)	66	1,75	(1,45-2,11)	306	1,79	(1,19-2,68)	63
>1 hazardous physical conditions									
≥1 demands at work	1,06	(0,65-1,75)	145	1,20	(1,03-1,41)	810	1,30	(0,86-1,96)	149
0 job control	1,15	(0,67-1,96)	162	1,31	(1,08-1,57)	1041	1,11	(0,71-1,73)	176
0 support at work	0,92	(0,56-1,51)	148	1,23	(1,05-1,43)	839	1,09	(0,74-1,63)	153
	1,43	(0,93-2,20)	96	1,25	(1,08-1,45)	557	1,39	(0,98-1,98)	95
Females									
< Good perceived general health									
>1 hazardous physical conditions									
≥1 demands at work	1,67	(1,01-2,76)	86	1,73	(1,24-2,42)	191	0,81	(0,34-1,90)	19
0 job control	0,94	(0,58-1,52)	74	1,53	(1,08-2,16)	196	1,13	(0,42-3,02)	24
0 support at work	1,61	(0,85-3,04)	103	1,14	(0,79-1,64)	209	0,92	(0,36-2,33)	23
≥1 Chronic conditions	1,07	(0,68-1,67)	51	1,86	(1,40-2,48)	129	1,56	(0,70-3,46)	14
>1 hazardous physical conditions									
≥1 demands at work	1,90	(1,24-2,91)	163	1,34	(1,07-1,66)	478	1,24	(0,66-2,31)	62
0 job control	1,13	(0,75-1,72)	155	1,46	(1,15-1,84)	530	0,67	(0,33-1,35)	75
0 support at work	2,24	(1,31-3,83)	198	0,96	(0,75-1,22)	550	0,98	(0,50-1,92)	74
	0,52	(0,35-0,78)	77	1,38	(1,12-1,69)	303	0,84	(0,46-1,51)	34

* Adjusted for age, education and level of urbanization.

^aLight-moderate drinkers: <=21 units/week among men; <=14 units/week among women.

^bHeavy drinkers: >21 units/week among men; >14 units/week among women.

Among women, almost none of the relationships between adverse working conditions and health outcomes showed a stress-buffering effect of light-moderate alcohol consumption. Support for the hypothesis that alcohol would buffer the effects of stressors on health was only found for the relationship between hazardous physical working conditions and low job control and chronic conditions.

9.4 Discussion

The aim of the study was to test the hypothesis that the stress-buffering properties of alcohol would explain the U-shaped relationship between alcohol and health. In previous studies on this same population, we found a curvilinear relationship between alcohol consumption and mortality and also between alcohol consumption and self-reported health (San José et al., 1999). We also found some evidence for an association between several stressors and both, abstinence and heavy drinking (San José et al., 2000^a; San José et al., 2000^b). In these previous publications we argued that the U-shaped curve could be partly explained by the fact that individuals at the two ends of the drinking spectrum were more vulnerable to the effects of stressors. In the present

study we tested this hypothesis by studying the stress-health relationship for the different levels of alcohol consumption.

Before interpreting our results, several limitations of our study should be noted. In the first place, our study is limited in its cross-sectional nature. Information on psychosocial stressors, health status and alcohol consumption was collected at the same time point, in 1991, and therefore, several explanations for our results are possible. In the presence of stressors, alcohol may be consumed as a way of coping with the stressors and this may have health consequences; or, it is also possible, that alcohol buffers the effects of stressors on health. On the other hand, drinking (especially heavy drinking or certain drinking patterns) may induce stress (financial stressors, unemployment or familiar difficulties) and these stressors, may lead to adverse health conditions. Health could also determine one's alcohol level and, at the same time, affect the presence of stressors (somebody may stop drinking because of ill health and may also become unemployed as a consequence of ill health). Future analyses with a longitudinal design should be conducted in order to clarify the directionality of the relationships.

Furthermore, information available for our study was self-reported. Respondents were asked whether they had experienced any of the events listed, whether they had housing or neighborhood problems, or whether they had financial difficulties. By using a checklist of events, the definition of the event and its interpretation was left to the individual and may therefore, vary in the reports of stressors may have occurred (e.g. one of the life-events, 'being a victim of a crime' for example, may range from being raped to robberies of few minor items). Most of the life events considered in our study, however, were rather objective and left little room for personal interpretation. Differences in reports of stressors become more relevant when they are related to the outcome under study, in this case, health. If individuals in ill health were more likely to respond in the affirmative even in the case of minor events compared to healthy individuals (e.g., looking for reasons for their ill condition) the results presented here could be partly due to this differential reporting. In addition, alcohol consumption was also based on self-reported measures. Underreporting of alcohol consumption in epidemiological studies has been reported before (e.g., Neve et al., 1993). Had that been the case in our study, light-moderate drinkers, (i.e. drinkers of ≤ 21 units/week for men and ≤ 14 units/week for women) would drink somewhat more than what they reported. In this case, we could have missed the buffering effect at low doses of alcohol since it may have been counterbalanced with the aggravating effect of alcohol at larger doses. Furthermore, underreporting of alcohol consumption could have biased our results if it was differential. However, this is not likely to be the case since underreports of alcohol consumption are not more likely among heavy drinkers than among light-moderate drinkers (Lemmens et al., 1988).

Among the strengths of our study we should emphasize the large sample size, which allowed us to conduct separate analyses for men and women, to study a wide spectrum of psychosocial stressors, from life-events to chronic stressors (simultaneously) or adverse working conditions, as well as the possibility to study the effects on two health measurements, varying in degree of objectivity.

The effect of moderate alcohol use on the relationship between stress and depression and anxiety has been studied before (Lipton, 1994; Neff, 1982; Neff & Husaini, 1982). Lipton reported light and moderate drinkers to have lower depression scores than abstainers and heavier drinkers, in the presence of stressors. In the study conducted by Neff and Husaini, life events seemed to be more strongly related to depression scores among abstainers than among drinkers. In our study, (with perceived general health and chronic conditions as outcomes instead of depression or anxiety) we found only little evidence to support the stress-buffering properties of alcohol consumption. What are the possible reasons for the findings of our study? Alcohol consumption, especially certain drinking patterns could be thought to aggravate rather than attenuate the effects of stressors on health. Although we observed that light-moderate drinking did not buffer the effects of some stressors on health, individuals with very different drinking patterns may be included in our light-moderate drinking category. Regular alcohol consumption has been reported in the literature to be associated with larger health benefits than occasional drinking of similar quantities, so the possibility that regular drinking and not merely light-drinking provides stress-buffering effects cannot be excluded in the light of these analyses.

The efficacy of alcohol as a coping strategy or as a stress-buffer has been reported to be different for the different types and severity of stressors (DeFrank, Jenkins & Rose, 1981; Neff, 1985). Respondents in our study were asked whether they had experienced a number of events or whether they had suffered from chronic stressors in the preceding year. Most of the stressors considered in our study were therefore, long-lasting stressors rather than stressors of daily living. While it could be thought that the stress buffering effects of alcohol are restricted to stress of daily life, it may be considered inappropriate in the case of long-term stressors. In our study we only found small evidence to support buffering effects of light-moderate drinking on health. Further research should be conducted in order to clarify whether type of stressor plays a role in determining the buffering effects of light-moderate drinking. Furthermore, the distance in time of the stressors was also not known to us; while for some respondents any mentioned life-event could have occurred twelve months before the data collection, for other respondents, it could have occurred closer in time (e.g. the previous month). The mechanisms used by the individual in these two circumstances could be radically different. Alcohol could be used as a coping mechanism immediately after the event occurred but not be used later on in time.

The expectancies of a person about the effects of alcohol, and about its stress-buffering properties, as well as the previous experience of the individual regarding the effects of alcohol have been suggested in the literature to play an essential role in determining the use of alcohol for its stress-buffering properties (Lipton, 1994). It should also be noted that often the motivation to drink of the individual is not determined by a single factor (i.e. stress-reduction) but is a result of a combination of circumstances. The availability of alternative coping mechanisms could influence the use of alcohol for its stress-buffering properties. In our study, information regarding expectancies towards alcohol, availability of alternative coping strategies, or previous experience with alcohol as a coping mechanism was not available.

Furthermore, characteristics other than the ones studied here could also be related to stress, health and alcohol consumption. For example personality-type may reflect certain drinking patterns and may be also associated to health (Pohorecky, 1991; Brown, 1998).

As we mentioned in the introduction, it has been suggested in the literature that the stress-buffering properties of light-moderate alcohol consumption could explain the health benefits associated with light-moderate drinking. In our study we found no evidence to support this hypothesis. One possible reason may be that the mechanisms by which stressors affect health are not modified by alcohol intake. For example, although alcohol may reduce muscular tension or contribute to relaxation, it may not affect the secretion of adrenaline. This adrenaline secretion could be responsible for the health damage associated with stress, rather than the muscular tension also associated with stress. In the light of the results, we concluded that the stress-buffering effects of alcohol consumption did not seem to contribute to the explanation of the health benefits associated with light-moderate drinking.

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CHAPTER 10

General Discussion

10 GENERAL DISCUSSION

10.1 Overview of the results

The research activities discussed in this thesis looked for possible explanations for the health benefits associated with light and moderate drinking (U-shaped curve). We studied the relationship using objective as well as subjective health measures and assessed the role of drinking pattern and psychosocial stressors in the U-shaped curve. We also tested the hypothesis that the stress-buffering properties of alcohol would contribute to the explanation of the low health risk associated with light-moderate drinking. The primary findings of our research are summarized in this chapter (10.1.1 and 10.1.2) and several limitations of our study and some validity issues are discussed (10.2). Furthermore, the degree to which our study contributes to the explanation of the U-shaped curve is addressed (10.3), and the policy implications of our results are discussed (10.4).

10.1.1 Alcohol consumption and health: various health measures and alcohol drinking patterns

Chapter 3: Subjective health measures

In agreement with results presented by other researchers, a J-shaped relationship in our study described the association between alcohol consumption and mortality. In addition, we found the same curvilinear pattern for subjective health measures (U or J-shaped relationships); compared with abstainers or heavy drinkers, light and moderate drinkers were observed to have lower mortality rates and also to be less likely to report adverse health conditions. We also observed that independent of average alcohol intake frequent heavy-drinking episodes were related to an increased likelihood for mortality and were not related to other health measures.

Chapter 4: Occasional versus regular drinking

Most of the research regarding the relationship between alcohol consumption and a number of objective health measures has been based on measures of average alcohol intake. Nevertheless, this approach may partly obscure health differences within the group of drinkers; individuals with similar average intakes of alcohol but different drinking patterns may also present health differences. In our study the lowest risk for subjective ill health was observed among those drinkers who consumed 1-2 glasses/6-7 days per week and those drinkers who consumed 3-5 glasses/3-5 days per week. Regular drinking was also associated with a lower health risk than was sporadic drinking, independently of average alcohol intake.

Chapter 5: Type of beverage

We also studied health differences by type of beverage consumed. Our results pointed out the potential benefits of wine consumption (and beer to a lesser extent) compared to other beverages when considering mortality and subjective health measures both for men and for women. We accounted for the possibility that the differences attributed to these beverages were in fact differences due to the drinking pattern associated with each of the beverages and also to other lifestyle and behavioural characteristics of the drinkers of the different beverage-types. Whereas behavioural characteristics of drinkers of diverse beverages seemed to contribute to the explanation of their health differences, the health differences observed by type of beverage were not explained by differences in average intake or the regularity of consumption.

Chapter 6: The health risk of abstainers

The contamination of the group of abstainers has been suggested as a possible explanation for the health risk associated with abstinence; the health risk of abstainers could be artificially elevated by the presence of former drinkers and sick-quitters in the group of abstainers (selection). We examined the contribution of former drinkers and sick-quitters to the explanation of the elevated health risk observed among abstainers for subjective health measures. Confirming the findings described for objective health measures, we observed that former drinkers and sick-quitters contributed partly to the excess risk for subjective ill health observed among abstainers.

We further examined socio-demographic and behavioral characteristics differentiating abstainers from drinkers, trying to understand whether these two groups differed in characteristics other than their alcohol consumption (or abstinence) and whether these characteristics were responsible for their health differences (confounding). Indeed, we observed that abstainers and drinkers differed in a number of socio-demographic and lifestyle factors. The elevated risk for subjective ill health of abstainers was partly explained by the presence of former drinkers and sick-quitters and by socio-demographic and behavioral characteristics differentiating abstainers and light-moderate drinkers. However, after accounting for selection and confounding, abstainers still remained at higher health risk than light-moderate drinkers.

10.1.2 The role of psychosocial stressors and the stress-buffering effects of alcohol consumption

In the second part of this thesis we report on the role of psychosocial stressors and the stress buffering effects of alcohol consumption in the explanation of the U-shaped curve for subjective health measures. We examined the relationship between several stressors, namely life-events, chronic stressors and adverse working conditions and abstinence and heavy drinking, the two ends of the U-shaped curve. We also explored

whether the effects of stressors on health would contribute to the explanation of health differences between light-moderate and abstainers or heavy drinkers, hypothesizing that these effects are lower among light-moderate drinking than among either abstainers or heavy drinking. The question we attempted to answer was: Could the elevated health risk observed among abstainers and heavy drinkers be due a) to the fact that they experience more stressful conditions, and b) to the fact that they suffer more the effects of stressors on health compared to light-moderate drinkers.

Chapter 7: Stressful life-events and chronic stressors in relation to alcohol consumption

Some life-events and some chronic stressors were positively related with abstinence among men and women; some life events and chronic stressors were also positively associated with heavy drinking among women. In our study, abstainers and heavy drinkers were not only at higher risk for ill health but they were also more likely than light-moderate drinkers to report life-events and chronic stressors.

Chapter 8: Adverse working conditions and alcohol consumption

Work-related stressors were also studied in relation to abstinence and heavy drinking in the working population. In our study, we did not find evidence to support the hypothesis that some individuals working in adverse working conditions would abstain rather than drink light-moderately. Individuals working in highly adverse physical working conditions and who reported high demands at work, on the other hand, were observed to be more likely to drink heavily than to drink light-moderately.

Chapter 9: The stress-buffering effects of alcohol consumption

We also assessed the role of alcohol consumption in relation to psychosocial stressors (life-events, chronic stressors and adverse working conditions) and subjective health. We explored the possibility that the stress-buffering effects of alcohol would contribute to the explanation of the U-shaped curve; if light-moderate drinking buffers the effects of stressors on health, in the presence of stressors light-moderate drinkers are likely to benefit from the stress-buffering properties of alcohol and enjoy better health. On the contrary, we hypothesized that abstainers were more prone to suffer the effects of stressors on health. At high levels of consumption, alcohol would no longer provide buffering effects but would aggravate the stressful situation. Our study found only little evidence to support this hypothesis.

10.2. Validity of our study

The validity of the results and several limitations of the study design are assessed. We address both internal validity issues and the generalizability (or external validity) of the study-results. However, before considering the limitations of our study, several strengths of its design should be mentioned. First, our sample size was very large ($N = 18,973$), which allowed us to conduct meaningful analyses and to study associations in subgroups of the population (i.e., men and women separately, among workers only, restricted to certain levels of alcohol intake). We also had information on a variety of health measures, ranging in degree of objectivity; we had detailed information on alcohol consumption and several aspects regarding the drinking pattern of the participants. Further, information on a number of psychosocial stressors facilitated us the study of different sources of stress, from life-events, to chronic stressors or work-related stressors. Other characteristics of the design of the study could, on the other hand, threaten the validity of our results and therefore need to be discussed.

10.2.1 Internal validity

Any systematic error in an epidemiologic study that results in an incorrect estimate of the association between exposure and risk is denominated bias (Hennekens & Buring, 1986). There are three main types of bias: selection bias, information bias and confounding. Selection bias derives from procedures used to select subjects that lead to an effect estimate among subjects included in the study different from the estimate obtainable from the entire population targeted for study (Rothman, 1986). Information bias occurs from errors while obtaining the information needed. A confounder is an extraneous factor that is related to the exposure and to the outcome under study, which is not an intermediate step in the causal path between the exposure and the outcome (Rothman, 1986).

Selection bias due to non-response is an important issue when carrying out health surveys in the general population. Although a baseline measurement response rate of 70.1 percent could be considered satisfactory, the effect of non-response should be evaluated. Differential non-response by sociodemographic factors and alcohol consumption could have resulted in selection bias if the non-response was associated with the outcome variables—health and psychosocial stressors. We observed only small differences in demographic variables between baseline respondents and non-respondents to the postal survey and oral interviews. With regard to alcohol consumption, non-response analyses showed that non-respondents drink somewhat more than respondents and have more frequent heavy-drinking episodes. The relationship between alcohol consumption and health among non-respondents could

not be assessed due to small numbers. As no differences were found between respondents and non-respondents concerning health measures, and differences with respect to drinking patterns were not large, non-response bias is not expected to have affected the results presented here with regard to the relationship between alcohol intake and health.

Additionally, we were concerned with the relationship between psychosocial stressors and alcohol consumption (Chapter 7 and Chapter 8). In order to assess the contribution of non-response to the explanation of our findings, information regarding psychosocial stressors among non-respondents would be necessary. However, this information was not available in our study so we could not evaluate differences in this respect between respondents and non-respondents. Furthermore, in longitudinal studies it is likely that a proportion of participants to the baseline measurement would no longer participate in follow-up measurements. This lost-to-follow-up might also influence the interpretation of the results presented here. Non-response to the follow-up survey may have biased our results regarding the health risk of abstainers, for whom longitudinal data was used (Chapter 6). The net response rate to the 1997 follow-up study was 76.6%. Differences in response rate to the 1997 follow-up were observed across levels of alcohol consumption (see Chapter 2). Among abstainers the response rate was of 70.6; it was 79.0%, 76.1%, and 79.8% among light drinkers, moderate drinkers, and heavy drinkers, respectively. We also observed that respondents who were in ill health at the time of baseline data collection were less likely to respond to the 1997 follow-up. The response rate among abstainers was also lower compared to drinkers; if this non-response is related to health, or in other words, if abstainers who were in ill health did not respond in 1997, the proportion of sick-quitters would in fact be greater than the one reported here. Consequently the contribution of sick-quitters to the explanation of the health risk observed among abstainers in our study would be an underestimation. The GLOBE-study data are self-reported. This could have biased the results of our study if there would have been systematic differences in the answering of the questions by alcohol consumption (information bias). Misclassification across different alcohol categories could have influenced our results. Comparisons of survey reports of alcohol consumption with sales statistics in The Netherlands suggest that underestimation of alcohol consumption occurs in survey studies (Neve et al., 1993). If all drinkers underestimate their consumption, there would be a shift to the right in the consumption at all levels. The health burdens of heavy drinking would start at higher consumption levels than the ones reported in our study (Chapter 3). Underestimation of alcohol consumption in a specific drinking category (e.g., underreporting among light and moderate drinkers is less likely than among heavy drinkers) might make the categories of light and moderate drinkers more similar to heavy drinkers and the possible health differences more difficult to

observe. Although inaccurate reporting of alcohol consumption is known to occur, this is unlikely to be different for amount and for frequency of the consumption separately (it is unlikely that one would underreport the amount consumed per occasion but would overreport frequency of the consumption, for example). It is also unlikely that misclassification occurred with respect to type of beverage. Although respondents reporting drinking one beverage type may also consume another type of beverage, most of the respondents consuming more than one type were expected to have been included in the category "vary all the time", so misclassification by type of beverage is unlikely in our study. Overall, if misclassification of alcohol consumption occurred in our study it is likely that it was underestimated and that the increase in health risk observed among heavy drinkers would occur in fact at higher levels of intake than those reported here. Specification of cut-off points was, however, beyond the scope of this study.

Measures of health status were based also on self-reports, which may have caused information bias in our study if misclassification of self-reported health status is related to alcohol consumption. Characteristics of the respondents, such as personality characteristics (e.g., negative affection) could have influenced the way respondents rated their health and reported their alcohol consumption. It could be that people more likely to complain about their health are also more likely to under- or over-report alcohol consumption. This explanation is not very plausible, as drinking patterns are not usually seen as a form of complaint.

Life-events, chronic stressors and adverse working conditions were also self-reported. Validity of self-reported measurements of stressors has been questioned in the literature (Brown, 1981; Paykel, 1983; Cooke, 1985). In the case of life-events, the interpretation of the event is left to the individual and some of the events listed were open to diverse interpretations. Most of the events considered here, however, were rather objective and left little room for personal interpretation. These differences in reports of stressors become more relevant when they are related to the outcome under study. Stressors were related to alcohol consumption (Chapter 7 and Chapter 8) and also to health status (Chapter 9). If heavy alcohol users were more likely to report stressors even in the case of minor events (e.g., alcohol consumption provokes negative life perception or heavy drinkers look for excuses to justify their heavy drinking), compared to light and moderate drinkers, results presented in our study could be partly due to this differential misreporting. However, this is not likely to be the case. Moreover, if individuals in ill health were more likely to report adverse life circumstances (in search of triggering factors of their ill condition) compared to those in good health, results presented in Chapter 9 could have resulted in an overestimation of the effect of stressors on health.

As it has already been described throughout the chapters, other aspects of drinking pattern (e.g., social drinking, or drinking with food) as well

as other lifestyle factors (dietary habits, for example), personality characteristics (e.g., personality type), as well as social factors such as social networks or measures of sociability might confound the relationship between alcohol consumption and health. With regard to the relationship between stressors and alcohol consumption, and also the association between stressors and health, the main characteristic that could be thought to mediate the relationship besides those mentioned above (personality characteristics, lifestyle factors, etc.) is the availability of alternative coping mechanisms. The availability of alternative coping mechanism may determine whether one turns to alcohol in the presence of stress and may also affect the relationship between stressors and health. Information regarding these characteristics was not available for the present study and should be taken into account when interpreting the results.

Another limitation in our study is that most of the empirical analyses described in this thesis are based on cross-sectional data. We assessed the association between alcohol consumption and health, between stressors and alcohol consumption and between stressors and health. In all these circumstances, we assumed a directionality of the relationships and we discussed the possibilities that the relationships would be in other directions. With regard to the relationship between drinking and health, use of longitudinal data was made in order to shed light on the directionality of the relationship. We observed that former drinkers were more likely to report adverse health conditions at baseline than drinkers who continued to drink, suggesting that individuals may stop drinking due to ill health. The directionality of the other relationships could not be assessed. While it is speculated that certain drinking pattern affect health, health could also determine whether one takes part in daily drinking activities or spreads one's drinking through longer periods of time, for example. Furthermore, stressors are thought to influence an individual's drinking behavior, and alcohol drinking could also affect the existence of certain stressors. Family disruption, for example, could be a cause or a consequence of alcohol consumption (of heavy drinking or adverse drinking patterns). Similarly, the relationship between stressors and health described in Chapter 9 could be thought to be bi-directional; whereas stressors may have a negative impact on health, ill health could also determine the presence of certain stressors. Longitudinal analyses of the relationships described in this thesis would be needed in order to fully assess their directionality.

10.2.2 External validity

The external validity of a study concerns the extent to which the results of a study might be generalized to other populations. Generalizability of our results to the Dutch population as well as to other European countries is discussed.

Two restrictions were imposed in the selection of the sample: Dutch

nationality and non-institutionalized individuals. Individuals with other than Dutch nationality are likely to differ from Dutch individuals with regard to health, as well as with regard to lifestyle and circumstantial characteristics, including alcohol consumption and exposure to stressors. Results presented here, therefore, do not necessarily apply to ethnic minorities. The exclusion of institutionalized individuals is far less likely to have affected our conclusions since the proportion of individuals in institutions in the age range 15-74 is small.

Generalizability of the study results to the rest of the country requires careful consideration due to the fact that in the area in which the study was conducted—Eindhoven and surroundings in the southeast of The Netherlands—the proportion of Roman Catholics is larger than that of Protestants or people with other religious affiliations. Drinking patterns and practices across religious groups differ; Roman Catholics tend to drink in a different pattern as part of their daily living, compared to Protestants (Knibbe and Swinkels, 1992). Religious affiliation could also be thought to be expressions of community life and social support. Thus, the sociodemographic characteristics of the population in which the study was conducted could in certain way limit the generalizability of the results to populations with similar religious backgrounds.

In order to generalize the results of our study to other countries, several aspects must be taken into consideration. Not only the distribution of health and the mortality risks differ across countries, but alcohol consumption levels (total volume as well as drinking pattern) are known to differ across countries as well. Self-reported health, for example, may not only depend on objective health, but also on availability of services and facilities for those disabled or in ill health, and may also have a different value across cultures, depending on how valuable health is considered. On the other hand drinking patterns also vary. Differences in the prevalence of drinking, heavy drinking, type of beverage, drinking situation, binge drinking, or the context in which drinking occurs has been reported to vary within Europe (Hupkens et al., 1993); from the Northern European countries where binge drinking is normative, to Southern Europe, characterized for daily drinking, or to differences in the beverage choice. Denmark, Germany, The Netherlands, the United Kingdom, Ireland and Belgium are typical beer drinking countries and are in the middle range of per capita consumption between the low consumption Scandinavian countries and the high consumption Mediterranean countries (World Drink Trends, 1998). These differences are likely to affect the generalizability of our results. Overall, results presented here are likely to be generalizable to other countries with similar drinking pattern. In our population, for example, we found lower health risks associated with regular rather than occasional drinking. In other cultures where binge drinking is a norm, besides the purely biological effects of such drinking practices, other social factors may also play a role in the differences observed for more subjective health

measures. Similarly, as we describe in Chapter 7, part of the health differences observed by type of beverage were explained by lifestyle characteristics of the respondents. Despite the chemical composition of the different beverages, other aspects of the drinking pattern associated with the beverages and other lifestyle characteristics of the respondents could affect the differential effects observed across countries.

Furthermore, the relationship between stressors and alcohol consumption could also be thought to vary across cultures. Alcohol may not be used as coping mechanisms in societies where family relationships or social networks are the bases for community life. However, strong social ties or networks could also be reflected in an increase in alcohol consumption (increase the number of social-drinking occasions). Research in other cultural contexts should be conducted in order to clarify whether the relationship between stressors and alcohol consumption presented here are also valid in other cultures.

10.3. Alcohol consumption and health: contributions to the explanation of the U-shaped curve

We analyzed the relationship between alcohol consumption and subjective as well as objective health measures. We also investigated the health differences among drinkers with different drinking patterns and studied the relationship between alcohol consumption and a number of psychosocial stressors. In this section, we shall discuss the contribution of our work to the explanation of the U-shaped curve.

Part I: Alcohol consumption and health: various health measures and alcohol drinking patterns

Chapter 3: Subjective health measures

The relationship between alcohol consumption and health has been widely studied. Most of the studies found health benefits associated with light-moderate drinking; light and moderate drinkers experience lower mortality rates, lower risks for myocardial infarction, stroke or cardiovascular diseases (Marmot et al., 1981; Marques-Vidal et al., 1996; Stampfer et al., 1988). In our study, in addition to lower mortality rates we observed that light-moderate drinkers were better off than either abstainers or heavy drinkers with regard to subjective health.

How does the study of the relationship between alcohol consumption and subjective health measures contribute to the explanation of the U-shaped curve? As we mentioned in the introduction of this thesis, if the same curvilinear pattern would not be observed for subjective health, one may speculate that only some kind of biological mechanism underlies the effects of alcohol on health. If, on the contrary, the same curvilinear relationship is found for subjective health measures, one may speculate that some other kind of mechanism (i.e. psychological, social, cultural) contributes to the explanation of the relationship as well, at least

for these subjective health measures. In our study we found a curvilinear relationship for objective as well as for subjective health measures, and as we shall discuss below, we proposed and assessed the possibility that a non-biological mechanism, based on the stress-buffering effects of light-moderate drinking, would contribute to the explanation of the U-shaped curve (Part II of this thesis).

In most of the studies conducted to date in the context of the U-shaped curve, drinkers have been categorized according to their average alcohol intake, calculated either in glasses per week or grams per month or any other equivalent measure. These methods of categorizing individuals tend to group together drinkers with very different drinking pattern. Someone who consumes one or two glasses of wine everyday is grouped together with someone who drinks six glasses of beer once or twice per week, since their average alcohol consumption is comparable. Differences in drinking pattern may also result in health differences within drinkers. How would drinking pattern contribute to the U-shaped curve? To answer this question we first examined the drinking pattern of drinkers with different average intakes (Table 10.1). We also studied the relationship between alcohol consumption and health, with and without accounting for these differences in drinking pattern (Table 10.2). Are heavy drinkers more likely than light-moderate drinkers to report drinking pattern associated with adverse health consequences (frequent heavy drinking episodes, occasional drinking, drinking beverages other than wine or beer)? If so, do these differences in pattern contribute to the explanation for their elevated health risk?

In our study several aspects of drinking pattern—namely, frequency of heavy drinking episodes, frequency of alcohol consumption and type of beverage consumed were examined. Below we shall discuss the contribution of each of these aspects of drinking pattern to the explanation of the U-shaped curve.

Table 10.1 Description of the population by average alcohol intake and drinking pattern (n and %)

	Light drinkers (1-14 units/week)		Moderate drinkers (15-28 units/week)		Heavy drinkers (≥29 units/week)	
	n	%	n	%	n	%
Heavy drinking episodes						
≥5 times/week	30	0,3	30	1,6	336	36,5
3-4 times/week	55	0,5	182	9,9	219	23,8
1-2 times/week	864	8,1	706	38,5	163	17,7
1-3 times/month	1112	10,5	262	14,3	54	5,9
3-5 times/6 months	946	8,9	142	7,8	20	2,2
1-2 times/6 months	1047	9,8	95	5,2	29	3,1
0 times/6 months	6579	61,9	415	22,7	100	10,9
Frequency of the consumption						
6-7 days/week	1330	12,5	823	44,9	696	75,4
3-5 days/week	2255	21,2	610	33,3	227	24,6
1-2 days/week	7074	66,4	401	21,9	0	0,0
Type of beverage						
Beer	3190	30,0	943	51,5	586	63,5
Wine	3702	34,8	397	21,7	123	13,3
Mixed drinks/spirits	1670	15,7	226	12,3	89	9,6
Varies all the time	2064	19,4	264	14,4	125	13,5

Note: the categorization of the variables is the same as the one used in Chapters 3, 5 and 6.

The first aspect of the drinking pattern that we shall discuss concerns the frequency of heavy drinking episodes. In Chapter 3 we observed that heavy-drinking episodes were related to mortality and not to subjective health measures, accounting for average alcohol intake. But what is the contribution of frequency of heavy drinking episodes to the explanation of the U-shaped curve? In Table 10.1, we observed that heavy drinkers were more likely to engage in frequent heavy drinking episodes compared to light or moderate drinkers. Among heavy drinkers, 36.5 percent reported drinking six or more glasses on one occasion as often as 5 or more times per week. This proportion was below 2 percent among moderate drinkers and was only 0.3 percent among light drinkers. But to what extent do these differences in the frequency of heavy drinking episodes contribute to the explanation of the U-shaped curve? To answer this question, two logistic regression models were constructed (Model 1 and Model 2 in Table 10.2). The aim was to assess health differences within drinkers with and without accounting for differences in the frequency with which they reported heavy drinking episodes (abstainers were excluded). The first model contained only average intake (independent variable) and age and gender as covariates. In Model 2, we further accounted for the role of frequency of heavy drinking episodes.

Table 10.2 The contribution of drinking pattern to the explanation of the U-shaped curve

	Model 1		Model 2		Model 3		Model 4	
	O.R.	95% CI	O.R.	95% CI	O.R.	95% CI	O.R.	95% CI
Mortality								
Light drinkers	1,00	(reference)	1,00	(reference)	1,00	(reference)	1,00	(reference)
Moderate drinkers	1,07	(0,84-1,36)	1,01	(0,78-1,31)	1,15	(0,88-1,49)	1,06	(0,83-1,34)
Heavy drinkers	1,46	(1,11-1,92)	1,04	(0,71-1,51)	1,57	(1,15-2,14)	1,42	(1,08-1,88)
Perceived general health								
Light drinkers	1,00	(reference)	1,00	(reference)	1,00	(reference)	1,00	(reference)
Moderate drinkers	1,05	(0,93-1,18)	0,97	(0,85-1,10)	1,25	(1,10-1,43)	1,02	(0,91-1,16)
Heavy drinkers	1,27	(1,08-1,48)	1,06	(0,86-1,30)	1,66	(1,39-1,98)	1,21	(1,03-1,41)
Health complaints								
Light drinkers	1,00	(reference)	1,00	(reference)	1,00	(reference)	1,00	(reference)
Moderate drinkers	1,06	(0,95-1,18)	0,95	(0,84-1,07)	1,23	(1,09-1,39)	1,05	(0,94-1,18)
Heavy drinkers	1,29	(1,12-1,50)	0,96	(0,79-1,17)	1,62	(1,38-1,92)	1,28	(1,10-1,48)
Chronic conditions								
Light drinkers	1,00	(reference)	1,00	(reference)	1,00	(reference)	1,00	(reference)
Moderate drinkers	1,07	(0,96-1,18)	1,10	(0,98-1,23)	1,13	(1,01-1,27)	1,08	(0,97-1,20)
Heavy drinkers	1,05	(0,91-1,20)	1,11	(0,92-1,33)	1,13	(0,96-1,32)	1,08	(0,94-1,20)

Model 1: adjusted for age and gender.

Model 2: Model 1 + frequency of heavy drinking episodes.

Model 3: Model 1 + frequency of alcohol consumption.

Model 4: Model 1 + type of beverage consumed.

The inclusion of frequency of heavy drinking episodes in the model for the relationship between alcohol consumption and health resulted in a reduction in the value of the odds ratio (OR) for the health risk for heavy drinkers for mortality, perceived general health and health complaints. Although for chronic conditions an increase in the value of the odds ratio was found after accounting for frequency of heavy drinking episodes, results should be interpreted cautiously due to the low number of respondents included in the different frequency categories (see Table 3.2.). Our results suggested that frequency of heavy drinking episodes contributed to the explanation of the elevated health risk among heavy drinkers for mortality, perceived general health and health complaints. Heavy drinkers were no longer at higher health risk than light drinkers when frequency of heavy drinking episodes were accounted for; in other words, the health risk of heavy drinkers was largely explained by frequency of heavy drinking episodes.

Chapter 4: Occasional versus regular drinking

As we mentioned above, differences in the drinking patterns across categories of average alcohol intake may result in health differences. Researchers looking at mortality, stroke, myocardial infarction or other objective health measures have reported that regular drinkers are better off than occasional drinkers (Palomaki & Kaste, 1993; Hendriks et al., 1994; Kauhanen et al., 1997). As stated in Chapter 4, we also found that regular drinkers were better off than occasional drinkers with respect to subjective health, accounting for differences in average alcohol intake. Regular drinking was associated with larger health benefits than sporadic drinking, at a given level of consumption.

What is the contribution of regularity of the consumption to the explanation of the U-shaped curve? As presented in Table 10.1., 75.4 percent of heavy drinkers reported drinking 6-7 days per week; the proportion of moderate drinkers consuming alcohol 6-7 days per week was 44.9 and the proportion only reached 12.5 percent among light drinkers. In order to assess the role of regularity of the consumption in the explanation of the U-shaped curve, we constructed two logistic regression models. In the first one (Table 10.2, Model 1), the relationship between alcohol intake and health was examined accounting only for age and gender differences; in the second one (Table 10.2., Model 3), frequency of the consumption was additionally added to the logistic regression model. To assess the role of frequency of the consumption in the explanation of the U-shaped curve, the odds ratios in Model 3 should be compared with those in Model 1 (Table 10.2). The odds ratio for mortality as well as for each of the subjective ill health measures was larger in the model including frequency of the consumption than in the model accounting only for age and gender. Because the majority of heavy drinkers drink regularly (see Table 10.1), their health risk without accounting for regularity of the consumption is lower than the risk

accounting for it (e.g., for mortality, the odds ratio of 1.46 without accounting for regularity of the consumption and 1.57 accounting for it). This finding suggests that the risk observed among heavy drinkers would be even larger if they did not drink regularly. Regularity of the consumption, therefore, seemed not to contribute to the explanation of the elevated risk for subjective ill health associated with heavy drinking.

Chapter 5: Type of beverage

Another aspect of drinking pattern, type of beverage, has also been studied in relation to health. The literature regarding health differences by type of beverage, however, shows inconsistent results. Some studies favored wine against other beverages whereas in other studies, the largest benefits were observed among beer or spirits drinkers (Rimm et al., 1996; Wannamethee & Shaper, 1999; Gronbaek et al., 1995). In our study we explored differences in terms of mortality and also with respect to subjective health measures. Wine drinkers (and to a lesser extent beer drinkers) were observed to be better off than drinkers of other beverages. What is the contribution of type of beverage to the explanation of the U-shaped curve? In the first place, we assessed whether heavy drinkers were characterized by the consumption of those alcoholic beverages that were adversely related to health (beverages other than wine). Heavy drinkers were observed to drink mainly beer (see Table 10.1); the proportion of wine drinkers (the healthiest beverage type in our study, according to the results presented in Chapter 5), was larger among light drinkers than either among moderate or heavy drinkers.

In order to assess the contribution of type of beverage to the explanation of the U-shaped curve, we compared two logistic regression models, one in which the association between alcohol intake and health is adjusted exclusively for age and gender (Model 1 in Table 10.2) and a second one, (Model 4 in Table 10.2), where we further accounted for the differences in type of beverage consumed. Despite the fact that the proportion of wine drinkers was higher among light drinkers than among moderate or heavier drinkers (Table 10.1), choice of beverage type did not seem to contribute to the explanation of the U-shaped curve, since no change in the values of the odds ratios was observed between Model 1 and Model 4.

Chapter 6: The health risk of abstainers

Selection had also been mentioned as a possible explanation for the elevated health risk among abstainers. Early studies in the field were criticized for not being able to distinguish within the group of abstainers those who were former drinkers, especially those who had stopped drinking due to ill health (sick-quitters), and those who were life-long abstainers (selection). Studies in which this distinction was possible, however, still pointed out higher health risks among abstainers for objective health measures. The contribution of former drinkers and of sick-quitters to the explanation of the health risk among abstainers for

subjective health measures had not been studied before. Our results were consistent with those reported for objective health measures; although the presence of former drinkers and sick-quitters contributed to the explanation of the elevated health risk for subjective health measures among abstainers, long-term abstainers were still observed to be at higher risk for subjective ill health than light-moderate drinkers. Results reported here were only partly explained by a selection mechanism.

Confounding was also considered an explanation for the elevated health risk among abstainers for objective health measures. Abstainers have been reported to differ from light-moderate drinkers in a number of characteristics (Hart et al., 1999; Fillmore et al., 1998; Mertens et al., 1996; Skog, 1996). These characteristics could be thought to be responsible for their health differences. In the present study, although socio-demographic and behavioral characteristics contributed partly to the explanation of the elevated risk for subjective ill health among abstainers, after accounting for these characteristics, abstainers were still observed to have higher health risks than light-moderate drinkers.

In the light of the results presented here, we concluded that the U-shaped curve for subjective health is not fully explained either by selection or by confounding. After removing former drinkers and sick-quitters from the group of abstainers and accounting for differences in socio-demographic and behavioral characteristics, abstainers were still observed to be at higher risk for subjective ill health than drinkers. Thus, besides selection and confounding, causation seemed to play a role in the explanation of the relationship between alcohol consumption and subjective ill health.

Part II: The role of psychosocial stressors and the stress-buffering effects of alcohol consumption

As explained above, the fact that the same curvilinear pattern described the relationship between alcohol consumption and mortality and also the relationship between alcohol consumption and subjective health measures was considered an indication for the existence of a non-purely biological mechanism for the explanation of the U-shaped curve. In the second part of this thesis we proposed and explored the possibility that a non-biological mechanism, based on the stress-buffering effects of alcohol consumption would contribute to the explanation of the U-shaped curve.

Chapter 7: Stressful life-events and chronic stressors in relation to alcohol consumption

The first step taken in this direction consisted in the study of the prevalence of psychosocial stressors among abstainers and heavy drinkers (the two ends of the U-shaped curves). In Chapter 7 we described how some life-events and some chronic stressors were related both to abstinence and heavy drinking. In this section, we shall examine the contribution of these stressors to the explanation of the U-shaped

curve. In order to do so, we constructed two logistic regression models; in the first one we studied the relationship between alcohol consumption and health (abstainers as a reference category) accounting only for age and gender differences; in the second model the results were additionally adjusted for life-events and chronic stressors (see Table 10.3). In order to assess quantitatively the contribution of these stressors to the explanation of the U-shaped curve, the odds ratios of the two logistic regression models were compared using the following formula: OR Model 1 - OR Model 2 / OR Model 1 - 1.

Table 10.3 The contribution of life-events and chronic stressors to the U-shaped curve

	Model 1		Model 2	
	O.R.	95% CI	O.R.	95% CI
Mortality				
Abstainers	1,00	(reference)	1,00	(reference)
Light drinkers	0,70	(0,60-0,81)	0,80	(0,68-0,95)
Moderate drinkers	0,73	(0,57-0,95)	0,83	(0,63-1,09)
Heavy drinkers	1,00	(0,75-1,34)	1,07	(0,78-1,47)
Perceived general health				
Abstainers	1,00	(reference)	1,00	(reference)
Light drinkers	0,47	(0,43-0,51)	0,53	(0,48-0,58)
Moderate drinkers	0,48	(0,43-0,55)	0,55	(0,47-0,64)
Heavy drinkers	0,58	(0,49-0,69)	0,61	(0,51-0,73)
Health complaints				
Abstainers	1,00	(reference)	1,00	(reference)
Light drinkers	0,64	(0,59-0,69)	0,71	(0,65-0,77)
Moderate drinkers	0,67	(0,59-0,75)	0,74	(0,65-0,84)
Heavy drinkers	0,80	(0,69-0,93)	0,86	(0,72-1,01)
Chronic conditions				
Abstainers	1,00	(reference)	1,00	(reference)
Light drinkers	0,79	(0,74-0,86)	0,82	(0,76-0,89)
Moderate drinkers	0,83	(0,74-0,93)	0,85	(0,75-0,96)
Heavy drinkers	0,81	(0,70-0,94)	0,82	(0,69-0,96)

Model 1: adjusted for age and gender.

Model 2: Model 1 + life-events + chronic stressors

Note: when adjusting for life-events and chronic stressors, those life-events that have their chronic counterpart were excluded ("loosing one's job", "death of one's partner" and "divorce").

Accounting for differences in life-events and chronic stressors resulted in change in the point estimates (Model 1 compared to Model 2); the odds ratio for light drinkers increased by 33.3% for mortality, by 11.3% for perceived general health, by 19.4% for health complaints and by 14.3% for chronic conditions. The corresponding proportions for moderate drinkers were 37%, 13.5%, 21.2% and 11.8% respectively. Additional analyses showed that the contribution of chronic stressors was somewhat larger than the contribution of life-events (results not shown). Results presented here indicate a reduction in the beneficial effects of light-moderate consumption when accounting for the differences in psychosocial stressors; in other words, psychosocial stressors partly contributed to the explanation of the health benefits associated with light-moderate drinking.

Chapter 8: Adverse working conditions and alcohol consumption

In our study, we also analyzed the relationship between alcohol consumption and adverse working conditions in the working population. In order to assess the contribution of these adverse working conditions to the explanation of the U-shaped curve, we conducted some additional analysis. In these analyses, we compared the health risk of light, moderate and heavy drinkers with that of abstainers (in the working population), with and without accounting for adverse working conditions (results not shown). Similarly to what we observed with regard to life-events and chronic stressors, results from our study suggested that adverse working conditions contributed partly to the explanation of the U-shaped curve in the working population.

Chapter 9: The stress-buffering effects of alcohol consumption

Furthermore, we proposed an alternative explanation to the U-shaped curve based on the stress-buffering effects of light-moderate drinking. Even though this possibility had been proposed before, it had not been tested. If light-moderate drinking buffered the effects of stressors on health, light-moderate drinkers would be less likely to suffer the effects of stressors on health than either abstainers or heavier drinkers. Although in our study some stressors were positively related with abstinence and also with heavy drinking, we found only little evidence to support the hypothesis that the stress-buffering effects of alcohol would contribute to the explanation of the U-shaped curve (see Chapter 9).

Summarizing, several conclusions could be drawn from our study:

- A U-shaped curve described the relationship between alcohol consumption and mortality but also the relationship between alcohol consumption and subjective health measures; light-moderate drinkers not only seemed to have lower mortality rates than either abstainers or heavy drinkers, but they seemed to enjoy better subjective health.

- Regular drinking was associated with larger subjective health benefits than sporadic drinking at any given level of consumption.
- Wine drinkers (and to a lesser extent beer drinkers) had lower mortality rates and also lower risk for subjective ill health than drinkers of other beverages.
- Some characteristics of drinking pattern, such as frequency of heavy drinking episodes, contributed to the explanation of the elevated health risk observed among heavy drinkers. On the contrary regularity of the consumption and type of beverage consumed did not contribute to the explanation of the U-shaped curve.
- The presence of former drinkers and of sick-quitters in the group of abstainers (selection) partly explained the elevated risk for subjective ill health among abstainers.
- Socio-demographic and behavioral characteristics differentiating abstainers and drinkers (confounding) also contributed partly to the explanation of the elevated risk for subjective ill health observed among abstainers.
- The elevated risk for subjective ill health observed among abstainers was not fully explained by either selection or confounding. Thus, besides selection and confounding, causation seemed to play a role in the explanation of the relationship between alcohol consumption and subjective ill health.
- Some life-events and some chronic stressors were related both to abstinence and heavy drinking (the two ends of the U-shaped curve). Individuals reporting adverse working conditions were also more likely to be heavy drinkers than light-moderate drinkers.
- Psychosocial stressors partly contributed to the explanation of the health benefits associated with light-moderate drinking.
- We found only little evidence to support that alcohol buffers the effect of stressors on health. Thus, the stress-buffering effects of alcohol consumption did not contribute substantially to the explanation of the U-shaped curve.

10.4 Policy implications

Several conclusions can be drawn from our study results from the public health standpoint, aiming at reducing alcohol-related harm to society and individuals. A large number of studies have shown that light-moderate drinkers experience lower mortality rates than abstainers and heavy drinkers. This finding is largely due to the lower risk of cardiovascular diseases among light-moderate drinkers. At high levels of consumption, the health benefits of alcohol are counterbalanced by its concomitant adverse effects on health (such as liver disease, cancers of the oral cavity, throat and larynx, injuries, poisoning, etc.). In the present study, light-moderate drinking was associated not only with lower mortality risk, but also with better subjective health as compared to

abstinence or heavy drinking. Additionally, our results suggested that the relationship between alcohol consumption and health seems to be partly a causal one.

Based on our results, it seems clear that certain drinking patterns, such as binge drinking or heavy drinking episodes, or sporadic drinking are associated with adverse physical health measures. Heavy drinkers, in addition to reducing their alcohol intake should also be encouraged to change their drinking pattern. In addition to heavy drinkers, the population at large should be targeted when aiming at reducing the adverse effects of certain drinking patterns. This opens the possibilities for preventive and intervention measures for the population, since not only heavy drinkers but also light drinkers should be targeted. As it has been demonstrated in other studies, the adverse effects of such drinking patterns are not restricted to health matters but apply to other areas such as drink-driving, violence, crime or family problems. By intervening on these drinking patterns, therefore, we would achieve benefits for the individual as well for the society at large.

What are the public health implications of a reduced mortality risk and reduced risk for subjective ill health among light and moderate drinkers? Would a message suggesting that 'moderate drinking is good for you' be adequate? What would be the consequences for the drinkers? And for the abstainers? As has been reported in the literature, such a measure would serve as an "excuse" for drinkers to increase or justify their drinking (Skog, 1996). Consequently, it is likely that such a public health message results in a shift of the drinking distribution to the right, provoking an increase in consumption. Populations with high average alcohol consumption are also populations with high rates of alcohol-related problems (Skog, 1996). On the other hand, if as a result of a public health message encouraging moderate alcohol use abstainers would start drinking, they would be at risk for developing alcohol-related problems, alcoholism and other complications associated with alcohol use. Therefore, instead of achieving a reduction in harm at a population level, the opposite effect would be achieved.

One of the controversial aspects when adopting a policy towards moderate drinking lies in the limitations when extrapolating results from individual studies to the population. It has been suggested that an optimal level for an individual may be too much for a population, given the distribution of alcohol consumption in a particular population (Skog, 1996). Furthermore, it should also be noted that the consequences of alcohol use vary from one individual to the other. While light-moderate drinking may prove beneficial for an individual, under certain circumstances it has also been associated with adverse consequences, even at low levels of consumption. One clear example is pregnant women, who should be recommended to abstain given the risk for Fetal Alcohol Syndrome reported even at low levels of consumption. Other populations, such as those at risk for developing alcohol dependence, or

with specific diseases for which alcohol is known to be contra-indicated should rather abstain.

When evaluating the public health consequences of a message promoting moderate alcohol use, one should not be limited to health-related aspects. The social and psychological problems associated with adverse drinking patterns could actually be of greater importance than the health consequences of alcohol use from a public health standpoint. The burden of family disruption, violence, crime, or being a victim of a road traffic accident caused by a drunk-driver therefore, must be kept in mind when discussing policy implications of alcohol use.

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SUMMARY

Summary

Introduction

The relationship between alcohol consumption and health has been widely studied. Most of the studies conducted to date reported health benefits associated with light-moderate doses of alcohol. Given the shape of the association, the relationship between alcohol consumption and health is often described as being U- or J-shaped. Although results seem to be consistent and have been replicated with case-control and prospective study-designs, in various countries, in both gender categories and across racial groups, the explanation of the findings is not yet well understood. With this study we aimed at gaining insight into the understanding of the mechanisms underlying the U-shaped curve.

We assessed the relationship between alcohol consumption and mortality but we added to the picture subjective health measures such as perceived general health, health complaints and chronic conditions. We studied the role of drinking pattern and of psychosocial stressors in the explanation of the U-shaped curve and we proposed and assess the possibility that the stress-buffering effects of alcohol consumption explained the lower health risk observed for light-moderate drinkers.

Data source

For the present study data from the GLOBE study was used. The GLOBE study is a longitudinal study conducted in the South East region of The Netherlands in 1991, aiming at investigating the health and living conditions of the population of Eindhoven and its surroundings. For the baseline data-collection, a response rate of 70,1% was achieved, which allowed the study to be conducted with a very large sample of 18,973 individuals. Detailed information on alcohol consumption as well as on health and other socio-demographic and behavioral factors were collected by means of a questionnaire; in order to obtain a more complete assessment of some specific factors (certain health and personality characteristics) additional personal interviews were conducted. For the present study, information collected also in one of the follow-up measurements, in 1997, was used to categorize individuals according to whether or not they were long-term abstainers or former drinkers and to study the possible health differences between these two groups.

Results

In Chapter 3 of this thesis we studied the association between alcohol consumption and a number of health indicators: mortality, perceived general health, health complaints, chronic conditions and the Nottingham health profile. In agreement with results presented by other researches, in our study, a J-shaped curve described the relationship

between alcohol consumption and mortality. We also found the same curvilinear pattern (U- or J-shaped) for subjective health measures. Light and moderate drinkers had lower mortality rates and enjoyed better subjective health than either abstainers or heavy drinkers.

Most of the studies conducted to date have classified individuals according to their average alcohol intake, disregarding other aspects of drinking pattern that could influence health. Someone who consumes one or two glasses of wine everyday is grouped together with someone who drinks six glasses of whiskey once or twice per week, since their average alcohol intake is comparable. These differences in drinking pattern could also be reflected in health differences within the drinkers. In our study, several aspects of drinking pattern, namely, heavy drinking episodes, frequency of the consumption and type of beverage consumed were studied.

In Chapter 3, frequent heavy drinking episodes were positively associated with increased mortality rates but did not seem to be related to other subjective health measures.

In Chapter 4 we assessed the health differences between drinkers of comparable average intakes and different drinking frequencies. The role of frequency of the consumption in determining the health consequences of drinking was also assessed. We found that at any given level of alcohol intake, regular drinkers were better off than sporadic drinkers.

In Chapter 5, we studied health differences in terms of mortality and subjective health measures among drinkers of different beverage-types. Wine drinkers, and to a lesser extent beer drinkers, were observed to be better off than drinkers of other beverages, after accounting for average alcohol intake. Although differences in drinking pattern did not seem to be responsible for the health differences observed, other socio-demographic and behavioral characteristics distinguishing drinkers of different beverage types contributed to the explanation of the health differences observed by type of beverage.

In Chapter 6 we assessed the contribution of former drinkers and sick-quitters to the explanation of the elevated health risk observed among abstainers for subjective health measures. We also explored the possibility that confounding would explain the differences in subjective ill health between abstainers and drinkers. In our study, both selection and confounding contributed partly to the explanation of the elevated risk for subjective ill health among abstainers. However, after removing former drinkers and sick-quitters from the group of abstainers (selection) and accounting for socio-demographic and behavioral differences (confounding), abstainers were still observed to be at higher risk for subjective ill health than drinkers. Thus, besides selection and confounding, causation seemed to play a role in the explanation of the relationship between alcohol consumption and subjective ill health.

The fact that the same curvilinear pattern was observed for the

relationship between alcohol consumption and mortality but also the relationship between alcohol consumption and subjective health measures was considered an indication for the existence of a non-purely biological mechanism for the explanation of the U-shaped curve. In the second part of the present study we proposed a model based on the stress-buffering effects of alcohol on health. The first step taken in this direction consisted in the study of the prevalence of psychosocial stressors among abstainers and heavy drinkers (the two ends of the U-shaped curves).

In Chapter 7, some life-events and also some chronic stressors were related to both, abstinence and heavy drinking. Abstainers and heavy drinkers were not only at higher health risk but they were also more likely to report adverse life-events and chronic stressors.

In Chapter 8, another type of stressor, adverse working conditions, was studied in association with abstinence and heavy drinking in the working population. Individuals working in highly adverse physical working conditions and those who reported high demands at work were observed to be more likely to drink heavily than to drink light-moderately. However, we failed to find a relationship between adverse working conditions and abstinence.

In Chapter 9 we proposed and tested the hypothesis that health benefits for light-moderate drinkers would be due to the fact that light-moderate alcohol consumption buffers the effects of stressors on health. In our study, we found only little evidence to support this hypothesis.

Contributions to the explanation of the U-shaped curve

The discussion of our results and the main conclusions of our study are exposed in Chapter 10 of this thesis. We observed that some characteristics of the drinking pattern, such as frequency of heavy drinking episodes contributed to the explanation of the U-shaped curve, by explaining the elevated health risk among heavy drinkers. Other aspects of drinking pattern, such as regularity of the consumption or type of beverage consumed, on the contrary, did not contribute to the explanation of the U-shaped curve.

The elevated health risk among abstainers was also an issue of study in this thesis. Selection and confounding contributed partly to the explanation of the elevated health risk among abstainers. However, neither of these two mechanisms fully explained the elevated health risk among abstainers and thus, besides selection and confounding, causation seemed to play a role in the explanation of the relationship between alcohol consumption and subjective ill health.

Psychosocial stressors (life-events, chronic stressors and adverse working conditions) were observed to contribute to the explanation of the U-shaped curve. However, we found no evidence to support the hypothesis that light-moderate alcohol consumption buffers the effects of stressors on health.

From the public health standpoint, our findings have several implications. In the first place, certain drinking patterns, such as binge drinking or heavy drinking episodes and also sporadic drinking, in addition to the already known adverse social consequences, were associated with adverse physical health measures. These findings should be used to prevent adverse drinking patterns, not only among heavy drinkers, but also among the total drinking population. Secondly, although our study supported that light-moderate drinking was associated with larger health benefits than abstinence, as we argued in Chapter 10, this finding should not be translated into a public health message encouraging light-moderate drinking. Such a message is likely to increase harm rather than to reduce it at the population level.

SAMENVATTING

Samenvatting

Inleiding

De relatie tussen het gebruik van alcohol en gezondheid is uitgebreid onderzocht. De resultaten van eerder verschenen onderzoeken wezen uit dat matig alcoholgebruik gunstige invloeden heeft op de gezondheid. De relatie tussen het gebruik van alcohol en het effect op de gezondheid wordt veelal beschreven door middel van een U- of een J-vormig verband. Ondanks de consistentie van de resultaten die zowel door middel van patiënt-controle onderzoeken als prospectieve studies onderzocht zijn in verscheidene landen, onder mannen en vrouwen en onder verschillende etnische groepen, was de verklaring van de bevindingen niet bevredigend.

Door middel van dit onderzoek hebben we getracht inzicht te verschaffen in het mechanisme wat ten grondslag ligt aan de U-vormige relatie. De relatie tussen het gebruik van alcohol en mortaliteit is onderzocht. Daarnaast hebben we subjectieve gezondheidsmaten zoals algemene gezondheidstoestand, gezondheidsklachten en chronische aandoeningen aan het model toegevoegd. Vervolgens hebben we de rol van drinkpatroon en psychosociale stress- veroorzakende factoren als mogelijk verklaring voor de U-vormige relatie onderzocht. Ook is de mogelijkheid onderzocht dat de stress-verlagende effecten van alcoholgebruik het risico op gezondheidsklachten bij licht-matig gebruikers verlaagt.

Onderzoekspopulatie

Het onderzoek dat ten grondslag lag aan dit proefschrift is uitgevoerd door gebruik te maken van gegevens van het GLOBE-onderzoek. Het GLOBE-onderzoek is een longitudinaal onderzoek, uitgevoerd in 1991 in een Zuid-Oostelijk gebied van Nederland. Het doel van het GLOBE-onderzoek was het onderzoeken van de gezondheid en levensomstandigheden van de bevolking van Eindhoven en omgeving.

Van 18.973 personen (response 70.1%) werden de gegevens verzameld. Gedetailleerde informatie op het gebied van alcoholconsumptie, gezondheid, socio-demografische en gedragsfactoren werd verzameld door middel van een vragenlijst. Teneinde complete informatie over specifieke factoren te verkrijgen (bepaalde gezondheids- en persoonlijkheidskarakteristieken) werden de deelnemers persoonlijk geïnterviewd.

Om te bepalen of personen geclassificeerd konden worden als langdurige onthouders of vroegere gebruikers van alcohol, en om mogelijke gezondheidverschillen tussen deze twee groepen te onderzoeken, zijn gegevens gebruikt van de follow-up meting die in 1997 heeft plaatsgevonden.

Resultaten

In hoofdstuk 3 van dit proefschrift hebben we de relatie onderzocht tussen het gebruik van alcohol en een aantal gezondheidsindicatoren: mortaliteit, perceptie van de gezondheid, gezondheidsklachten, chronische ziekten en het Nottingham gezondheidsprofiel. De resultaten van ons onderzoek toonden, in overeenstemming met eerdere bevindingen van andere onderzoekers, een J-vormig verband tussen het gebruik van alcohol en mortaliteit aan. Hetzelfde curvilineaire verband (U- of J-vormig) werd gevonden voor subjectieve gezondheidsmaten. De sterfte bij lichte en matige alcoholgebruikers was lager. Zij voelden zich eveneens gezonder dan personen die geen alcohol gebruikten en dan zware drinkers.

De meeste onderzoeken die tot dusverre zijn uitgevoerd hebben de onderzoekspersonen geassocieerd op basis van hun gemiddelde alcoholinname. Hierbij wordt geen rekening gehouden met andere aspecten van het drinkpatroon die van invloed kunnen zijn op de gezondheid. Een persoon die één of twee glazen wijn per dag drinkt, wordt dan vergelijkbaar geacht met een persoon die één of twee maal per week zes glazen whisky drinkt, omdat de gemiddelde alcoholinname vergelijkbaar is. Deze verschillen in drinkpatroon zouden ook verschillen in gezondheid binnen de drinkers kunnen veroorzaken. In dit onderzoek hebben we verscheidene aspecten van het drinkpatroon, namelijk episodes van zwaar drankgebruik, frequentie van het alcoholgebruik en type drank, onderzocht.

Zoals beschreven in hoofdstuk 3 bleken frequente episodes van zwaar drankgebruik positief geassocieerd te zijn met een toegenomen mortaliteit. Zij leken echter niet gerelateerd te zijn aan andere subjectieve gezondheidsmaten.

In hoofdstuk 4 hebben we de gezondheidsverschillen tussen gebruikers van vergelijkbare gemiddelde hoeveelheden en verschillende gebruiksfrequenties met elkaar vergeleken. De rol van frequentie van alcoholconsumptie in relatie tot gezondheidsklachten is eveneens onderzocht. Wij vonden dat bij een gelijkgestelde alcoholinname, personen die regelmatig dronken zich beter voelden dan personen die zo nu en dan drinken.

In hoofdstuk 5 zijn de resultaten beschreven van het onderzoek waarin we gezondheidsverschillen in termen van mortaliteit en subjectieve gezondheidsmaten vergeleken hebben tussen verschillende dranksoorten. Rekening houdend met het gemiddelde alcoholgebruik, voelden gebruikers van wijn, en in mindere mate bierdrinkers, zich beter dan gebruikers van andere dranksoorten.

Ofschoon verschillen in drinkpatroon niet verantwoordelijk leken te zijn voor verschillen in gezondheid, droegen andere socio-demografische en gedragskarakteristieken bij aan de verklaring van gezondheidsverschillen tussen de verschillende dranksoorten.

In hoofdstuk 6 hebben we de bijdrage bepaald van vroegere drinkers en

personen die stopten met drinken vanwege een slechte gezondheid op het toegenomen gezondheidsrisico voor subjectieve gezondheidsmaten onder onthouders.

Eveneens werd onderzocht of confounding de verschillen in subjectieve slechte gezondheid tussen onthouders en drinkers kon verklaren. In ons onderzoek bleek zowel selectie als confounding deels bij te dragen aan de verklaring voor het verhoogde risico op subjectieve slechte gezondheid bij onthouders. Na het uitsluiten van vroegere drinkers en personen die stopten met drinken vanwege een slechte gezondheid (selectie) en rekening houdend met socio-demografische en gedragsverschillen (confounding), bleef het risico bij onthouders hoger dan bij drinkers. Naast selectie en confounding, leek een causaal verband van belang te zijn in de relatie tussen alcoholgebruik en subjectieve slechte gezondheid.

Het feit dat zowel de relatie tussen alcoholgebruik en mortaliteit als de relatie tussen alcoholgebruik en subjectieve gezondheidsmaten beschreven konden worden met behulp van een curvilineair patroon, werd gezien als een indicatie voor het bestaan van een niet geheel biologisch mechanisme voor de verklaring van het U-vormig verband. In het tweede deel van het onderzoek hebben we een model gebaseerd op de stress-verminderende effecten van alcohol op de gezondheid.

De eerste stap in deze richting was het onderzoek naar de prevalentie van psychosociale stress- veroorzakende factoren onder onthouders en zware drinkers (de twee uiteinden van de U-vormige curve).

In hoofdstuk 7 bleken enkele life-events en enkele chronische stress- veroorzakende factoren gerelateerd aan zowel onthouding als zwaar alcoholgebruik. Het risico was niet alleen hoger bij onthouders en zware drinkers, maar zij meldden ook vaker negatieve life-events en chronische stress- veroorzakende factoren.

In hoofdstuk 8 hebben we een ander type stress- veroorzakende factor, namelijk slechte arbeidsomstandigheden, onderzocht in relatie tot onthouding en zwaar drankgebruik in de werkende populatie. Personen die werken in een omgeving met zeer slechte fysieke arbeidsomstandigheden en personen die meldden dat de werkdruk te hoog was, gebruikten frequenter grote dan matige hoeveelheden. Er was geen duidelijke relatie tussen slechte arbeidsomstandigheden en onthouding. In hoofdstuk 9 hebben we de hypothese getest dat het gezondheidsvoordeel voor licht-matige alcoholgebruikers verklaard wordt door het feit dat deze hoeveelheden alcohol de effecten van stress- veroorzakende factoren op de gezondheid vermindert. In onze studie hebben we weinig bewijs gevonden dat deze hypothese ondersteunt.

Bijdrage aan de verklaring van de U-vormige relatie

De discussie van de resultaten en de conclusies van onze onderzoeken zijn beschreven in hoofdstuk 10 van dit proefschrift.

We vonden dat enkele karakteristieken van het drinkpatroon, zoals frequentie van episodes van zwaar drinken, bijdroegen aan de verklaring

van de U-vormige curve en het verhoogde gezondheidsrisico onder zware drinkers. Daarentegen droegen andere aspecten van het drinkpatroon, zoals regelmaat van consumptie of type drank, niet bij in de verklaring van de U-vormige curve.

Het verhoogde risico bij onthouders werd beschreven in dit proefschrift. Selectie en confounding vormden deels een verklaring voor het verhoogde risico bij onthouders. Echter, geen van beide mechanismen kon het verhoogde risico geheel verklaren en daarom zal naast selectie en confounding een oorzakelijke verband van belang zijn voor de verklaring van de relatie tussen alcoholgebruik en subjectieve slechte gezondheid.

De bijdrage van psychosociale stress-veroorzakende factoren (life-events, chronische stressoren en slechte arbeidsomstandigheden) aan de U-vormige relatie is onderzocht. Echter, we waren niet in staat bewijs te leveren voor de hypothese dat licht-matig alcoholgebruik het effect van stress-veroorzakende factoren op de gezondheid tegen gaat.

Vanuit het standpunt van de maatschappelijke gezondheidszorg bezien, hebben onze resultaten verscheidene implicaties. Ten eerste, bepaalde drinkpatronen, zoals in korte tijd zeer veel drinken of episoden van zwaar- of sporadisch drankgebruik, naast de reeds bekende negatieve sociale consequenties van drankgebruik, hielden verband met negatieve gezondheidsmaten. De resultaten zouden moeten worden gebruikt om slechte drinkpatronen, niet alleen onder zware drinkers maar ook in de totale populatie drinkers, te voorkomen. Ten tweede, ondanks het feit dat ons onderzoek ondersteunde dat licht-matig alcoholgebruik geassocieerd was met grotere gezondheidsvoordelen dan onthouding (hoofdstuk 10), is het niet mogelijk om dit resultaat dat licht-matig alcoholgebruik stimuleert, te vertalen in een maatschappelijk verantwoord advies. Dit advies zal op populatieniveau waarschijnlijk meer schade aanrichten dan voordelen opleveren.

Resumen

Resumen

Introducción

La relación entre el consumo de alcohol y la salud ha sido muy estudiada. La mayoría de los estudios llevados a cabo hasta la fecha coinciden en señalar efectos beneficiosos asociados con el consumo ligero o moderado de alcohol. Dada la forma de esta asociación, la relación entre el consumo de alcohol y la salud se describe a menudo como una relación en forma de U o de J. Aunque los resultados parecen ser coherentes y han sido replicados con diseños experimentales de casos y controles como con estudios longitudinales, en diversos países, entre hombres y mujeres, y en diferentes grupos raciales, los mecanismos que explican estos resultados no se conocen con claridad. Con el presente estudio nos proponemos contribuir al entendimiento de los mecanismos que actúan de fondo en la curva en forma de U entre el consumo de alcohol y la salud. Para ello, investigamos la relación entre el consumo de alcohol y la mortalidad pero también incorporamos el estudio de aspectos más subjetivos del ámbito de la salud, tales como la percepción general de la propia salud, así como las molestias o enfermedades crónicas. En nuestro estudio, analizamos el papel que desempeñan los distintos aspectos que constituyen el patrón de consumo de alcohol, así como el que desempeñan los factores psicosociales en la explicación de esta relación en forma de U, y propusimos y valoramos la posibilidad de que el consumo de alcohol, mediante sus propiedades para la amortiguación del estrés, contribuyan a la explicación del menor riesgo de salud asociado con el consumo ligero o moderado de alcohol.

Fuente de datos

Para la realización de este estudio nos servimos de los datos de un estudio llamado GLOBE. El GLOBE es un estudio longitudinal llevado a cabo en la región del sudeste de Holanda en 1991 y que tenía como objetivo principal investigar la salud y las condiciones de vida de la población de Eindhoven y de sus alrededores.

En la primera recopilación de datos del estudio se consiguió una tasa de participación del 70.1%, lo cual nos permitió disponer de una gran muestra poblacional para nuestro estudio, formada por 17.973 individuos. A través de un cuestionario se obtuvieron datos relativos al consumo de alcohol y la salud, así como sobre aspectos socio-demográficos de los participantes y otros aspectos de su conducta. Además, se llevaron a cabo entrevistas personales para la obtención de información más detallada sobre aspectos más específicos, tales como ciertos aspectos relativos a la salud o a la personalidad de los participantes.

Para el presente estudio, también hemos utilizado la información recogida en uno de los cuestionarios de seguimiento, realizado en 1997, con el

fin de poder clasificar a los participantes del estudio dependiendo de que fueran o no abstemios a largo plazo o de que hubieran dejado de beber alcohol en un pasado reciente, y de este modo estudiar las posibles diferencias a nivel de salud entre estos dos grupos.

Resultados

En el Capítulo 3 de esta tesis, estudiamos la asociación entre el consumo de alcohol y una serie de indicadores de salud: mortalidad, percepción sobre la salud general, molestias y enfermedades crónicas, así como el cuestionario Nottingham sobre salud general. De acuerdo con los resultados presentados por otros investigadores, en nuestro estudio observamos una relación en forma de J entre el consumo de alcohol y la mortalidad. El mismo patrón, una relación curvilínea (en forma de U o de J) nos sirvió para caracterizar la relación entre el consumo de alcohol y el resto de los indicadores de salud. Los bebedores ligeros o moderados se caracterizaron por tener tasas de mortalidad más bajas y por tener mejor salud a nivel subjetivo que los abstemios o los bebedores excesivos.

La mayoría de los estudios realizados hasta la fecha clasifican a los individuos en base al consumo medio de alcohol, dejando de lado otros aspectos sobre el patrón de consumo que pueden incidir sobre su salud. Una persona que bebe uno o dos vasos de vino al día y una persona que consume seis vasos de whisky en un día se agrupan dentro de la misma categoría puesto que su consumo medio de alcohol es equivalente. Estas diferencias en el patrón de consumo pueden reflejarse en diferencias a nivel de salud. En nuestro estudio hemos tenido en cuenta diversos aspectos sobre el patrón de consumo, tales como episodios de intoxicación alcohólica, la frecuencia del consumo o el tipo de bebida consumida.

En el Capítulo 3 observamos cómo aquellas personas que frecuentemente presentan episodios de intoxicación, tenían una mayor tasa de mortalidad, aunque no parecían tener mayor riesgo en cuanto a otros aspectos de salud más subjetivos.

En el Capítulo 4 estudiamos las diferencias a nivel de salud entre bebedores que teniendo el mismo consumo medio de alcohol se caracterizaban por beber con distinta frecuencia. Es decir, investigamos el papel que juega la frecuencia con la que se consume alcohol en la determinación de las consecuencias a nivel de salud. A un mismo nivel de consumo medio de alcohol, los bebedores que distribuyen el consumo a lo largo de la semana disfrutaban de mejor salud que los que concentran el consumo en menos días.

En el Capítulo 5 investigamos las posibles diferencias entre los consumidores de las distintas bebidas alcohólicas, tanto a nivel de mortalidad como con respecto a otros aspectos más subjetivos de la propia salud. De acuerdo con nuestro estudio, los consumidores de vino, y en menor medida los consumidores de cerveza, tienen mejor salud que los consumidores de otras bebidas alcohólicas. Estas diferencias no parecen

deberse a diferencias en el patrón de consumo, si no más bien a diferencias sociodemográficas y conductuales entre los consumidores de los distintos tipos de bebidas.

En el Capítulo 6, para explicar el elevado riesgo de salud a nivel subjetivo observado entre los abstemios, estudiamos la contribución de la presencia de ex-bebedores y, en especial, de aquellas personas que dejaron de beber por motivos de salud. También estudiamos la posibilidad de que otros factores extraños pudieran confundir la relación entre el consumo de alcohol y la salud, contribuyendo a explicar las diferencias observadas. En nuestro estudio, tanto la presencia de ex-bebedores como las diferencias sociodemográficas y conductuales entre bebedores y abstemios contribuyeron a la explicación del elevado riesgo de salud observado entre los abstemios. Sin embargo, después de eliminar a los ex-bebedores del grupo de los abstemios, y de tener en cuenta las diferencias sociodemográficas y conductuales, los abstemios seguían presentando un mayor riesgo sanitario que los bebedores ligeros o moderados. Por ello, parece que detrás de la explicación de dicho riesgo hay factores de causalidad.

El hecho de que se presentara la misma forma curvilínea en la relación entre el consumo de alcohol y la mortalidad, así como entre el consumo de alcohol y aspectos relativos a la salud de carácter más subjetivo, fue considerado como un indicio de la existencia de factores que no fueran puramente biológicos en la explicación de dicha relación. En la segunda parte de esta tesis, por tanto, propusimos y pusimos a prueba un modelo basado en los efectos de amortiguación del estrés causados por el consumo de alcohol. El primer paso a seguir fue el estudio de la prevalencia de factores estresantes tanto sobre los abstemios como sobre los bebedores excesivos (los dos extremos de la U).

En el Capítulo 7, algunos acontecimientos vitales y algunos factores estresantes de carácter crónico se relacionaron con la abstinencia, por un lado, y con el consumo excesivo, por otro. Abstemios y bebedores excesivos no sólo tienen un mayor riesgo a nivel de salud, sino que también se mostraron más propensos a sufrir acontecimientos adversos y situaciones estresantes de carácter crónico, en comparación con los consumidores ligeros o moderados.

En el Capítulo 8, estudiamos la relación entre otro tipo de factor estresante, como son las condiciones laborales adversas, la abstinencia y el consumo excesivo de alcohol. Aquellas personas que ocupaban puestos de trabajo en condiciones físicas adversas y aquellas que tenían mucha presión laboral, eran más propensos a beber de manera excesiva. Sin embargo, a lo largo de nuestro estudio no encontramos relación alguna entre condiciones laborales adversas y la abstinencia.

En el Capítulo 9 propusimos y pusimos a prueba la hipótesis de que los efectos beneficiosos del consumo ligero o moderado de alcohol se debieran al hecho de que el alcohol sirve de amortiguador frente a los factores estresantes. En nuestro estudio encontramos muy poca evidencia para confirmar esta hipótesis.

Contribución a la explicación de la relación en forma de U

En el Capítulo 10 de esta tesis analizamos los resultados y presentamos las principales conclusiones de nuestro estudio. En él observamos cómo algunas características del patrón de consumo de bebidas alcohólicas, tales como la frecuencia de episodios de intoxicación, han contribuido a la explicación de la relación en forma de U entre los bebedores excesivos. Sin embargo, otros aspectos del patrón de consumo, como son la frecuencia del consumo o el tipo de bebida consumida, no parecen contribuir a la explicación de los resultados.

El alto riesgo de salud observado entre los abstemios fue también objeto de nuestro estudio. La presencia de ex-bebedores y las diferencias a nivel sociodemográfico y conductual observadas entre abstemios y bebedores explican en parte su elevado riesgo para padecer enfermedades. Sin embargo, ninguno de estos dos mecanismos sirvió para explicar completamente este riesgo y, por ello, cabe esperar un factor de causalidad como alternativa a la explicación de este riesgo.

Algunos factores psicosociales (acontecimientos adversos, factores estresantes de carácter crónico o condiciones laborales adversas) contribuyeron a la explicación de la relación en forma de U. A pesar de ello, en nuestro estudio no pudimos confirmar la hipótesis de que esta reducción del riesgo entre bebedores ligeros o moderados se deba al hecho de que el alcohol amortigüe los efectos de los factores estresantes sobre la salud.

Nuestro estudio tiene varias consecuencias desde el punto de vista de la salud pública. En primer lugar, algunos aspectos del patrón de consumo de bebidas alcohólicas, tales como los episodios de intoxicación y la distribución temporal del consumo de alcohol, están relacionados no sólo con consecuencias adversas a nivel social sino también con consecuencias adversas a nivel de salud. Estos resultados pueden ser utilizados para prevenir ciertos patrones de consumo, no sólo entre los bebedores excesivos sino entre todos los bebedores. En segundo lugar, aunque nuestro estudio mantiene que el consumo ligero y moderado de alcohol está asociado con aspectos beneficiosos a nivel de salud, tal y como discutimos en el Capítulo 10, estos resultados no deben ser interpretados como un mensaje que promueva el consumo ligero o moderado de alcohol entre la población, puesto que tal mensaje es probable que suponga un aumento en los riesgos asociados con el consumo de alcohol más que una reducción de los mismos.

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CURRICULUM VITAE

Curriculum vitae

Begoña San José was born in Bilbao, Vizcaya (Spain), on the 30th of December of 1972. In June 1995 she obtained a Psychologist degree from the University of Deusto (Vizcaya, Spain). In August the same year, she moved to The Netherlands to do her postgraduate studies; she enrolled in the Master of Sciences program of Netherlands Institute for Health Sciences (NIHES) at the Erasmus University Rotterdam (The Netherlands); in June 1996 she obtained a Masters degree in Health Services Research and in 1998 she obtained a Doctor of Sciences degree. Her research activities as a Ph.D.- student were conducted at the department of Public Health of Erasmus University and at the Addiction Research Institute Rotterdam (IVO).

