Mikko Laaksonen

INTERRELATIONSHIPS AMONG DAILY HEALTH BEHAVIOURS: TOWARDS HEALTH-RELATED LIFESTYLE

Department of Epidemiology and Health Promotion,
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Helsinki, Finland
2002

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ACADEMIC DISSERTATION

To be presented, with the permission of the Faculty of Medicine of the University of Helsinki, for public examination in Auditorium XII, University Main Building, on May 28th, 2002, at 12 o'clock noon

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National Public Health Institute and
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en vivir bien, en comer, beber y arder,
y en molestarse 10 menos posible.
A Ganivet: Cartas finlandesas, 1896-97

Suomalainen ymmärtää hyvällä elämisellä
ennen muuta syömistä, juomista ja polttamista
ja vähintä mahdollista vaivannäköä.
A Ganivet: Suomalaiskirjeita (suom. K Hirvonen)

To Katja and Zambo

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ABSTRACT

In Finland, as in other developed societies, a large proportion of deaths are attributable to a small number of health-related behaviours. Information on the occurrence of such behaviours in different subgroups of the population is essential to developing and targeting public health programmes that are aimed at altering these behaviours. While the majority of research has concentrated on one behaviour at a time, this study examines interrelationships between behaviours that contribute to multifactorial chronic diseases.

The study aims to provide a comprehensive view of the associations among daily health behaviours and sociodemographic variation in these associations among Finnish men and women during the 1990s. The behaviours are examined in a symmetric setting, so that no preference is given to any of the behaviours in advance. The study makes use of the concept of health-related lifestyle, which refers to socially structured patterns of behaviours that are relevant to health. Health-related lifestyles thus consist of a group of interrelated behaviours that are collective in the sense that they are closely linked with different sociodemographic characteristics. A number of reasons to expect that health behaviours would be interrelated can be presented. However, health behaviours also have intrinsic differences, suggesting that these behaviours might be unrelated or perhaps even inversely associated. Previous research suggests that while few people behave consistently in a healthy or unhealthy way, health behaviours are not independent of each other but tend to emerge in larger patterns. However, what these patterns might be is still largely unknown.

The data consisted of 20–64-year-old respondents to postal surveys conducted among a random sample of Finnish adults between 1991 and 1998. The annually repeated cross-sectional surveys provided 12,192 male and 13,822 female respondents. In addition, a follow-up study in 1997 among the participants in the surveys in 1989 and 1990 yielded panel data with 5081 respondents. Health behaviours included in the study were smoking, alcohol use, physical activity and dietary behaviour. In the longitudinal analyses being overweight was also examined.

Several pairwise associations between health behaviours were found. Smoking was positively associated with all unhealthy behaviours but not with being overweight. Associations between alcohol use and the other health behaviours were less clear, and for women alcohol use tended to be inversely associated with diet and overweight. Positive associations were observed between each pair of physical inactivity, unhealthy diet and overweight. However, all associations could not be reduced to pairwise associations. In both genders, a three-behaviour association between smoking, alcohol use and physical activity was found. In addition, alcohol use, physical inactivity and

unhealthy diet were associated in men. In these combinations the association between any two behaviours was different depending on the third behaviour.

Furthermore, various longitudinal associations between health behaviours were observed. Over the seven years of the follow-up, smoking at the baseline predicted all health behaviours but not being overweight in men. However, other behaviours also tended to predict smoking. In men, physical inactivity and unhealthy diet predicted each other. Overweight was not predictive of any of the unhealthy behaviours. Concurrent changes in health behaviours involved either smoking or body weight.

Although clear associations were observed between health behaviours, their distribution into different combinations was quite diverse. People behaving unhealthily in one respect were spread to numerous categories according to their other behaviours. Some combinations of unhealthy behaviours were relatively common, largely reflecting the prevalence of their individual constituents. Smoking played a central role in the associations between health behaviours. Nevertheless, the majority of smokers either only smoked or had only one additional unhealthy habit.

Sociodemographic variation in the associations between health behaviours was modest. The variation was not consistent with respect to any of the sociodemographic characteristics examined. Even when sociodemographic differences were observed, only the strength of the association varied. However, owing to an unequal sociodemographic distribution of the individual unhealthy behaviours their co-occurrence varied considerably across sociodemographic groups.

In sum, several pairwise associations between health behaviours were found both cross-sectionally and longitudinally. However, all associations could not be reduced to pairwise associations. Smoking played a primary role in determining the associations between and co-occurrence of health behaviours. Sociodemographic differences in the associations were few and the patterns of behaviour were also largely similar in men and women.

LIST OF ORIGINAL PUBLICATIONS

The thesis is based on the following original publications, which are referred to in the text by their Roman numerals (I–IV):

I Laaksonen M, Prättälä R, Karisto A. Patterns of unhealthy behaviour in Finland. European Journal of Public Health 2001;11:294–300.

II Laaksonen M, Prättälä R, Lahelma E. Sociodemographic determinants of multiple unhealthy behaviours. Scandinavian Journal of Public Health (In press).

III Laaksonen M, Lahelma E, Prättälä R. Associations among health-related behaviours: sociodemographic variation in Finland. Social and Preventive Medicine (SPM) (In press).

IV Laaksonen M, Luoto R, Helakorpi S, Uutela A. Associations between health-related behaviors: a seven-year follow-up of adults. Preventive Medicine 2002;34:162–170.

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1 INTRODUCTION

Personal behaviours markedly contribute to chronic diseases, which in Finland, as in other developed societies, constitute the major causes of morbidity and mortality (European Commission 1996, Murray and Lopez 1996, WHO 1998). Current trends suggest that such diseases continue to present the principal public health challenge for many years to come. As a response to this challenge, modifiable health behaviours are of particular concern because much of the future improvement in population health is likely to depend on favourable developments in health behaviours. While the number of factors associated with the risk of disease or the likelihood of dying is continuously increasing, a large proportion of death and disability is attributable to a small number of health-related behaviours. These behaviours include smoking, unhealthy eating, lack of regular physical activity, excessive alcohol consumption and failure to maintain appropriate body weight (McGinnis and Foege 1993, Davis et al. 1994). Information on the occurrence of these behaviours in different subgroups of the population is essential in developing and targeting public health measures that are aimed at altering these behaviours.

It is characteristic to the major chronic diseases that they may be affected by several ways of behaviour, and each behaviour may be related to several disease outcomes. The risk of adverse health consequences rises with the increasing number of unhealthy behaviours (Berkman and Breslow 1983, Brock et al. 1988, Rotevatn et al. 1989, Segovia et al. 1991). Information on the associations between health behaviours and their co-occurrence is therefore crucial. Examining associations among health behaviours may also offer new insights to understand why people engage in these behaviours. There are a number of reasons to expect that health behaviours would be interrelated. However, health behaviours can also be assumed to be unrelated or perhaps even inversely associated. People make choices that are relevant to health but are not driven by explicit health concern. The social meanings of behaviours may not always be in agreement with a consistently healthy or unhealthy way of life. Furthermore, the prevalence of health behaviours is known to vary across sociodemographic groups. Sociodemographic differences may therefore also exist in their associations, and evidence of these differences may clarify the logic of engaging in these behaviours.

The purpose of this study is to add our knowledge about the occurrence of health-related behaviours among Finnish adults. While the majority of previous research has concentrated on one behaviour at a time, the overall view of the distribution of behaviours that are central for the major chronic diseases is incomplete. This study tries to fill that gap by examining associations between health behaviours as well as their co-occurrence across various sociodemographic groups. In previous research,

the concept of health-related lifestyle has been used to denote socially structured patterns of behaviour that are relevant to health (Dean 1988, Abel 1991, Green and Kreuter 1991, Cockerham et al. 1997). Health-related lifestyle thus consists of a group of interrelated behaviours that are collective in the sense that they are closely linked with different sociodemographic characteristics (Abel et al. 2000). The study begins with an overview of the principal constituents of the health-related lifestyle concept and the use of this concept in health behaviour research. The empirical part of the study examines associations among the daily health behaviours and sociodemographic variation in these associations in Finland during the 1990s. Associations between the behaviours are examined comprehensively in a symmetric setting, so that any of the behaviours is not preferred to the others in advance. Multiple associations among the behaviours are analysed and pairwise associations between each two behaviours are examined both cross-sectionally and longitudinally.

2 CONCEPTUAL BACKGROUND

2.1 Health behaviour

The factors that centrally affect health change over time. During the last decades personal behaviours have been recognised as increasingly important determinants of health status and mortality. Epidemiological and medical research carried out over the past 50 years or so has provided systematic evidence of the impact of various behavioural practices on health status and health risks (e.g. Berkman and Breslow 1983, McGinnis and Foege 1993). Such practices include, but are not limited to, smoking, alcohol and drug use, eating habits and nutrition, exercise and physical activity, sexual risk behaviours, traffic safety, and utilisation of health services and medical care. These practices can be broadly termed health behaviours.

While the contribution of behaviours to health and illness has been known for a long time, the concept of health behaviour itself is relatively late-born. The first users of the concept were Stanislav Kasl and Sidney Cobb (1966), who distinguished health behaviour from illness behaviour and sick role behaviour, defining it as "any activity undertaken by a person believing himself to be healthy, for the purpose of preventing disease or detecting it in an asymptomatic stage". Some limitations of their definition were soon pointed out: it was reminded that health behaviour did not have to be intentional and that all people engaged in some behaviours to protect their health. Although not stated in Kasl and Cobb's original definition, only medically approved preventive behaviours were commonly regarded as health behaviour (Anderson 1988). A broader definition (Harris and Guten 1979) considered health behaviour to be any behaviour of a person, regardless of his or her perceived or actual health status, which was aimed to protect, promote or maintain his or her health, whether such behaviour was objectively effective or not.

Several divisions of health behaviour into subtypes have been suggested. One commonly adopted classification separates health-enhancing behaviours, health-maintaining behaviours and health-damaging behaviours (McQueen 1987, RUHBC 1989). Health-enhancing behaviours are consciously undertaken in order to improve health, health-maintaining behaviours are related to prevention, and health-damaging behaviours refer to harmful behaviours, such as the traditional behavioural "risk factors" for disease. In other divisions a similar distinction has also been made between conscious attempts to maintain or improve health or to prevent illness and behaviours which do not need to be intentionally health-striven, but which as regular practices of everyday life may have direct or indirect implications for health (Kickbusch 1988, Noack 1988, Dean 1989).

The above division into three subtypes also separates health-promoting behaviours from health risk behaviours. A similar division has also been commonly made elsewhere (e.g. Rakowski 1986, Waldron 1988). However, since health risk behaviours may be inverse counterparts of health-promoting behaviours, this division seems somewhat problematic. For example, smoking is regarded as harmful whereas smoking cessation or non-smoking are health promoting, and having regular physical activity is beneficial whereas sedentary behaviour is harmful. A related, equally debatable division exists between active and passive health behaviours (Gochman 1988, Krick and Sobal 1990, Karvonen 1997). Some behaviours may be labelled as health-enhancing even when they do not require active involvement or when the behaviour actually means refraining from that behaviour. In addition, many other divisions have been suggested. For example, health behaviours have been classified by their recurrence: while some behaviours require daily repetition, others are practised periodically and some may be performed only once in a lifetime (Kannas 1981, Ungemack 1994, Liang et al. 1999).

However, at the same time as these behaviours affect health and illness they also have other qualities. Many factors other than health concern influence choices that have relevance to health. All behaviours are culturally embedded and they carry various meanings. Behaviours that are relevant to health may therefore be guided by motives other than the desire to stay in good health. What health professionals consider healthy or unhealthy may have other meanings for people in the context of their everyday lives (Thorogood 1992, Calnan 1994, Lupton 1994, Davison and Davey Smith 1995, Backett and Davison 1995). Furthermore, behaviours that have adverse health consequences may also have positive connections. People may choose to engage in harmful behaviours consciously and while being well aware of their health-damaging effects, for example as a means of controlling stress or dealing with adverse material and social circumstances (Rahkonen 1994, Piispa 1997). Unhealthy behaviour may even be intentional counter-articulation and symbolic protest against the dominant way of life (Karisto 1989, Karisto et al. 1993).

Health-related choices can be deliberately and consciously made rational decisions. However, this is not always the case. A large part of our behaviour is routine and conducted more or less unthinkingly. Many choices that are relevant to health are built into the flow of everyday life so that people do not give them much thought. Furthermore, even when decisions are deliberately made people do not necessarily rationalise their behaviour on the basis of health – or any other single value (Stott and Pill 1992, Williams 1995).

The different forms of health behaviour have mostly been examined one at a time. However, the above considerations give reasons to expect that health behaviours may be interrelated. Health behaviours may reflect broader health consciousness or

attitudes towards health. The existence of a common health concern suggests consistency in healthy or unhealthy behaviour. During the last decades, the cultural value of health has increased and health issues have attracted a wide public attention, suggesting that the number of health-oriented people may have augmented (Karisto et al. 1993, Burrows et al. 1995). However, health behaviours may also be interrelated because of their other qualities. Other motives for healthy or unhealthy behaviour may even be more important than the health concern itself. At the same time, all health behaviours cannot be expected to be interrelated in a theoretically meaningful way. Health-related behaviours also have intrinsic differences, suggesting that these behaviours would be unrelated or perhaps even inversely associated. Motives for engaging in health-promoting or health-damaging behaviours are often mixed and remain unperceived even for those who practise them. The other meanings that health-related behaviours have may not always be in agreement with a consistently healthy or unhealthy way of life.

2.2 Sociodemographic differences in health behaviours

Many theoretical approaches to health behaviour have been criticised for detaching it from the social and situational context in which it occurs (RUHBC 1989, Thorogood 1992). Social factors are given, at best, a limited role while these approaches concentrate on the more proximal causes of behaviour. However, health behaviour should not only be seen as a matter of individual choice that is unrelated to socio-economic circumstances and structural conditions. Instead, health behaviour is socially and culturally conditioned and needs to be placed in a broader perspective that emphasises structural constraints as well as individual choices.

Evidence of the influence of social conditions on health behaviours is abundant. One expression of this evidence can be found at the level of broad sociodemographic categories. Health behaviours show clear differences in characteristics such as gender, age, socio-economic position, marital status and area of residence. In Finland, as in most industrialised countries, women generally behave more healthily than men, but have less free-time physical activity (Arinen et al. 1998, Aromaa et al. 1999, Helakorpi et al. 2000). Those in lower socio-economic positions engage in unhealthy behaviours more frequently than the better-off. The only important exception is alcohol consumption, as those in higher socio-economic positions generally drink more frequently and more on average than those in lower positions. Smoking and high alcohol use are more common but physical inactivity less common in younger than in older age groups. Divorced and widowed people usually behave in a more unhealthy manner than the single, who in turn behave more unhealthily than the married. Differences between living areas are relatively small and inconsistent, but they cannot be entirely explained by individual characteristics of the residents (Karvonen 1997, Berg 2000).

Sociodemographic differences in health behaviours may be due to a variety of reasons. People belonging to the different sociodemographic groups may differ in their personal characteristics or the differences may arise from the social and cultural environment itself (Umberson 1992, Macintyre et al. 1993, Macintyre 1997). Sociodemographic groups differ in the range of options for health behaviours that are possible and appropriate. The resources and constraints that limit or enable health behaviours can be considered in terms of material circumstances, but also in terms of customs and traditions. The social living environment may provide specific cultural norms that determine appropriate behaviours. Consequently, health behaviours of people who occupy different sociodemographic positions are in various ways determined by their background and experiences, resources and group membership.

Since the prevalence of individual health behaviours varies across sociodemographic groups, it is plausible to assume that sociodemographic variation can also be found in their associations. Health behaviours can be considered to be associated if those with one unhealthy behaviour are also more likely to engage in other unhealthy behaviours than those who behave healthily. While these associations can also be examined within the sociodemographic groups, individual-level associations should be distinguished from the co-occurrence of unhealthy behaviours at the collective level, which is affected by both the individual-level associations and the prevalence of individual unhealthy behaviours in the sociodemographic groups. The co-occurrence of unhealthy behaviours reveals the sociodemographic groups in which behaving in an unhealthy manner in several respects is frequent. However, this does not exclude the possibility of polarisation within sociodemographic groups: the same groups in which unhealthy behaviours tend to co-occur may also include subgroups of people who behave consistently in a healthy manner.

2.3 Lifestyle

The concept of health-related lifestyle has its background in the general sociological lifestyle discussion. In sociological theory, lifestyles refer to distinctive patterns of behaviour that differentiate people. In most definitions, lifestyles consist of a set of activities or behaviours that make sense or are compatible. Lifestyles thus refer to patterns of human behaviour that have a certain degree of coherence (Veal 1993, Chaney 1996). The concept of lifestyle is often used interchangeably with the concept of way of life. While lifestyles can be examined at the level of individuals, social groups and whole societies (Lööv and Miegel 1990, Veal 1993), the present study concentrates on such uses of the concept that are ultimately interested in differences and similarities between large social categories.

Among the early theorists who used the concept of lifestyle, the work of Max Weber has been most influential. In his theory of stratification, Weber (1978, orig. 1922)

made a division between social classes and status groups. Social classes are based on economic relationships whereas status groups are based on honour or prestige accorded to them by other groups. Social classes and status groups often overlap, but people's position in production and their resulting material living conditions do not determine their social status. Lifestyles are based on what people consume rather than on what they produce. Social status is expressed by having a specific lifestyle, and status groups are aggregates of the people who share a similar lifestyle. Weber made a distinction between life conduct and life chances as two constituents of lifestyle (see Abel 1991, Cockerham et al. 1997). Life conduct refers to people's choices in their selection of lifestyle and life chances to structural conditions restricting these choices. In realising lifestyles, Weber regarded choices as more important but influenced by structural conditions. Thus, people have freedom to choose their lifestyle within the boundaries set by the social constraints of their life chances.

Another often cited theorist who also used the concept of lifestyle in the context of social stratification is Pierre Bourdieu. According to Bourdieu (1984), objective conditions of existence together with one's position in the social structure produce "the habitus", a system of persistent attitudes and orientations (dispositions), which acts as a common generative principle of practices. Lifestyles are the product of habitus, which is expressed in and through taste. Bourdieu's primary interest was in the symbolic struggle for power between different class fractions or status groups. People who belong to the same class fractions share similar experiences and material circumstances, and their lifestyle choices reflect the position in the class structure, and simultaneously reproduce class differences. The classes seek to maintain and improve their social position by adopting and following lifestyles that are culturally and symbolically valued. Especially the new middle classes try to distinguish themselves from the lower classes with their lifestyle choices. Taste is the practical operator used in transforming things into distinctive signs, and taste and distaste for cultural objects characterise status groups. Taste is consciously perceived only to a certain extent. As lifestyles are ultimately reducible to the habitus, they are relatively coherent and stable.

In a framework presented by Erik Allardt (1986), the concept of lifestyle is differently located than in the above two theories. As opposed to Weber and Bourdieu, who regarded lifestyles as a set of practices that consists of socially and economically conditioned choices, Allardt names lifestyle as one of the three determinants of choices. The other two alternatives on which people base their everyday choices are reflection and fashion. Choices are based on lifestyle when an individual follows internalised routines and habits. Reflection refers to rational comparison of available options, and choices resting on fashion are affected by external influences. All of these three alternatives appear in every society and are mixed in each individual's decisions. The interrelationships between lifestyle, reflection and fashion can be

described through three dimensions, which are: rationality-irrationality, consciousness-unconsciousness and stability-instability. Choices following lifestyle are unconscious and stable, but can consist of both rational and irrational practices. Reflection is conscious and rational, but varies in its stability. Fashion is characterised by instability and irrationality, and it is sometimes followed consciously and sometimes unconsciously. Thus, the concept of lifestyle is best suited to describe practices that are stable and persistent, and that are followed unconsciously and unthinkingly. Lifestyle cannot be explained by referring to external influences or rational reflection. People can change their lifestyle, however, if forced by external factors or rational arguments.

Lifestyle has been a central concept also in the recent sociological developments, where this concept has been especially related to the post-industrial society. In the past social position, occupation and place of residence largely determined how people lived and who they were. It has been argued that today lifestyle has replaced social position as the main source of identity. People are freer to choose their lifestyles, as both the situations of choice and the options available have continuously expanded (Coreil and Levin 1985, Chaney 1996). The choices of everyday life are less dependent on the structural constraints, and people have to make choices in situations in which their ancestors used to follow norms and traditions. People do not only follow lifestyles, but are forced to do so, they have "no choice but to choose" (Giddens 1991). Lifestyle choices largely become visible in consumption, which constitutes a basic means of self-expression and identity formation. The concept of consumption not only refers to the purchase of material commodities but also to broader choices and practices that are related to obtaining and using symbolic goods. Social and cultural meanings attached to commodities are important for shaping self-identity (Giddens 1991, Chaney 1996).

Anthony Giddens (1991) defines lifestyles as a more or less integrated set of routinised practices which an individual embraces in the course of everyday life. Lifestyles are routinised practices, i.e. the routines incorporated into habits. However, these routines are reflexively open to change as self-identity is continuously transforming and developing. Each small decision a person makes affects to such routines. Despite the large number of choices people have to make, the overall lifestyle patterns are less diverse than the plurality of alternatives would suggest. A lifestyle involves a cluster of habits and orientations that have a certain unity. Moreover, although individuals have gained more freedom to choose and create their own specific lifestyles, this does not mean that their social positions no longer played a significant role in the forming of lifestyles. All choices are not equally open to everyone. This view is supported by empirical studies which suggest that collective styles of consumption persist and they continue to be grounded socially (e.g. Warde 1997). While traditional social categories may be less attractive to people with individualistic lifestyles, their

ways of behaviour are still influenced by socio-economic circumstances and different kinds of social relationships. However, it has been argued that societies are producing new types of groups less strongly linked with social classes (Bauman 1993, Maffesoli 1996) or that new middle classes are becoming fragmented and these fractions cannot be ranked hierarchically (Warde 1997, Wynne 1998). Hence, rather than explaining lifestyle differences between predefined social categories, attempts have been made to identify social groups on the basis of their lifestyle choices (Wynne 1998, see O'Brien 1995).

2.4 Health-related lifestyle

The concept of lifestyle, referring to the whole of actions and their external conditions, first appeared into the health behaviour research in the 1970s, when the analysis of individual health behaviours was extended to the analysis of clustering of harmful behaviours and their determinants (Wold 1989). As adopted by the WHO (1986), lifestyle refers to "a general way of living based on the interplay between living conditions in the wide sense and individual patterns of behaviour as determined by sociocultural factors and personal characteristics". This definition implies focusing on broad patterns of behaviour instead of a limited number of practices examined separately. It contrasts sharply with the more widespread use of the lifestyle concept, which refers simply to discrete unhealthy behaviours or an aggregation of such behaviours (Elämäntavan terveystutkimuksen... 1980, Coreil et al. 1985, Aarø et al. 1986). Kathryn Dean (1989) has proposed that the concept of lifestyle should be reserved for patterns of behaviour that cluster together and interact with cultural, social and psychosocial factors whereas discrete health-related practices were more appropriately termed self-care behaviours. Lifestyle research would thus concentrate on interrelationships between health-related behaviours and the interacting social and situational factors that influence them (Dean 1988, Dean et al. 1995).

In the 1990s, the concept of health-related lifestyle was elaborated by Thomas Abel and William C. Cockerham. According to their most recent definition (Cockerham et al. 1997), health-related lifestyles are "collective patterns of health-related behaviour based on choices from options available to people according to their life chances". Their notion rests strongly on the separation of life choices and life chances, proposed by Weber as the two factors producing lifestyles (Abel 1991, Cockerham et al. 1997). Life chances and life choices are distinct but interdependent components of lifestyles, referring to socio-structural conditions and individuals' choices. Health-related lifestyles are open to individual choice but restricted by the options people have in their current situations of life. However, health behaviour choices may also influence life chances (Abel 1991, Cockerham et al. 1997).

Health-related lifestyles, generated by the interplay between choices and chances, may include behaviours with both adverse and beneficial health consequences. Nevertheless, health-related lifestyles are not just collections of discrete behaviours but they form overall patterns of practices which have unity and consistency (Cockerham et al. 1997, Cockerham 2000). These practices include contact with the medical profession for preventive health care and routine check-ups, but the majority of the activities take place outside the health care setting. For most people, health-related lifestyles involve decisions concerning daily activities, such as diet, exercise, smoking, drinking and drug use (Cockerham et al. 1997). Health-related lifestyles may include behaviours that have been scientifically shown to have implications for health but also behaviours that are considered important by lay people. The behaviours do not have to be intentionally conducive to health or avoidance of illness (Abel et al. 2000). Apart from behaviours, values, attitudes and orientations may also be considered equally important constituents of health-related lifestyles (Abel 1991, Abel et al. 2000).

According to Abel and Cockerham, health-related lifestyles are ultimately collective attributes (Abel 1991, Cockerham et al. 1997). Consequently, an appropriate strategy to examine health-related lifestyles is to identify patterns of health behaviour in relation to social groups that practise and reproduce them. Life chances constraining choices are mainly, but not entirely, socio-economic. Since the concept of lifestyle has its historical origins in the social stratification theory, other forms of social division, such as gender, age, race, ethnicity and religion, have often been neglected. However, these factors can markedly contribute to the performance of health behaviours and may even exceed the influence of social class, and should therefore be considered in relation to health-related lifestyles (Cockerham et al. 1997, Cockerham 2000).

The earlier sociological discussion on lifestyle as well as that on health behaviour provide material to further consider the use of the lifestyle concept in the context of health behaviour. The question about the relative importance of external structural factors and free individual choice is prominent. While the early conceptualisations of lifestyles emphasised structural determinants and constraints of choice, several contemporary scholars emphasise the role of personal choice and reflexive control (see O'Brien 1995, Williams 1995). It has been argued that the importance of lifestyle as a discriminator between social groups would have increased, while the influence of traditional social groupings and especially that of social class would have diminished. Concepts such as social class and gender have been claimed to have lost at least some of their explanatory power. However, empirical studies conducted in Finland and elsewhere indicate clear differences between sociodemographic groups in their health status and health behaviours (Cavelaars 1998, Aromaa et al. 1999). It is therefore justified to examine differences in health behaviours and their patterns

across population subgroups. As the concept of lifestyle inherently means ways or styles of living that are not the same for all people (Dean et al. 1995), socio-demographic groups form an important level of analysing health behaviour.

In the previous discussion another contrast exists between the views that emphasise deliberate choice and those that attach greater importance to routines. Conscious decision making and routines may be considered two extremes of a continuum. The more routinised practices are concerned, the smaller is the role of reflection and rationality. Arguably, routines play a major role in the everyday conduct. Frequent actions are likely to be more routinised than those practised occasionally. Behaviours that are frequently repeated do not require conscious commitment since they have become routinised habits (Stott and Pill 1992, Ilmonen 1998). While active choice may be important in the adoption of behaviours, the behaviours that have become established occur as part of the routines of everyday life. Many behaviours are practised unconsciously and unthinkingly but sometimes choices are made purposefully. At the same time, however, lifestyles do not only follow from constrained and routinised choices. As pointed out by Allardt (1986), choices are also expressions of lifestyles. Lifestyles can thus be seen as both determinants of choices and determined by choices. While choices are based on lifestyles, these choices at the same time reproduce lifestyles.

Both of the above polarisations involve individual choice. First, choice is seen as an opposite to external structural conditions. Second, choice is placed as an opposite to routines. These same dimensions that appear in the debate about lifestyles are present in the sociological critiques of health promotion (RUHBC 1989, Thorogood 1992). On the one hand, health promotion has been argued to emphasise individual choice and overlook structural factors that constrain them. On the other hand, health promotion has been claimed to place too much emphasis on active individual choice at the expense of routines and non-reflection.

The Weberian conceptualisation of health-related lifestyles is largely reduced to the division between life choices and life chances. In doing so, it tends to overemphasise rational and formal choice of behaviour, with the structural constraints posed by life chances as its dialectical opposite (Cockerham et al. 1993, Cockerham et al. 1997). Although it has been conceded that factors such as addictions and habits may influence health behaviour (Cockerham et al. 1993, Abel et al. 2000), this view would benefit from placing more emphasis on the non-rational and unconscious aspects of health behaviours.

What is characteristic of the general sociological lifestyle concept is its comprehensiveness. It has the objective to embrace actions that occur in any central domain of life and to consider them in relation to each other. In addition, the comprehensiveness

appears in the ambition to take into account external conditions of these actions (Karisto 1984, Chaney 1996). Following the general lifestyle concept, the concept of health-related lifestyle leads to an approach that examines the entity of health-relevant behaviour and its external conditions. As health behaviour is seen as a whole and influenced by its social and situational context, the notion of health-related lifestyle draws specific attention to the non-health-related meanings of these behaviours and to people's motives for engaging in these behaviours as part of their everyday life. The health-related lifestyle approach implies that it is not sufficient to examine each behaviour on its own. In accordance with this approach, the present study will reach beyond individual behaviours by examining interrelationships among health behaviours and the consistency of these interrelationships across broad sociodemographic categories.

Ideally, the research on health-related lifestyles should not be restricted to a limited number of practices (Dean et al. 1995). However, almost every action can have real or alleged implications for health, whether these implications are beneficial or detrimental. It is difficult to separate actions that are significantly related to health from those that are not. Moreover, since health-related actions can have various other meanings (Roos 1989, Backett and Davison 1995), it is difficult to justify concentration on health behaviour as an area on its own right. Health-related lifestyles should therefore be understood as lifestyles applied to health behaviour rather than lifestyles restricted to health behaviour. In empirical research, some criteria besides the supposed health effects have to be used in selecting the behaviours that are taken under examination. In the present study the approach outlined by the health-related lifestyle concept will be applied to behaviours practised on a daily basis.

3 PREVIOUS RESEARCH ON THE ASSOCIATIONS BETWEEN HEALTH BEHAVIOURS

This review of literature focuses on the associations among daily health behaviours, namely smoking, alcohol use, physical inactivity, different aspects of unhealthy diet as well as being overweight. A vast majority of previous research has examined pairwise associations between two of these behaviours. Here, the pairwise associations are first considered rather extensively as they lay the basis for a more sophisticated examination. Furthermore, examining several pairs of behaviour in parallel is advantageous since the results of each pair provide perspective for evaluating the significance of the findings concerning all other pairs. Examining associations systematically in all possible pairs of behaviours also establishes a general view of their patterning.

Cross-sectional and longitudinal studies are viewed separately. While a wealth of cross-sectional studies have been conducted, the evidence gathered from longitudinal studies is limited. Longitudinal studies are further divided into those examining one behaviour as a predictor of the others and those examining concurrent changes in the behaviours. Finally, studies on multiple associations among the behaviours are considered. Preference is given to observational studies on the general adult population. The review is restricted to western industrialised countries, but while previous Finnish studies are considered separately, an effort to distinguish other cultural settings will not be made. Emphasis is placed on the latest research, and review articles are used when they are available.

3.1 Pairwise cross-sectional associations

A positive association between smoking and drinking has been repeatedly observed, although studies on the general population are relatively rare (Istvan and Matarazzo 1984, Bien and Burge 1990, Shiffman and Balabanis 1995). Some evidence suggests that the association may be slightly stronger among women. The association has not only been observed between smoking and drinking but also between the amount of smoking and the amount of drinking, and the association seems to become stronger as the volumes of smoking and drinking increase. Explanations proposed for the association have been mainly physiological but also the influence of psychological and social factors has been supported (Bien and Burge 1990, Shiffman and Balabanis 1995).

Recent reviews generally lend support to a modest inverse association between smoking and leisure-time physical activity. The association may be somewhat stronger

among men (Blair et al. 1990, Wankel and Sefton 1994, Johnson et al. 1995). However, a number of studies report no association between these behaviours. This inconsistency may reflect true differences across populations but may also result from flaws in the measurement. Assessing the involvement in physical activity, in particular, has been problematic. The reviews suggest that the inverse association may be stronger for vigorous physical activity than for overall physical activity, whereas smoking status and the number of cigarettes smoked per day have provided similar results (Blair et al. 1985, Wankel and Sefton 1994).

In general, smokers have unhealthier diets than non-smokers do. Most studies report slightly higher intake of energy for smokers than non-smokers, but the pattern may be less clear for women (Perkins 1992, Thompson et al. 1992, Dallongeville et al. 1998). Smokers consume more total fat and saturated fat but less polyunsaturated fat than non-smokers. In Britain, Whichelow (1989) examined social class differences in the type of fat used on bread between smoking categories and found that these differences were partly inverse between men and women. Smokers also have lower intake of fruit, vegetables and wholemeal bread than non-smokers (Thompson et al. 1992, Dallongeville et al. 1998). Consequently, smokers have lower intake of antioxidants, especially vitamin E, vitamin C and beta-carotene (Dallongeville et al. 1998, Marangon et al. 1998, Ma et al. 2000) and dietary fibre (Thompson et al. 1992, Dallongeville et al. 1998) than non-smokers. In protein and carbohydrate intake, differences between smokers and non-smokers are relatively small (Thompson et al. 1992, Dallongeville et al. 1998). Ex-smokers place themselves as an intermediate group between current smokers and never-smokers, with increasing resemblance to never-smokers as time since quitting increases (Bolton-Smith et al. 1993, Morabia et al. 1999).

Average body weight and the prevalence of overweight are lowest among current smokers, intermediate among never-smokers and highest among ex-smokers (Klesges et al. 1989, Leischow and Stitzer 1991, Perkins 1993). However, heavy smokers have body weights approaching those of never-smokers (Klesges et al. 1989), and in two studies (Molarius and Seidell 1997, Laaksonen et al. 1998) the association between smoking and body weight varied according to educational level: smokers weighed less than never-smokers only among the less educated whereas among the better educated an opposite association was observed. These findings suggest that social and behavioural factors may modify the relationship between smoking and body weight. Weight differences between smokers and non-smokers may be larger in women than in men. Also the finding that ex-smokers have a higher body weight than never-smokers has been more consistent among men than among women (Klesges et al. 1989, Molarius et al. 1997).

Studies on the association between alcohol consumption and physical activity are few and their findings inconsistent. Most studies have not found an association

between the two behaviours. When observed, a positive association has been more commonly reported than an inverse association (Blair et al. 1985, Wankel and Sefton 1994, Johnson et al. 1995, Steptoe et al. 1997).

Studies on the association between alcohol use and dietary habits are also sparse. The findings are inconsistent and the associations observed generally moderate. An inverse association has been observed between alcohol use and fruit and vegetable consumption (La Vecchia et al. 1992, Serdula et al. 1996, Agudo et al. 1999). Drinking has been found to be inversely associated with the intake of carbohydrates (Hellerstedt et al. 1990) while a positive association between alcohol use and fat consumption has been observed in several but not in all studies (Hellerstedt et al. 1990, La Vecchia et al. 1992, Veenstra et al. 1993). Increased energy intake has been observed among higher alcohol users, partly reflecting the energy contained in alcohol itself. The findings on whether the energy derived from alcohol is compensated by lower energy intake from other sources are inconsistent (Hellerstedt et al. 1990, Colditz et al. 1991, La Vecchia et al. 1992, Veenstra et al. 1993), but a recent review suggests that among moderate drinkers energy derived from alcohol is added to the diet (Suter et al. 1997).

Alcohol has a high caloric density and it is a considerable source of energy. Experimental evidence suggests that alcohol consumption may have a significant influence on body weight and obesity. Epidemiological evidence, in contrast, remains inconclusive, which may be due to methodological flaws, but also a number of other behavioural practices may confound this relationship (Suter et al. 1997). Alcohol may be more strongly associated with body weight in women than in men. Several studies have reported an inverse association between alcohol use and body weight for women and a weaker positive association for men (Hellerstedt et al. 1990).

Energy intake is positively associated with physical activity, but few studies have examined the association between physical activity and dietary composition in the general population (Blair et al. 1985, Wankel and Sefton 1994). Recent studies suggest that active people more often than the sedentary have a better overall quality of diet (Wankel and Sefton 1994, Matthews et al. 1997), including lower intake of fat (Eaton et al. 1993, Simoes et al. 1995, Matthews et al. 1997, Johansson and Andersen 1998, Boutelle et al. 2000) and higher intake of fruit and vegetables (Eaton et al. 1993, Serdula et al. 1996, Matthews et al. 1997, Johansson and Andersen 1998, Agudo et al. 1999).

Although genetic factors may predispose people to overweight, energy derived from diet and energy expenditure by means of physical activity are fundamental in regulating body weight. Both high-energy diet and lack of physical activity have been found to be independently associated with overweight (Van Zant 1992, WHO

1998, Astrup 1999, Martínez-González et al. 1999). Ecological studies suggest that sedentary behaviour may be the main determinant of increased prevalence of overweight and obesity in the affluent societies (Prentice and Jebb 1995, Fogelholm et al. 1996, Jebb and Moore 1999). Nevertheless, other studies suggest that recreational physical activity, such as participation in vigorous exercise or sports, would have only a modest effect on body weight independently of dietary behaviour (Van Zant 1992, Zelasko 1995, Wilmore 1996, Tremblay et al. 1999). The measure of diet has usually been the total energy intake or the percentage of energy derived from fat. Measures based on other macronutrients such as carbohydrates and protein have also been sometimes used, whereas studies examining the association between body weight and specific food preferences have been sparse. Fat content of the diet has been considered the primary determinant of body fatness (Rolls and Shide 1992, Mela 1996, Doucet and Tremblay 1997, WHO 1998), while the association between carbohydrate intake and body weight seems to be inverse (Doucet and Tremblay 1997, Astrup 1999). Several mechanisms have been proposed to support a causal role of physical activity in regulating body weight (Van Zant 1992, Wilmore 1996, Horton and Hill 1998), but also the possibility that infrequent physical activity would be a consequence of overweight has been put forward (Hosmer and Lemeshow 1989, Williamson et al. 1993).

3.2 Pairwise longitudinal associations

An association between two behaviours can become existent if one behaviour leads to the other or if the behaviours follow from common antecedents. Longitudinal studies may shed more light on how the associations between health behaviours arise by showing the order in which the behaviours are adopted. However, establishing a causal link between the behaviours would also call for some assumption of the mechanism by which one behaviour may lead to another.

Alcohol use seems to predict uptake of smoking (Shiffman and Balabanis 1995), but the evidence of other behaviours being predictors of smoking initiation is limited. Drinking may also restrain smoking cessation. This latter association was also observed in two recent Danish studies that examined other health behaviours as predictors of smoking cessation. In one study (Osler et al. 1999), lower alcohol use in both genders and being overweight in women predicted smoking cessation, whereas physical activity proved not to be a statistically significant predictor of subsequent quitting. The other study (Osler and Prescott 1998) demonstrated a tendency for both lower alcohol use and physical activity to increase the likelihood of successful smoking cessation, but only alcohol use reached borderline statistical significance.

Smoking has been found to predict initiation of alcohol use. The interrelationship between the initiation of smoking and drinking may thus be bidirectional: the use of

either one of these substances is likely to increase the risk of starting the other (Shiffman and Balabanis 1995, Dawson 2000). Studies examining other behaviours as predictors of alcohol use could not be found.

Sallis and co-workers examined other health behaviours as predictors of the adoption and maintenance of physical activity, and the results were mostly disproving. In men, adopters of moderate physical activity were leaner (Sallis et al. 1986) and those who were active at the baseline but sedentary in the follow-up weighed more (Sallis et al. 1992). Men who were intermediately active at the baseline but sedentary in the follow-up, and women who remained sedentary, smoked more often at the baseline (Sallis et al. 1992).

Prevost and co-workers (1997) identified four dietary components and examined whether other behaviours were predictive of subsequent changes in these components over the period of seven years. Fresh foods (fruit and salads), high-fibre foods (fruit, vegetables and "brown" bread), and low-fat spread and milk comprised the first component. Smoking was associated with changes in this component in both genders, as non-smokers improved their diet more than smokers did. In addition, moderately drinking men had the greatest improvement in their diet. Inactivity and overweight were not included in the study.

As opposed to what might have been expected on the basis of experimental studies, in a review of prospective observational studies physical activity and diet turned out to be only weak and inconsistent predictors of weight change (Williamson 1996). In most of the studies reviewed the measure of diet was the total energy intake or the percentage of energy from fat. Another review (DiPietro 1999) suggests that while regular physical activity may reduce weight gain that tends to occur with the advancing age, it has little effect in promoting weight loss. Neither was smoking predictive of subsequent weight change (Klesges et al. 1992), while a number of epidemiological studies suggest that alcohol consumption may increase the risk of weight gain (Suter et al. 1997).

Few studies have examined concurrent changes in health behaviours among the general adult population. Changes accompanying smoking cessation have been observed in diet, but these changes may be temporary: eating tends to increase during the first weeks after smoking cessation but may return to pre-cessation levels with continuing abstinence (Perkins 1992). Furthermore, changes in the contents of the diet are less clear. Two population-based studies (Perkins et al. 1993, French et al. 1996) have systematically examined how changes in diet and other health behaviours are related to smoking cessation, showing parallel results. In both studies those who quit smoking increased physical activity more often than persistent smokers, but no difference was observed in alcohol use or the contents of the diet. However, a study

on correlates of dietary change (Prevost et al. 1997) found that quitters improved their diets more than persistent smokers, and smoking initiators had smaller improvements in their diets than those who remained non-smokers.

An inverse association between smoking and body weight has been well established in longitudinal studies: weight usually increases among smokers who quit, and those who initiate smoking tend to lose weight. Weight gain occurs in most quitters, but there is some controversy over its magnitude and stability (Klesges et al. 1989, Chen et al. 1993, Froom et al. 1998). On average, the amount of weight gained is only a few kilograms (Klesges et al. 1989, Froom et al. 1998) although a recent study on continuous abstainers arrived at a larger figure (Klesges et al. 1997). The weight gain may be higher among women, younger people and those who smoked more before quitting (Williamson et al. 1991, Froom et al. 1998). The increase appears to be primarily due to a change in energy intake, while physical activity has only a minor modifying effect, and the role of resting metabolism remains controversial (Klesges et al. 1989, Leischow and Stitzer 1991, Perkins 1993).

Previous studies have not observed an association between changes in alcohol use and body weight in either men or women (Klesges et al. 1992, French et al. 1994). Similarly, changes in physical activity are not accompanied by changes in alcohol use (Blair et al. 1985). Results on concurrent changes in alcohol use and diet are not available.

Longitudinal studies suggest that changes in energy expenditure through physical activity are not compensated by changes in energy intake in the short term. Long-term results have also failed to demonstrate the total adjustment of energy intake in response to increased physical activity, which is both counter-intuitive and contrasts the findings of cross-sectional studies. Studies on food preferences are few, but some evidence supports increased intake of carbohydrates after sustained increase in physical activity (King 1998). Few observational studies among the general adult population have examined whether these two behaviours, physical activity and diet, are associated with body weight. Most studies on physical activity and body weight show an inverse association. Instead, the results on diet and body weight are inconsistent but in general fail to repeat the positive association found in experimental studies (Williamson 1996, Jebb and Moore 1999).

3.3 Multiple associations between health behaviours

The first approach examining multiple health behaviours in relation to health summarised the behaviours in an additive index. This was first done within the Alameda County Study, conducted in California, USA. According to Slater and Linder

(1988), this simple measure "rendered the first scientifically compelling portrait of a 'healthful lifestyle'". The Alameda County Study included seven everyday health practices that supposedly affected health and longevity. These were never having smoked, never drinking to excess, getting adequate sleep, having regular exercise, controlling weight, not eating between meals, and eating breakfast. In the first analyses, all of the seven health practices showed a strong relationship with physical health status in cross-sectional analyses (Belloc and Breslow 1972) and were related to the future mortality risk (Belloc 1973, Breslow and Enström 1980). Later, five of these practices (smoking, alcohol use, physical activity, sleeping and weight control) were found to predict morbidity over nine years (Wiley and Camacho 1980) and to be independently associated with subsequent mortality (Wingard et al. 1982), whereas eating breakfast and snacking did not have any independent effects. Not only did these behaviours predict mortality individually, but their effects seemed to be additive: the more positive behaviours a person followed, the greater the benefits. The results were interpreted to suggest that health behaviours reflected a unitary dimension, and health education was assigned to convince people to adopt as many positive practices as possible.

Several studies have followed the footsteps of the Alameda County Study and summarised health behaviours in a single ordinal dimension. Using an index similar to that used in Alameda or a modified one, a number of studies have indicated an association between an additive score of health behaviours and health status (e.g. Brock et al. 1988, Rotevatn et al. 1989, Segovia et al. 1991). This approach has been strongly criticised because of its underlying assumption of unidimensionality of health behaviours (Slater and Linder 1988, Dean and Salem 1998). However, despite this criticism composite health behaviour indices are still frequently used. Some recent evidence suggests that health behaviours may interact to exert even a greater effect on subsequent morbidity and mortality than if the effects of the individual unhealthy behaviours were simply added together (Luoto et al. 1998, Johansson and Sundquist 1999, Meng et al. 1999). Several studies have also examined sociodemographic differences in the overall health behaviour using indices of various sets of potentially harmful (Petridou et al. 1997, Pomerleau et al. 1997, Galambos and Tilton-Weaver 1998) or beneficial behaviours (Pill et al. 1995, Blacconiere and Oleckno 1999).

One of the most powerful sources of criticism towards health behaviour indices came from statistical multivariate analyses, supporting the idea of multi-dimensionality of health behaviour. The first dominant multivariate approach was factor analysis. In general, these studies found low intercorrelations between health behaviours and indicated that health behaviour had several dimensions. These studies, however, have not reached an agreement on what the underlying dimensions of health behaviour would be. The results of factor analysis intrinsically depend on which and how many variables are initially included in the analyses, which makes comparison

of the results between studies difficult. The selected variables have also been operationalised and measured in various ways. In addition, the communities studied have varied widely and many studies have been based on selected samples.

Some factor-analytic studies have comprised health protective behaviours, some have included only health risk behaviours while others have not made a difference between them. When all health-related behaviours have been considered, health-promoting behaviours have often been separated as one group (Tapp and Godenthal 1982, Aarø et al. 1995). Some other dimensions have also been repeatable and interpretable. Several studies have separated preventive behaviours from risk-taking behaviours (Tapp and Godenthal 1982, Vickers et al. 1990, Liang et al. 1999), behaviours that require active participation from behaviours that are adopted or maintained passively (Kannas 1981, Tapp and Godenthal 1982, Stephens 1986, Ungemack 1994) and behaviours that expose people to direct risk from those that pose an indirect risk (Langlie 1979, Stephens 1986). However, in many studies some of the behaviours have remained outliers or variables with high loadings on the same factor have consisted of conceptually distinct items and lacked clear substantive interpretation. While somewhat overlapping, the dimensions of active participation and direct risk have often been based on the close interrelationship between smoking and alcohol use (Kannas 1981, Tapp and Godenthal 1982, Hays et al. 1984, Norman 1985, Stephens 1986, Vickers et al. 1990, Ungemack 1994, Aarø et al. 1995, Petridou et al. 1997, Liang et al. 1999), yet some studies have placed smoking and alcohol use on different factors (Kronenfeld et al. 1988, Krick and Sobal 1990, Sobal et al. 1992).

In the second wave of multivariate methods, cluster analysis became dominant. While factor analysis attempts to reduce the data to a smaller number of underlying dimensions by grouping variables across observations, cluster analysis groups observations across variables. Cluster analysis can therefore be used to identify groups of people sharing similar health behaviour patterns (see Abel 1991). Similarly to factor analysis, variables included in the analyses affect the solutions and limit the generalisability of the results. The studies have been able to identify a discrete number of dimensions, characterised by different sociodemographic and attitudinal variables (Harris and Guten 1979, Abel and Kohlmann 1989, Abel 1991, Slater and Flora 1991, Lüschen and Niemann 1995). Other multivariate methods, such as discriminant analysis (Calnan 1985, Oleckno and Blacconiere 1990, Emmons et al. 1994), association analysis (Burke et al. 1997) and correspondence analysis (Abel et al. 2000) have been employed to analyse interrelationships between health behaviours only to a small extent.

Most of the above studies thus give support to the multi-dimensionality of health behaviour, especially when behaviours related to the use of preventive health services have been examined alongside personal health practices. The number of variables

used in these studies has been quite large. Furthermore, the range of variables examined has been mixed, also including actions whose contribution to health is rather poorly evidenced. It may not be reasonable to consider the different forms of health behaviour together. As the present study concentrates on behaviours practised on a daily basis, in the following earlier studies that have focused primarily on the associations among a limited number of daily health behaviours will be viewed separately.

A wealth of studies has examined how one daily health behaviour is associated with a range of others. However, since these studies give a priority to one of the behaviours, they are more appropriately regarded as a series of pairwise examinations. Instead, examining several pairs of behaviours in parallel from a neutral perspective can be regarded as an analysis of multiple associations. In studies that make use of multivariate methods, pairwise associations between the behaviours have often been presented as a background. However, most of these studies have focused firmly on the multivariate analyses and more profound examination of these associations has been mainly neglected. Only a few studies have made an attempt to interpret the pairwise associations presented in parallel (Blaxter 1990, Abel and McQueen 1995). Many studies have regarded the pairwise associations between the behaviours as weak or moderate, which has not encouraged to pay attention to their multiple associations. However, other or even the same studies have found associations of considerable strength among subgroups of health behaviours, suggesting that patterns of multiple health behaviours may exist.

Few studies have specifically concentrated on multiple associations between a limited number of daily behaviours. Dean and co-workers (1995) used graphical interaction models to examine interrelationships between situational, behavioural and health variables in Spain. This multivariate technique is based on the examination of several pairwise associations in parallel, and is advantageous when the analysis consists of more than two levels. After adjusting for the other associations, alcohol consumption was related to smoking among men and to physical inactivity among women, but other associations were not observed among the three behaviours.

Blaxter (1990) examined associations between smoking, alcohol use, physical activity and diet using data from the British Health and Lifestyle Survey. Several pairwise associations between unhealthy behaviours were first observed, including some inverse associations, and gender and sociodemographic differences were detected. Turning to multiple associations, only a few people proved to engage in all four unhealthy behaviours, while for most people the patterns of unhealthy and healthy behaviours were mixed. The prevalence of the combinations varied across sociodemographic groups, reflecting the prevalence of the individual unhealthy behaviours in the corresponding groups. Blaxter also analysed the occurrence of

unhealthy behaviours in the presence or absence of other behaviours. The results suggest that a third behaviour may modify an association between two behaviours, but since the grouping was formed progressively in one specific order (starting from smoking and ending with physical inactivity), it is not possible to evaluate the modifying effect of other behaviours on all associations systematically.

Barrett and co-workers (1995) examined associations between alcohol use and other behaviours that might act as confounders in the relationship between alcohol use and cardiovascular mortality. Also three-dimensional associations among smoking, alcohol use and physical activity were analysed with survey data from South Carolina. Among the few statistically significant findings, female drinkers who did not smoke reported regular leisure-time physical activity more often than non-drinkers. Among smokers such an association was not observed. These findings suggest that associations between health behaviours may vary according to other behaviours.

A couple of studies have employed cluster analysis to examine the patterning of daily health behaviours. Patterson and co-workers (1994) searched for population subgroups with similar combinations of cigarette smoking, alcohol consumption, physical activity and diet quality among American adults. Again, only few people behaved healthily or unhealthily in all respects. Seven clusters of daily health behaviours were identified. Each of the four behaviours alone characterised one cluster, while three clusters showed mixed patterns: drinking and smoking formed the first mixed pattern, healthy diet and physical activity the second, and diet quality and physical activity below average, combined with smoking and drinking slightly above average, the third. The clusters were differently related to various sociodemographic characteristics. De Bourdeaudhuij and van Oost (1999) also used cluster analysis on a sample of Belgian adults. Smoking, alcohol use, sleeping patterns, being overweight and physical activity at work were included in the analyses, in which healthy and unhealthy clusters were found in each of the three age groups examined. Smoking was the behaviour that separated the unhealthy cluster from the healthy cluster. Higher alcohol use and, in the two youngest age groups, lower physical activity and fewer hours of sleep were also related to the unhealthy cluster.

3.4 Previous Finnish studies

Previous Finnish research on the interrelationships between health behaviours is patchy. The data used in many studies is by now quite old and many samples have been selective. Associations with other health behaviours have often been studied among other kinds of correlates.

In a study comparing dietary habits across smoking categories, smoking was inversely associated with both vegetable use and avoidance of milk fat (Prättälä et al. 1998).

Ex-smokers were especially healthy in their food choices. In a follow-up of twins, Kaprio and Koskenvuo (1988) compared health behaviour as well as psychosocial and socio-economic characteristics between persistent smokers and future quitters. Average alcohol consumption was higher among those who remained smokers than those who quit, but there were no differences in leisure-time physical activity or body weight over the period of six years.

Männistö and co-workers (1997) found that differences in smoking, diet and relative weight were larger between abstainers and alcohol consumers than between consumers of different alcoholic beverages. Abstainers smoked less and had higher body weights than drinkers. Fat intake was lower and carbohydrate intake higher among abstainers than among drinkers. There were no differences between the drinking categories in the total physical activity. Among male smokers (Männistö et al. 1996), alcohol consumption was associated, either positively or inversely, with almost all foods examined, whereas differences in nutrient intakes were small. Alcohol use was positively associated with body weight.

Marti and co-workers examined how leisure-time physical inactivity and other cardiovascular risk factors were associated with smoking and body weight in selected areas of Finland. Among adults (Marti et al. 1988), an inverse association was observed between physical activity and both smoking and body weight, whereas among adolescents (Marti and Vartiainen 1989) inactivity was inversely associated only with smoking. In a follow-up of men, those who increased their physical activity smoked less after 20 years than those who remained sedentary (Marti et al. 1989). Aarnio and co-workers (1997) examined associations of other health behaviours with physical activity among adolescents. Smoking, alcohol use, and saturated fat use were inversely associated with physical activity.

Rissanen and co-workers examined health behaviours as determinants of overweight (Rissanen et al. 1991) and weight gain (Rissanen et al. 1989, Rissanen et al. 1991). The prevalence of overweight was inversely associated with leisure-time physical activity but not with smoking or alcohol use. Those who started smoking lost weight whereas quitters gained weight. Higher drinking was positively and frequent physical activity inversely associated with weight gain. In north-eastern Finland (Haapanen et al. 1997), low physical activity predicted higher weight gain over the 10-year study period among women but not among men. In both genders, weight gain was highest among those who had decreased their physical activity and lowest among those who had increased their activity.

In Finland, associations between multiple unhealthy behaviours have been examined among both adults and adolescents. Two studies have included a large number of behaviours in their analyses. Rimpelä and co-workers (1978) examined correlations

between 12 health behaviours among adolescents. Smoking showed the strongest associations with other health behaviours, especially with alcohol use and coffee drinking, but was not clearly related to physical inactivity. Kannas (1981) used factor analysis to examine associations among 16 preventive health behaviours among adolescent men. Five dimensions of health behaviour were identified. The dimensions were named as the use of sugar and fat, active health-oriented behaviour, regularity of eating and resting habits, dental care, and "la dolce vita", characterised by alcohol use, smoking and having several sexual partners.

Other studies have examined associations among a group of daily health behaviours. Miilunpalo and co-workers (1984) used data from central eastern Finland to examine the co-occurrence of five unhealthy behaviours, which were infrequent free-time physical activity, smoking, unhealthy diet, heavy alcohol use and being overweight. The appearance of pairwise combinations of behaviours was compared with those calculated assuming that the behaviours were independent of each other. Most behaviours were weakly but statistically significantly associated: in both men and women, smoking was associated with alcohol use, physical inactivity and unhealthy diet. Being overweight was positively associated with inactivity and inversely associated with smoking. In men, alcohol use was associated with inactivity, unhealthy diet and being overweight, while these associations were not examined among women owing to the small number of heavy alcohol users. Approximately one fifth of the respondents had none of the unhealthy behaviours while 8% of men and 1% of women had at least four of them. Both of these proportions were larger than expected, were the behaviours independent of each other. A number of different factors were found to be related either to the healthy or the unhealthy end of the summary measure.

Karisto, Prättälä and Berg (Karisto et al. 1993, Prättälä et al. 1994) examined co-occurrence of smoking, high alcohol use, physical inactivity and unhealthy diet using the Health Behaviour among the Finnish Adult Population surveys from the 1980s. The proportion of those with three or four unhealthy behaviours decreased over time, mostly because of dietary changes. Only a few people had all four unhealthy behaviours while the majority belonged to the intermediate category of one or two unhealthy behaviours. The prevalence of having multiple unhealthy behaviours also differed by sociodemographic background characteristics that were examined individually and in combination. In addition, accumulation of three or four unhealthy behaviours in the same individuals was examined. All other combinations except that of non-smoking, high alcohol use, physical inactivity and unhealthy diet were more prevalent than would have been expected if the behaviours were independent of each other, indicating that the behaviours tended to accumulate. Accumulation of the unhealthy behaviours remained similar over the study period. The accumulation was more pronounced in population subgroups where the prevalence of individual unhealthy behaviours was low.

Raitakari and co-workers (1995) conducted a similar analysis of accumulation of none to four of these behaviours among adolescents. Approximately one third of the respondents did not engage in any of the unhealthy behaviours whereas 3% presented all four of them. The proportion of persons with none of the unhealthy behaviours as well as that of three or four of them was larger than expected, were the behaviours independent of each other. In contrast, having one or two unhealthy behaviours was less common than expected. Several independent determinants of the co-occurrence of these behaviours were identified among sociodemographic, psychosocial and health status indicators.

3.5 Summary of the previous studies

A large number of studies have examined pairwise associations between health behaviours. Taken together, the findings suggest several positive associations, yet some behaviours seem not to be associated and some associations are even inverse. Studies including more than two behaviours have most often summarised the behaviours in an additive index or used multivariate methods to examine associations among them. Health behaviour patterns seem to be mixed for most people while only a small minority behave in an unhealthy manner in all respects. There is some evidence to suggest that a third behaviour may modify an association between other behaviours and that several forms of unhealthy behaviour may cluster, suggesting that meaningful patterns of more than two behaviours may exist. As a whole, however, research on the multiple associations between health behaviours has been sparse and sporadic. A comprehensive account of the associations among daily health behaviours is lacking.

Gender differences have been reported in some pairs of behaviours. Combinations of behaviours observed in cluster analyses have been associated with different sociodemographic and psychosocial characteristics. Little attention has otherwise been paid to the possible gender and sociodemographic variation. Whether the associations between health behaviours are similar in different subgroups of the population is not known. Compared with foreign studies, previous Finnish research is quite voluminous and the findings generally agree quite well with those from other countries. However, even in Finland the overall view of the associations among health behaviours and their sociodemographic variation is incomplete.

4 SCOPE AND PURPOSE

The purpose of this study is to examine interrelationships among health behaviours and sociodemographic variation in these interrelationships among Finnish men and women in the 1990s. The behaviours included smoking, alcohol use, physical activity and dietary behaviour. In addition, being overweight was examined in one substudy. These behaviours were taken under examination because they are more or less routinely practised on a daily basis and their contribution to the major chronic diseases is well established.

The study concerns a period when Finland first fell into and then recovered from a deep economic recession, characterised by an unprecedentedly high rate of unemployment. However, this unusual period seems not to have affected much the population trends in health behaviours. During the last decades, changes in these behaviours have been slow and varied in direction (Prättälä et al. 1994, Lahelma et al. 1997, Helakorpi et al. 2000). Smoking has slightly decreased among men but increased among women. Alcohol consumption has increased. Free-time physical activity has also increased, and dietary habits have become healthier, yet average weight and the prevalence of overweight have increased. Sociodemographic changes in the trends of the health behaviours have been moderate. Overall, a recent cohort study (Luoto et al. 1999) showed changes compatible with these population-level trends. However, smoking declined in both genders and gaining weight was more common than in trend studies, as could be expected owing to the advancing age of the respondents.

Previous research suggests that while few people behave consistently in a healthy or unhealthy way, health behaviours are not independent of each other but may emerge in larger patterns. The concept of health-related lifestyle as applied here refers first of all to the whole of health-related behaviours. Health-related lifestyle may consist of both healthy and unhealthy components. Although traditional structural constraints may have been eroded and people can more freely than previously choose their own lifestyles, health behaviours are nevertheless closely linked with various sociodemographic factors. Stability of the associations is therefore examined across several sociodemographic characteristics. Men and women are analysed separately throughout the study.

In this study the unhealthy end of the health behaviours is taken under examination. Hence, the focus is on risk behaviours rather than on health-promoting behaviours. The behaviours are examined in a symmetric setting, so that no preference is given to any of the behaviours in advance. Multiple associations between the behaviours are examined, and several pairs of behaviours are analysed in parallel in order to

evaluate the findings concerning each pair against the other pairs. Associations between each pair of behaviours, or their absence, provide perspective for evaluating the significance of the associations observed between other behaviours. Moreover, examining the associations systematically in all possible pairs of behaviours provides a general view of their patterning. Pairwise associations among the health behaviours are examined both cross-sectionally and longitudinally.

The specific aims of the study are to examine:

1. Multiple associations among health behaviours. First, accumulation of unhealthy behaviours in the same individuals is examined. Second, importance of the associations as determinants of the whole distribution of the behaviours is assessed.

2. Sociodemographic determinants of engaging in multiple unhealthy behaviours.

3. Sociodemographic variation in the associations between health behaviours.

4. Longitudinal associations between health behaviours. The first aim is to examine whether each of the health behaviours predicts changes in the other behaviours over seven years. The second aim is to find out whether changes in each health behaviour are related to changes in the other behaviours.

5 MATERIAL AND METHODS

5.1 Data sources

Two datasets were used in this study. The data in studies I–III derived from a series of cross-sectional surveys conducted within the Health Behaviour among Finnish Adult Population project (Helakorpi et al. 2000). These nationwide surveys have been repeated annually since 1978. The surveys were carried out among independent samples of 5000 Finns aged 15–64 years, drawn at random from the National Population Register. The present study consisted of 20–64-year-old respondents to the surveys conducted between 1991 and 1998. Response rates, provided by anonymous postal questionnaires with two reminders to the non-respondents, varied from 64% to 72% among men and from 75% to 82% among women. Data from the successive study years were pooled. Altogether 12,192 males and 13,822 females were included in the analyses.

The data for study IV came from a follow-up study among the participants in the annual surveys in 1989 and 1990. To form a panel design, 3664 male and 4025 female respondents to either of these surveys were recontacted in 1997 (Luoto et al. 1999). Out of the original 7689 persons, 7435 could be traced from the National Population Register. Sixty-nine percent of men and 78% of women participated in the follow-up, yielding 5494 respondents. Those aged 20–64 years at the initial contact were included in the present study, comprising 2229 men and 2852 women.

5.2 Study variables

The questionnaires were structured and they included predefined response alternatives. To ensure comparability, core questions, timing and implementation of the study were kept similar from year to year. Health behaviours included in the present study were smoking, use of alcohol, physical activity and dietary habits. In study IV being overweight was also considered.

The health behaviours were measured using different scales. Alcohol use and relative weight were measured as continuous variables while the other variables were categorical. In order to treat the behaviours uniformly, all variables were dichotomised and the unhealthy end of the behaviours was taken under examination. While the selection of the behaviours was based on their well-established roles in the aetiology of the major chronic diseases, judgements about their appropriate levels are much more problematic. In most cases there is no strict limit where the health risk associated with the behaviours would suddenly appear or sharply increase. However,

dichotomisation reduces statistical power and may therefore underestimate the strength of the associations observed.

Smoking status was determined on the basis of several questions concerning the smoking history and the last smoking occasion. In study I current smoking was taken under examination. Those who declared to have smoked regularly for at least one year and having smoked during the previous month were considered current smokers. Studies II–IV examined daily smokers, restricted to those who had last smoked within two days.

Alcohol consumption was estimated as the sum of last week's consumption of beer, long drinks, wine and distilled spirits. Because the consumption of cider was low in the beginning of the 1990s but increased considerably during the decade (STAKES 1999), the follow-up measurement of study IV also included cider and light wine (alcoholic content vol. ~5%). The use of these beverages was converted into comparable units based on their content of pure alcohol and summed together. In study I, men consuming more than 8 units of alcohol a week and women consuming more than 5 units of alcohol a week were classified as high alcohol users. In studies II and III those belonging to the upper quartile of alcohol use, separately for each gender, were considered heavy users, corresponding to more than 12 weekly units for men and more than 5 units for women. In study IV the upper quartile of alcohol use was likewise taken under examination, calculated separately for each gender from the mean of the baseline and the follow-up measurements. The corresponding cut-off points were more than 10 and more than 4 units a week, respectively for men and women.

Physical activity was assessed by asking the frequency of leisure-time activity on a six-point scale, the alternatives ranging from daily to a couple of times a year or less. Respondents exercising less than once a week (for at least 30 minutes making them at least mildly short of breath or perspiring) were considered to have infrequent physical activity.

For diet, a sum-index was constructed. The components of the index were eating fresh vegetables or root vegetables (potatoes excluded) less than three times a week, using butter on bread or drinking whole milk, and eating less than 5 slices of bread a day. Making two or three unhealthy choices from these items was used as an indicator of unhealthy diet.

Although relative body weight may be considered a physical dimension rather than a behaviour, being overweight was also examined in study IV. Overweight was described in terms of the body mass index (BMI). People were asked to provide their weight in light clothing at an accuracy of 1 kg and their height in centimetres. The

BMI was calculated as weight (kg) divided by the square of height (m^2). The upper quartile of the BMI, calculated separately for each gender from the mean of the two measurements, was taken as the limit for overweight, corresponding to the value of 27.6 kg/m^2 for men and 26.8 kg/m^2 for women.

Sociodemographic variables used in the study were educational level, age group, marital status and living area. Each of these sociodemographic variables was divided into three categories. Educational level (studies I–III) was measured by the number of school years, and classified as those having 9 years or less, 10–12 years and 13 or more years of education. In studies I–III the respondents were divided into those aged 20–34 years, 35–49 years and 50–64 years. In study IV age was adjusted for. Marital status (studies I–III) was categorised as married, single and divorced or widowed. In studies II and III the respondents were classified by the degree of urbanisation of their living area into those living in the capital area, other cities and rural municipalities. The distribution of the behaviours by each of the socio-demographic background variables is presented in Table 1.

5.3 Statistical methods

All analyses were conducted using SAS statistical software (SAS Institute Inc 1989). Methods suitable for dichotomised variables were applied, and the results from most analyses are presented as odds ratios. In statistical tests, 5% significance level was used and the results are reported with 95% confidence intervals. All analyses were carried out separately for men and women.

Accumulation of unhealthy behaviours was examined by comparing the occurrence of each possible combination of behaviours with that expected assuming the behaviours to be independent of each other (I). Expected proportions were calculated by multiplying the probabilities of the individual unhealthy behaviours. Confidence intervals for the ratios were calculated using the formula for confidence intervals for proportions considering expected frequencies as fixed values.

General log-linear models (Knoke 1981, Fienberg 1985) were fitted to examine key associations among the behaviours (I). A four-way contingency table (2*2*2*2 table), in which health behaviours served as the classifying variables, was taken as the basis of the analysis. A series of log-linear models of increasing complexity was fitted to the observed counts, starting with the model of independence and adding terms to the model in the order of their statistical significance. Interactions between the variables were interpreted to indicate mutual dependence among the behaviours. The simplest model that fitted the data adequately was searched for. The fit of the model was assessed by comparing the deviance to the degrees of freedom and

Table 1. Number of respondents and prevalence of individual unhealthy behaviours by sociodemographic background variables and gender

	N		Smoking (%)		High alcohol use (%)		Inactivity (%)		Unhealthy diet (%)	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Age group										
20-34	3914	4415	34	23	28	28	28	23	21	19
35-49	4600	5307	35	23	31	30	30	24	19	15
50-64	3678	4100	27	12	19	17	23	20	26	21
Education										
0-9 years	3777	3580	36	22	22	18	30	23	30	25
10-12 years	4007	4055	38	25	28	26	29	23	21	19
13+ years	4216	5961	24	16	31	30	23	22	14	13
Marital status										
Married	8313	9698	30	18	25	24	27	23	19	17
Single	2947	2376	35	24	30	31	27	21	27	19
Divorced	879	1689	49	27	35	27	26	22	30	23
Area										
Capital area	2010	2637	30	24	34	37	26	25	17	15
Other cities	5631	6350	34	21	28	26	26	22	20	17
Rural areas	4551	4835	31	16	22	20	30	22	25	21

evaluating the statistical significance of the terms added to the model. Complementary analyses were conducted to check how well the patterns detected in the whole population applied across sociodemographic groups. Each background variable was considered one at a time, and a procedure similar to that explained above was followed.

An index of unhealthy behaviours was compiled by summing up the values for the four behaviours, each unhealthy choice providing one point to the overall score (II). The score thus ranged from 0 to 4, higher values representing unhealthier combinations of behaviours. Analysis of variance (Fox 1997) was employed to compare the mean number of unhealthy behaviours across sociodemographic groups. One-way analysis was performed to examine the effect of each sociodemographic characteristic individually. Independent effects of the characteristics were examined by multi-way analysis of variance adjusting for all other sociodemographic characteristics. Univariate and multivariate logistic regression analyses (Hosmer and Lemeshow 1989) were similarly used to examine the proportion of those with three or four unhealthy behaviours. Interaction effects of the sociodemographic characteristics were tested for statistical significance and included in the model if they were significant at the 5% risk level.

Mantel-Haenszel odds ratios (Rothman 1986) were used to measure associations between each pair of behaviours (III). Breslow-Day test for homogeneity (Breslow and Day 1980) was employed to test whether the associations differed between sociodemographic groups. Stratum-specific odds ratios were calculated if the Breslow-Day statistic indicated sociodemographic differences. Co-occurrence of two unhealthy behaviours was examined across sociodemographic groups by comparing the proportion of those with two unhealthy behaviours to those with only one adverse behaviour.

Two sets of prospective analyses were conducted (IV). First, each behaviour in turn was selected as a predictor variable, and it was examined whether its value at the baseline measurement predicted other behaviours in the follow-up. Logistic regression analysis was used, adjusting for age and the baseline value of the outcome variable. Second, concurrent changes in the health behaviours were examined. Separate analyses were carried out for possible healthy and unhealthy changes in each behaviour. Four different cases were thus formed: both behaviours changed in a positive or negative direction, or one of them showed a positive change while the other changed negatively. When considering negative health behaviour changes, only initially positive cases were included and those who experienced a change in the other behaviour were compared with those with no such change. Similarly, for possible positive changes, only initially negative cases were included and those with a change in the other behaviour were compared with those whose behaviour remained

unchanged. Logistic regression analysis was again used, and adjustment for age was made. The proportion of those who changed each behaviour is shown in Table 2.

Table 2. Respondents' initial status in each health behaviour and the number and proportion of those who changed their behaviours over seven years by gender

	Men			Women		
	N	Changed (N)	Changed (%)	N	Changed (N)	Changed (%)
Smoking	655	188	29	525	139	27
High alcohol use	533	216	41	609	244	40
Inactivity	661	377	57	739	442	60
Unhealthy diet	585	398	68	670	483	72
High BMI	508	102	20	593	88	15
Nonsmoking	1454	67	5	2202	81	4
Low alcohol use	1696	254	15	2243	341	15
Activity	1433	214	15	1922	264	14
Healthy diet	1644	152	9	2182	194	9
Low BMI	1721	231	13	2259	344	15

6 RESULTS

6.1 Multiple associations among health behaviours

6.1.1 Accumulation of health behaviours

Study I examined multiple associations among health behaviours. The data were first divided into all 16 possible combinations that could be derived from the four behaviours after dichotomising them into unhealthy and non-unhealthy ends (Table 3). Distribution of the respondents into each combination was first viewed. Few people reported all four unhealthy behaviours while the proportion of those with none of them was relatively large. Among the mixed combinations, smoking and high alcohol use as the only unhealthy behaviours, as well as the pairwise combination of these two unhealthy behaviours, were relatively common. In contrast, the combination of high alcohol use, physical inactivity and unhealthy diet, as well as that of smoking, physical inactivity and unhealthy diet were infrequent.

The observed prevalence of each combination of health behaviours was then compared with their expected prevalence, calculated assuming the behaviours to be independent of each other. The ratio of observed and expected proportion was used to measure accumulation of unhealthy behaviours in the same individual. The combination of all four unhealthy behaviours showed the highest ratio of accumulation (Table 3). Among men, the combination of smoking, alcohol use and physical inactivity, and that of smoking, physical inactivity and unhealthy diet were also more prevalent than expected under the assumption of independence of the behaviours. Among women, all three-behaviour combinations that included smoking showed accumulation. In contrast, in both genders the combination without smoking was clearly less prevalent than would have been expected. Among the two-behaviour combinations, smoking and alcohol use as well as physical inactivity and unhealthy diet showed accumulation, while the other two-behaviour combinations were less prevalent than expected. The behaviours appearing alone were all relatively close to their expected prevalence, with the exception of smoking, which was clearly less prevalent than expected. To counterbalance the accumulation of unhealthy behaviours, the opposite end of all healthy behaviours also showed some accumulation.

The mixed combinations of three and two unhealthy behaviours were also examined without taking into account whether the remaining one or two behaviours were healthy or unhealthy (I, Table 3). When the combinations of three unhealthy behaviours were analysed regardless of the healthfulness of the fourth behaviour, all of them turned out to be more prevalent than expected if the behaviours were independent of

Table 3. Combinations of the unhealthy behaviours among men and women. Observed numbers, observed and expected proportions and their ratios with the 95% confidence intervals

				Men				Women			
S	A	E	D	Count	Obs %	Exp %	O/E ratio	Count	Obs %	Exp %	O/E ratio
1	+	+	+	+	261	2.4	0.9	2.7 (2.33-2.97)	105	0.9	0.3	3.2 (2.56-3.77)
2	+	+	+	-	568	5.3	3.6	1.5 (1.37-1.61)	317	2.6	1.3	2.1 (1.82-2.27)
3	+	+	-	+	262	2.5	2.4	1.0 (0.88-1.12)	160	1.3	0.9	1.4 (1.22-1.66)
4	+	-	+	+	189	1.8	1.3	1.4 (1.20-1.59)	139	1.2	0.8	1.5 (1.26-1.75)
5	-	+	+	+	103	1.0	1.4	0.7 (0.54-0.80)	69	0.6	0.8	0.7 (0.55-0.89)
6	+	+	-	-	1205	11.3	9.5	1.2 (1.13-1.26)	783	6.5	4.3	1.5 (1.41-1.61)
7	+	-	+	-	443	4.1	4.9	0.9 (0.77-0.92)	350	2.9	3.6	0.8 (0.73-0.89)
8	+	-	-	+	291	2.7	3.4	0.8 (0.72-0.90)	251	2.1	2.6	0.8 (0.71-0.91)
9	-	+	+	-	358	3.3	5.6	0.6 (0.54-0.66)	280	2.3	3.7	0.6 (0.55-0.70)
10	-	+	-	+	251	2.3	3.8	0.6 (0.54-0.69)	165	1.4	2.7	0.5 (0.44-0.59)
11	-	-	+	+	266	2.5	2.0	1.3 (1.10-1.40)	338	2.8	2.2	1.3 (1.13-1.40)
12	+	-	-	-	941	8.8	13.0	0.7 (0.64-0.72)	993	8.2	12.0	0.7 (0.65-0.73)
13	-	+	-	-	1491	14.0	14.8	0.9 (0.90-0.98)	1307	10.8	12.5	0.9 (0.83-0.91)
14	-	-	+	-	735	6.9	7.7	0.9 (0.83-0.96)	1173	9.7	10.4	0.9 (0.89-0.99)
15	-	-	-	+	573	5.4	5.3	1.0 (0.93-1.10)	898	7.4	7.4	1.0 (0.94-1.07)
16	-	-	-	-	2750	25.7	20.4	1.3 (1.22-1.30)	4730	39.2	34.7	1.1 (1.11-1.16)

symbols: S=smoking, A=alcohol use, E=physical inactivity, D=unhealthy diet, + =presence of the adverse habit, -=absence of the adverse habit

each other. When the combinations of two unhealthy behaviours were summed up without paying attention to the two remaining behaviours, the combinations of two unhealthy behaviours were also more prevalent than expected, with two exceptions: the combination of alcohol use and unhealthy diet was slightly less prevalent than expected, and that of alcohol use and physical inactivity did not differ from its expected prevalence.

6.1.2 Key associations among health behaviours

Multiple associations between the behaviours were then analysed by fitting general log-linear models (I). The aim of the modelling was to examine which associations are important determinants of the whole distribution of the behaviours. Because the order in which the terms are included in the models are indicative of their relative importance, the progress of the modelling that was not presented in the original articles is shown in Table 4. The modelling was carried out separately for men and women but it turned out to advance in the same order in both genders. All main effects, representing the individual behaviours, were included in the base model. Pairwise interactions between the variables, representing bivariate associations between the behaviours, were first added to the models in the order of their statistical significance. The interaction between alcohol use and physical inactivity was not statistically significant. The first three-behaviour interaction of smoking, alcohol use and physical activity was then added to the model. For women, this model was adequate and subsequent terms added to the model did not improve the fit. For men, the three-behaviour interaction of alcohol use, physical activity and diet was also needed to make the model fit. Thus, for women the final model included all two-behaviour interactions and the three-behaviour interaction of smoking, alcohol use and physical activity (deviance 3.53 on 4 df). Among men, the same model plus the three-behaviour interaction of alcohol use, physical activity and diet (deviance 4.43 on 3 df) was deemed the best fit.

Table 4. Fitting of the successive log-linear models on the associations between health behaviours

	Men			Women		
	Deviance	df	p-value	Deviance	df	p-value
Main effects	876.8	11	0.001	862.2	11	0.001
+Smoking*Alcohol use	398.0	10	0.001	234.9	10	0.001
+Smoking*Inactivity	194.0	9	0.001	141.1	9	0.001
+Inactivity*Diet	62.6	8	0.001	60.1	8	0.001
+Smoking*Diet	30.2	7	0.001	34.3	7	0.001
+Alcohol use*Diet	14.7	6	0.001	9.8	6	0.001
+Alcohol use*Inactivity	14.7	5	ns.	9.8	5	ns.
+Smoking*Alcohol use*Inactivity	8.4	4	0.01	3.5	4	0.01
+Alcohol use*Inactivity*Diet	4.4	3	0.04			

Table 5 shows odds ratios drawn from the parameter estimates of the final models. The three-behaviour associations were returned into three pairs of odds ratios, each conditional to the third behaviour.

Among men, smoking showed a positive association with alcohol use and physical inactivity, stronger when the third behaviour (physical activity or alcohol use, respectively) was unhealthy (Table 5). There was also a positive association between smoking and unhealthy diet as well as between inactivity and unhealthy diet, the latter again being stronger among high alcohol users. The association between high alcohol use and unhealthy diet was inverse, and it was stronger among the physically active. The association between alcohol use and inactivity depended on smoking status or the choice of diet: the association was positive when the third behaviour (smoking or diet) was unhealthy but inverse when the third behaviour was healthy.

Among women, all other associations were positive but the association between high alcohol use and unhealthy diet was inverse, and the association between high alcohol use and inactivity depended on smoking status, similarly to men. Overall, the conditional odds ratios were higher when the third behaviour was unhealthy.

Table 5. Associations between health behaviours according to the log-linear models by gender. Conditional odds ratios with the 95% confidence intervals

	Men	Women
SA among physically inactive	2.86 (2.46-3.33)	3.80 (3.19-4.53)
SA among physically active	2.30 (2.09-2.53)	2.94 (2.65-3.25)
SE among high alcohol users	2.06 (1.80-2.36)	1.85 (1.57-2.17)
SE among low alcohol users	1.66 (1.47-1.87)	1.43 (1.27-1.61)
SD	1.38 (1.25-1.52)	1.40 (1.26-1.56)
AE among smokers	1.05 (0.86-1.29)	1.16 (1.00-1.36)
AE among nonsmokers	0.86 (0.75-0.98)	0.90 (0.79-1.02)
AE among those with unhealthy diet	1.06 (0.92-1.22)	
AE among those with healthy diet	0.86 (0.75-0.98)	
AD (in men among physically inactive)	0.94 (0.80-1.11)	0.75 (0.67-0.84)
AD (in men among physically active)	0.76 (0.68-0.86)	
ED (in men among high alcohol users)	1.95 (1.67-2.28)	1.59 (1.43-1.76)
ED (in men among low alcohol users)	1.59 (1.39-1.82)	

symbols: S=smoking, A=alcohol use, E=physical inactivity, D=unhealthy diet

6.2 Sociodemographic determinants of multiple unhealthy behaviours

The above examination shows that while behaving in an unhealthy manner in several respects is relatively uncommon, people with four unhealthy behaviours can be found

and their number is larger than expected if the behaviours were independent of each other. Most combinations of three unhealthy behaviours were also more prevalent than expected. Study II examined sociodemographic characteristics of those with multiple unhealthy behaviours.

In both genders, those in the oldest age group and the most highly educated were least likely to have three or four unhealthy behaviours (Tables 6 and 7). Adjusting for other sociodemographic characteristics slightly increased the differences. Single men were more likely to engage in three or four unhealthy behaviours than married men, and divorced men did so most often. Among women, the married were least likely to have three or four unhealthy behaviours. Single women engaged in three or four unhealthy behaviours slightly more often than the divorced, but adjusting for other sociodemographic characteristics changed the order of these categories to show a similar marital pattern with men. Men had no differences between the living areas, but in women the proportion of those with three or four unhealthy behaviours increased with the increasing degree of urbanisation. In the mean number of unhealthy behaviours sociodemographic differences were small and statistically non-significant. However, the mean distribution showed a pattern similar to the proportion of those with three or four unhealthy behaviours.

Table 6. Mean number of unhealthy behaviours and the proportion of those reporting three or four unhealthy behaviours by sociodemographic characteristics among men. Means and odds ratios with the 95% confidence intervals, unadjusted and adjusted for the other sociodemographic characteristics

| | Mean | | Three or four unhealthy behaviours | | |
	Unadjusted	Adjusted	%	Unadjusted OR	Adjusted OR
Age group	p=0.21	p=0.12		p<0.001	p<0.001
20-34	1.10 (0.94-1.26)	1.26 (1.03-1.49)	9.8	1.57 (1.32-1.86)	2.05 (1.67-2.52)
35-49	1.14 (0.99-1.29)	1.28 (1.07-1.48)	9.8	1.57 (1.33-1.85)	1.86 (1.56-2.21)
50-64	0.94 (0.76-1.11)	1.01 (0.77-1.25)	6.5	1.00 (reference)	1.00 (reference)
Education	p=0.05	p=0.02		p<0.001	p<0.001
0-9 years	1.17 (0.99-1.35)	1.34 (1.11-1.57)	10.4	1.91 (1.62-2.27)	2.49 (2.07-3.00)
10-12 years	1.15 (0.98-1.32)	1.23 (1.01-1.45)	10.7	1.97 (1.67-2.32)	2.01 (1.70-2.38)
13+ years	0.90 (0.74-1.06)	0.98 (0.77-1.19)	5.7	1.00 (reference)	1.00 (reference)
Marital status	p=0.05	p=0.12		p<0.001	p<0.001
Divorced	1.39 (1.03-1.76)	1.39 (1.00-1.78)	14.0	1.97 (1.59-2.44)	1.93 (1.56-2.40)
Single	1.18 (0.98-1.37)	1.15 (0.93-1.38)	10.8	1.46 (1.27-1.69)	1.29 (1.10-1.51)
Married	0.99 (0.88-1.11)	1.01 (0.87-1.14)	7.6	1.00 (reference)	1.00 (reference)
Area	p=0.98	p=0.95		p=0.80	p=0.08
Capital area	1.05 (0.82-1.28)	1.21 (0.93-1.49)	8.9	1.04 (0.87-1.26)	1.24 (1.02-1.51)
Other cities	1.07 (0.93-1.20)	1.18 (0.99-1.36)	9.0	1.05 (0.91-1.20)	1.11 (0.96-1.28)
Rural areas	1.08 (0.92-1.23)	1.16 (0.96-1.37)	8.6	1.00 (reference)	1.00 (reference)

Interactions between the sociodemographic characteristics were few. For the mean number of unhealthy behaviours, none were observed. In the proportion of those with three of four unhealthy behaviours two interactions were found for both genders.

In both men and women education and age interacted (p<0.001 and p=0.007, respectively). In addition, men showed an interaction between marital status and age (p<0.001) and women between educational level and the degree of urbanisation of the living area (p=0.03).

Table 7. Mean number of unhealthy behaviours and the proportion of those reporting three or four unhealthy behaviours by sociodemographic characteristics among women. Means and odds ratios with the 95% confidence intervals, unadjusted and adjusted for the other sociodemographic characteristics

	Mean		Three or four unhealthy behaviours		
	Unadjusted	Adjusted	%	Unadjusted OR	Adjusted OR
Age group	p=0.04	p=0.03		p<0.001	p<0.001
20-34	0.95 (0.80-1.09)	1.09 (0.89-1.30)	6.8	3.17 (2.50-4.02)	4.47 (3.40-5.89)
35-49	0.92 (0.79-1.06)	1.04 (0.86-1.22)	6.3	2.91 (2.30-3.69)	3.65 (2.84-4.68)
50-64	0.69 (0.53-0.85)	0.75 (0.55-0.96)	2.3	1.00 (reference)	1.00 (reference)
Education	p=0.57	p=0.18		p<0.001	p<0.001
0-9 years	0.88 (0.70-1.06)	1.05 (0.83-1.27)	5.4	1.25 (1.04-1.52)	2.28 (1.84-2.83)
10-12 years	0.93 (0.77-1.10)	1.00 (0.81-1.20)	6.5	1.52 (1.28-1.82)	1.83 (1.53-2.20)
13+ years	0.82 (0.68-0.96)	0.83 (0.66-1.00)	4.4	1.00 (reference)	1.00 (reference)
Marital status	p=0.26	p=0.36		p<0.001	p<0.001
Divorced	0.99 (0.73-1.24)	1.06 (0.78-1.34)	6.8	1.58 (1.27-1.96)	1.89 (1.51-2.37)
Single	0.98 (0.76-1.19)	0.96 (0.72-1.21)	7.6	1.79 (1.49-2.15)	1.57 (1.30-1.91)
Married	0.82 (0.71-0.92)	0.86 (0.74-0.98)	4.4	1.00 (reference)	1.00 (reference)
Area	p=0.16	p=0.23		p<0.001	p=0.001
Capital area	1.03 (0.83-1.22)	1.10 (0.87-1.33)	6.7	1.54 (1.25-1.90)	1.56 (1.26-1.93)
Other cities	0.86 (0.74-0.98)	0.93 (0.76-1.09)	5.3	1.21 (1.01-1.44)	1.18 (0.99-1.42)
Rural areas	0.79 (0.65-0.93)	0.86 (0.67-1.05)	4.5	1.00 (reference)	1.00 (reference)

Young age and low education together increased the likelihood of having three or four unhealthy behaviours (II, Figure 1). Differences in the highest educational category were small, but in the lowest and the intermediate categories the likelihood of three or four unhealthy behaviours increased with lowering age. When age was examined together with marital status among men, it had a contrasting effect: multiple unhealthy behaviours were more common among the non-married in the two oldest age groups. Among the married differences between age groups were small. Among women a tendency for "urban" unhealthy behaviour was observed. Considering the combined effect of living area and educational level among women, the likelihood of three or four unhealthy behaviours varied only slightly. The effect of urbanisation turned out to be moderate when examined together with educational level.

6.3 Sociodemographic differences in the associations between health behaviours

In study I, log-linear modelling was used to check whether the associations observed between health behaviours were consistent across sociodemographic groups. Some sociodemographic differences were detected. However, only a few interactions between the behaviours were needed in the models as their influence may have been overwhelmed by the sociodemographic characteristics. Therefore, the results remain only suggestive. In study III sociodemographic differences in the associations between health behaviours were examined in more detail. The analysis was restricted to pairwise associations between the behaviours, which were examined in parallel by several sociodemographic characteristics.

Table 8 shows pairwise associations between health behaviours in the whole study population (see also I, Table 3). The strongest association was observed between smoking and high alcohol use. This association was especially strong among women. The associations between smoking and other unhealthy choices were also clearly positive, as was the association between physical inactivity and unhealthy diet. The association between high alcohol use and physical inactivity was weaker but positive, scarcely reaching statistical significance in women. The association between high alcohol use and unhealthy diet was inverse, but not statistically significant in men.

Table 8. Pairwise associations between health behaviours by gender. Mantel-Haenszel odds ratios with the 95% confidence intervals (compared with no association between the behaviours, OR=1.00)

	Men	Women
Smoking and Alcohol use	2.14 (1.97-2.33)	2.68 (2.46-2.92)
Smoking and Inactivity	2.16 (1.99-2.36)	1.70 (1.55-1.87)
Smoking and Unhealthy diet	1.58 (1.44-1.73)	1.51 (1.36-1.68)
Alcohol use and Inactivity	1.25 (1.15-1.37)	1.10 (1.00-1.20)
Alcohol use and Unhealthy diet	0.95 (0.86-1.05)	0.82 (0.74-0.91)
Inactivity and Unhealthy diet	1.82 (1.65-2.01)	1.62 (1.46-1.79)

Also in study IV pairwise associations between the behaviours were first viewed cross-sectionally (IV, Table 1). The results from the first and the second measurement were fairly consistent and in agreement with the above results. In addition, associations with relative body weight and the health behaviours were examined: being overweight was positively associated with inactivity and unhealthy diet. The association between overweight and alcohol use was positive in men but inverse in women. Smoking and overweight were not associated.

Table 9. Sociodemographic differences in the associations between health behaviours by gender. Mantel-Haenszel odds ratios with the 95% confidence intervals for the pairs in which the Breslow-Day statistic indicated differences at the 5% risk level (no association between the behaviours, OR=1.00)

Background variable	Men		Women	
Age group	Smoking*Unhealthy diet		Smoking*Alcohol use	Smoking*Unhealthy diet
20-34	1.40 (1.19-1.65)		3.72 (3.12-4.43)	1.19 (0.99-1.43)
35-49	1.64 (1.41-1.92)		2.56 (2.20-2.98)	1.66 (1.39-1.98)
50-64	1.93 (1.63-2.28)		2.69 (2.34-3.09)	1.51 (1.24-1.84)
Education	Alcohol use*Inactivity			
0-9 years	1.48 (1.26-1.74)			
10-12 years	1.34 (1.15-1.55)			
13+ years	1.10 (0.94-1.28)			
Marital status			Smoking*Alcohol use	
Married			2.40 (2.15-2.68)	
Single			3.38 (2.79-4.09)	
Divorced			2.75 (2.18-3.46)	
Area	Smoking*Unhealthy diet	Smoking*Alcohol use	Smoking*Alcohol use	Alcohol use*Inactivity
Capital area	2.13 (1.67-2.73)	1.64 (1.34-2.00)	1.98 (1.65-2.37)	0.95 (0.79-1.15)
Other cities	1.62 (1.41-1.86)	2.13 (1.89-2.40)	2.70 (2.38-3.07)	1.02 (0.89-1.17)
Rural areas	1.40 (1.21-1.62)	2.56 (2.22-2.96)	3.04 (2.58-3.58)	1.30 (1.10-1.53)

Sociodemographic differences in the associations between health behaviours were few. Only nine out of 48 possible associations showed statistically significant differences. Table 9 shows the pairs in which differences were detected. For men, the association between high alcohol use and physical inactivity was the weaker, the higher the educational attainment. The association between smoking and unhealthy diet was stronger for the older and the higher the degree of urbanisation of the living area. The association between smoking and high alcohol use was stronger in the less urbanised areas. For women, the association between smoking and high alcohol use showed most variation; this association was strongest among the least educated, single women and in the less urbanised areas. Furthermore, the association between smoking and unhealthy diet was weakest among the least educated, and the association between high alcohol use and physical inactivity was found only among rural women.

The prevalence of the individual unhealthy behaviours differs notably across sociodemographic groups (see Table 1). Since the prevalence of individual unhealthy behaviours and the strength of their association together determine the distribution of the behaviours within the sociodemographic groups, we also examined sociodemographic differences in the co-occurrence of unhealthy behaviours. The results showed that even if the associations between health behaviours were relatively similar in all sociodemographic groups, variation in their co-occurrence was remarkable (III).

6.4 Longitudinal associations between health behaviours

6.4.1 Health behaviours as predictors of each other

Pairwise associations between health behaviours were finally studied longitudinally (IV). The first aim was to examine whether each of the behaviours predicted other behaviours seven years later. In both genders, smoking at the baseline was associated with high alcohol use, inactivity and unhealthy diet in the follow-up (Table 10). In addition, smoking predicted overweight in women. High alcohol use predicted smoking in both genders, as well as physical inactivity in women. Compared with the initially active, those who were physically inactive at the baseline were more likely to have an unhealthy diet in the follow-up in both men and women. Furthermore, physical inactivity predicted overweight in women. Men with an unhealthy diet were more likely to be smokers and inactive, and less likely to be high alcohol users, than those with a healthy diet at the baseline. Being overweight was not associated with changes in any health behaviours in either gender.

Table 10. Unhealthy behaviours at the baseline as predictors of each of the other behaviours in the follow-up by gender. Odds ratios with the 95% confidence intervals, adjusted for age and the outcome behaviour at the baseline

Follow-up	Baseline measurement Smoking	High alcohol use	Inactivity	Unhealthy diet	High BMI
Men					
Smoking		1.5 (1.09-2.09)	1.2 (0.87-1.59)	1.5 (1.07-2.04)	1.2 (0.82-1.68)
High alcohol use	1.5 (1.18-1.88)		0.9 (0.73-1.16)	0.7 (0.58-0.96)	1.1 (0.85-1.44)
Inactivity	1.5 (1.20-1.92)	1.2 (0.91-1.50)		1.6 (1.28-2.07)	0.9 (0.72-1.24)
Unhealthy diet	1.3 (1.01-1.71)	1.1 (0.79-1.43)	1.3 (1.01-1.71)		0.8 (0.62-1.15)
High BMI	1.0 (0.76-1.29)	1.0 (0.74-1.30)	1.0 (0.74-1.25)	1.2 (0.95-1.63)	
Women					
Smoking		1.7 (1.23-2.38)	1.2 (0.90-1.72)	1.2 (0.87-1.75)	1.2 (0.82-1.80)
High alcohol use	1.7 (1.34-2.14)		1.1 (0.86-1.32)	0.8 (0.66-1.07)	0.9 (0.67-1.13)
Inactivity	1.4 (1.12-1.80)	1.3 (1.04-1.66)		1.1 (0.88-1.41)	1.3 (0.97-1.63)
Unhealthy diet	1.5 (1.15-1.99)	1.0 (0.73-1.30)	1.5 (1.14-1.86)		1.2 (0.92-1.59)
High BMI	1.4 (1.06-1.80)	1.0 (0.78-1.31)	1.4 (1.14-1.81)	1.1 (0.88-1.44)	

6.4.2 Concurrent changes in health behaviours

The second set of the longitudinal analyses examined whether changes in each health behaviour were accompanied by changes in the other behaviours. Table 11 shows concurrent changes in health behaviours in men. Smoking cessation was associated with an increase in physical activity (a positive change in inactivity). Quitters were also less likely to decrease physical activity (a negative change in inactivity) than those who continued smoking. Furthermore, smoking initiation was associated with an increase in physical inactivity. Quitters were more likely to gain weight than persistent smokers and smoking initiators were more likely to lose weight than those who remained non-smokers. Those who increased alcohol use were more likely to gain weight and less likely to lose weight than those who maintained a moderate

Table 11. Concurrent changes in health behaviours among men. Odds ratios with the 95% confidence intervals, adjusted for age

	Both changes positive	First mentioned positive, second mentioned negative	First mentioned negative, second mentioned positive	Both changes negative
Smoking*Alcohol use	0.7 (0.33-1.66)	0.8 (0.45-1.36)	0.5 (0.16-1.57)	1.2 (0.52-2.58)
Smoking*Inactivity	2.3 (1.19-4.63)	0.5 (0.23-0.99)	0.8 (0.29-2.09)	2.4 (1.12-4.97)
Smoking*Diet	2.1 (0.85-5.45)	1.2 (0.61-2.48)	1.2 (0.36-3.79)	1.4 (0.51-3.79)
Smoking*BMI	0.7 (0.12-3.79)	3.5 (2.03-6.19)	8.4 (1.49-47.64)	1.4 (0.67-3.09)
Alcohol use*Inactivity	0.9 (0.37-1.99)	0.9 (0.45-1.69)	1.1 (0.60-1.85)	1.2 (0.79-1.93)
Alcohol use*Diet	1.1 (0.34-3.51)	0.7 (0.30-1.63)	1.0 (0.50-2.09)	1.0 (0.59-1.74)
Alcohol use*BMI	0.5 (0.14-1.65)	1.3 (0.66-2.50)	0.3 (0.10-0.89)	1.9 (1.24-2.80)
Inactivity*Diet	0.8 (0.41-1.67)	0.6 (0.30-1.21)	0.8 (0.37-1.67)	0.7 (0.33-1.46)
Inactivity*BMI	1.7 (0.54-5.46)	0.9 (0.52-1.71)	0.5 (0.14-1.64)	1.2 (0.71-1.87)
Diet*BMI	2.4 (0.71-8.30)	1.4 (0.70-2.61)	0.5 (0.14-1.63)	1.7 (1.01-2.79)

level of alcohol use. In addition, a decrease in alcohol use tended to be inversely associated with weight loss, but this association did not reach statistical significance. Dietary change in an unhealthy direction was associated with an increase in body weight. Furthermore, weight loss tended to be often accompanied by an improvement in diet and rarely by a negative change in diet, but neither of these associations reached statistical significance.

In women, few statistically significant associations were observed (Table 12). Smoking initiation was associated with an increase in alcohol use. The positive association between smoking and alcohol use also received slight support from the tendency that a positive change in either of these behaviours was unlikely to be accompanied by a negative change in the other one. These two inverse associations were not statistically significant, however. Smoking cessation tended to be positively associated with an increase and inversely associated with a decrease in physical activity, but unlike in men these associations were not statistically significant in women. Women who initiated smoking were less likely to gain weight than those who remained non-smokers. The inverse relationship between smoking and body weight was also supported by the tendency of weight loss to be associated positively with smoking initiation and inversely with smoking cessation, but these associations did not reach statistical significance. A decrease in physical activity was accompanied by a negative change in diet.

Table 12. Concurrent changes in health behaviours among women. Odds ratios with the 95% confidence intervals, adjusted for age

	Both changes positive	First mentioned positive, second mentioned negative	First mentioned negative, second mentioned positive	Both changes negative
Smoking*Alcohol use	0.7 (0.32-1.58)	0.5 (0.26-1.13)	0.4 (0.16-1.04)	4.3 (2.33-7.84)
Smoking*Inactivity	2.1 (0.92-5.00)	0.6 (0.29-1.33)	1.6 (0.64-3.85)	1.3 (0.59-2.66)
Smoking*Diet	1.9 (0.57-6.57)	0.6 (0.27-1.29)	0.9 (0.26-3.16)	1.5 (0.67-3.57)
Smoking*BMI	0.1 (0.00-1.32)	1.3 (0.70-2.30)	2.1 (0.54-8.17)	0.3 (0.09-0.94)
Alcohol use*Inactivity	0.6 (0.30-1.30)	1.2 (0.66-2.25)	0.9 (0.52-1.43)	0.8 (0.51-1.23)
Alcohol use*Diet	1.2 (0.36-4.19)	0.8 (0.39-1.68)	2.0 (0.97-4.23)	1.0 (0.65-1.66)
Alcohol use*BMI	1.3 (0.22-7.88)	1.7 (0.95-2.90)	0.4 (0.14-1.31)	1.1 (0.76-1.59)
Inactivity*Diet	1.6 (0.71-3.63)	0.7 (0.41-1.37)	0.6 (0.30-1.22)	2.1 (1.28-3.38)
Inactivity*BMI	1.3 (0.29-5.75)	1.1 (0.68-1.74)	0.4 (0.14-1.32)	1.3 (0.89-2.03)
Diet*BMI	1.3 (0.38-4.29)	0.7 (0.38-1.18)	1.8 (0.78-4.26)	0.8 (0.49-1.37)

7 DISCUSSION

7.1 Overview of the main findings

The purpose of this study was to examine interrelationships among daily health behaviours and sociodemographic variation in these interrelationships among Finnish adults. The study sought to maintain a neutral perspective, examining multiple associations between the behaviours and several pairwise associations among them in parallel.

Several pairwise associations between health behaviours were observed. The findings agree quite well with previous studies. The association between smoking and high alcohol use proved to be especially strong in women, while the association between smoking and physical inactivity was more pronounced in men. There was no association between smoking and overweight, which is somewhat unexpected. However, neither was such an association observed in another Finnish study based on data from the 1970s (Rissanen et al. 1991), and a more recent study found that smokers weighed less than never-smokers only at the lowest educational level (Laaksonen et al. 1998). While the previous findings on the association between alcohol use and the other health behaviours (except smoking) have been inconsistent and the associations observed generally moderate, the present study established that unhealthy diet was positively associated with physical inactivity but inversely associated with high alcohol use. In agreement with our results, several studies reviewed by Hellerstedt and co-workers (1990) reported a positive association between alcohol use and relative weight in men but an inverse association in women. In comparison with the previous observational studies, fairly clear pairwise associations were observed between physical inactivity, unhealthy diet and being overweight.

All associations could not be reduced to pairwise associations, however. In both genders, a three-behaviour association between smoking, alcohol use and physical activity was observed. In addition, a three-behaviour association between alcohol use, physical inactivity and unhealthy diet was detected in men. In these combinations the association between any two behaviours was different depending on the third behaviour. While in most cases only the strength of the association varied according to the third behaviour, in the case of alcohol use and physical inactivity the direction of the association was also reversed.

Some of the associations observed may be more easily interpreted than others. For the positive association between smoking and alcohol use, for example, several alternative explanations have been offered (Bien and Burge 1990, Shiffman and

Balabanis 1995). These explanations range from those relying on physiological mechanisms to others building on social and situational linkages. The explanations are not mutually exclusive but in certain cultural settings some of them may be more important than others. Instead, for some of the associations observed a clear substantive interpretation may be harder to think of.

For the three-behaviour association of smoking, alcohol use and physical activity observed in both genders, one possible interpretation relates to the "hedonic" character of these behaviours. While many people may see smoking and alcohol use to be bad for their health but still a pleasurable activity, physical activity may be seen to be beneficial for health but unpleasant. However, other explanations relating to the social and cultural dimensions of these behaviours or to general personality features, such as susceptibility to addictions, must also be recognised. This three-behaviour association is certainly largely based on the relationship of smoking with high alcohol use and physical inactivity, but also the combination of high alcohol use and physical inactivity may play a part here. This combination turned out to be the most vacillating: high alcohol use and physical inactivity showed a positive association among smokers and among men with unhealthy diet, but not among non-smokers or men eating healthily. This combination may therefore have potential for the accumulation of several unhealthy behaviours when other behaviours are unhealthy.

The association between physical inactivity and unhealthy diet was also strong. This finding may point to another dimension of health behaviour that is separate from the use of the psychoactive substances, smoking and alcohol use. Both physical inactivity and unhealthy diet were also consistently related to the BMI, although perhaps more weakly than with each other. In contemporary societies, physical appearance has become an increasingly important issue, not least because it has been related to the themes of self-expression and self-identity (Featherstone 1991, Giddens 1991). Physical appearance can be affected by lifestyle choices, in which weight control is centrally involved. Choices related to physical activity and diet may therefore be centred around social values relating to body shape and physical appearance.

Although clear associations were observed between health behaviours, their distribution into different combinations was quite diverse. People behaving unhealthily in one respect were spread to numerous categories according to their other behaviours. For most people, health behaviour patterns consisted of both healthy and unhealthy components. Some combinations of unhealthy behaviours were relatively common, reflecting the prevalence of their individual constituents. This finding is consistent with the previous Finnish studies, reporting few people behaving unhealthily in several respects (Karisto et al. 1993, Prättälä et al. 1994), and similar to foreign studies (Blaxter 1990, Patterson et al. 1994) which have found mixed health behaviour patterns for most people.

The combination of all four unhealthy behaviours was more prevalent than expected if the behaviours were independent of each other, as were most combinations of three of them. The proportion of those with three or four unhealthy behaviours differed with respect to most of the sociodemographic background characteristics examined. Adjusting for other background characteristics did not diminish the differences. On the contrary, differences between age groups and educational categories tended to increase. Interactions between the sociodemographic characteristics were few. While some of the sociodemographic determinants tend to correlate with each other, these findings suggest that sociodemographic characteristics are relatively independent determinants of multiple unhealthy behaviours in the sense that they are not reducible or conditional to each other. The effect of having several unfavourable socio-demographic characteristics seems therefore to be cumulative. Even if behaving unhealthily in several respects is uncommon on the whole, in some population subgroups it may be common.

Sociodemographic differences in the associations between health behaviours were few. Furthermore, the differences observed were not consistent with respect to any of the sociodemographic characteristics. Even when differences were observed, only the strength of the association varied. High alcohol use and physical inactivity were not associated in urban women, but none of the health behaviour pairs showed a positive association in one sociodemographic group and an inverse association in another. Smoking was involved in most pairs that showed sociodemographic differences. Among women, differences were most often observed in the association between smoking and high alcohol use, yet this association was very strong in all sociodemographic groups. Three of the pairs (smoking and physical inactivity, high alcohol use and unhealthy diet, and physical inactivity and unhealthy diet) did not show differences with respect to any of the sociodemographic characteristics for either gender.

Given the clear sociodemographic variation in the prevalence of individual health behaviours, the similarity of their associations across sociodemographic groups is somewhat unexpected. However, since the prevalence of individual health behaviours and the strength of their association together determine how unhealthy behaviours are distributed, their co-occurrence varied remarkably across sociodemographic groups. Unequal distribution of health behaviours is likely to contribute to sociodemographic differences in morbidity and mortality (Davey Smith et al. 1994, Stronks et al. 1996). Since the associations between health behaviours were relatively similar across sociodemographic groups, these findings suggest that the excess risk posed by multiple unhealthy behaviours to any particular group is primarily determined by the high prevalence of individual unhealthy behaviours and only slightly modified by differences in the strength of their associations.

Several longitudinal associations between health behaviours were also detected. Smoking at the baseline predicted all other unhealthy behaviours but not being overweight in men. However, other behaviours also tended to predict smoking, although not all of these associations were statistically significant. Concurrent changes in health behaviours related to either smoking or body weight. Only in a few cases comparable changes were observed in both negative and positive directions. The results thus suggest that positive and negative health behaviour changes contribute differently to their existing associations. This is plausible since adoption and abandonment of health behaviours typically occur in different phases of the life cycle and can therefore be expected to have unmatching behavioural correlates.

All analyses were carried out separately for men and women. Gender differences in health behaviours are often anticipated because men and women occupy different roles and encounter different expectations. Empirical studies have indicated that men behave unhealthily more often than women, with the general exception of free-time physical activity (Cockerham 2000, Helakorpi 2000). However, the sociodemographic patterning of health behaviour is in many respects similar in both genders (Lahelma et al. 1997, Helakorpi et al. 2000). The present study showed that the associations between health behaviours were also largely similar in men and women. Some differences were evident, however: body weight and alcohol use were positively associated in men but inversely associated in women. Furthermore, changes in body weight were dissimilarly associated with changes in alcohol use and diet. In addition to the three-behaviour association between smoking, alcohol use and physical inactivity detected in both genders, there was also a three-behaviour association between alcohol use, unhealthy diet and physical inactivity in men. Furthermore, sociodemographic patterning of the associations was relatively similar in men and women. Indeed, few differences in the associations were detected between the sociodemographic groups in both genders. Sociodemographic determinants of having multiple unhealthy behaviours were also quite similar in men and women.

In order to evaluate their relative importance, all health behaviours were treated equally throughout the study. The results strongly suggest a primary role for smoking. In the pairwise analyses smoking was positively associated with all other unhealthy behaviours. Smoking appeared in most of the combinations that were more prevalent than expected assuming the behaviours independent of each other, and appeared alone less frequently than expected. However, it should be noted that the majority of smokers either only smoked or had only one other unhealthy habit. In the longitudinal analyses smoking was involved in most of the associations observed. Smoking predicted all other unhealthy behaviours but not being overweight in men. However, several other unhealthy behaviours also tended to predict smoking. Concurrent changes in health behaviours involved a change in either smoking or body weight.

Why does smoking seem to play as central a role in the associations between unhealthy behaviours? Among the behaviours examined, smoking stands out as the most distinctive unhealthy habit. In public discussion, harmful health consequences of smoking may even have become increasingly emphasised over time. Nowadays few people deny the risks of long-term smoking. Smoking may thus be a marker of people for whom health is not a salient issue, and therefore these people are also more likely to engage in other health-damaging behaviours. However, it is likely that smoking is just one important component in a broader constellation of behaviours that emerges from the overall way of life. Consequently, smoking should be considered not only as a separate health behaviour or together with other health-related behaviours, but as a part of other everyday activities, social interaction and time consumption.

7.2 Methodological considerations

The data used in the study were based on postal surveys. Postal surveys are usually considered rather efficient and reliable means of data collection, although several possible sources of bias exist, the main bias arising from inadequate sampling, incomplete response and inaccurate reporting.

Data in studies I–III derived from annually repeated cross-sectional surveys. Each survey was based on a large representative random sample with a reasonable, although gradually decreasing response rate. The response activity has been higher for women than for men and increased with age and educational attainment (Helasoja 1998, Keski-Karhu 1998). Little is known whether respondents differ from non-respondents in their health behaviour. Comparison between the early and late respondents did not point to remarkable underestimation of smoking (Berg et al. 1993), but non-respondents were likely to consume higher amounts of alcohol than those who agreed to participate (Helasoja 1998). Other studies have found differences in smoking, alcohol use and physical activity between respondents and non-respondents, although not always in the expected direction (Smith and Nutbeam 1990, Hill et al. 1997). The present study focused on the associations between health behaviours. Selective drop-out may lead to underestimation of the true associations if those with several unhealthy behaviours are less likely to respond than those with fewer of them. Sociodemographic differences may also be larger than observed if the members of those groups where unhealthy behaviours are frequent are less willing to participate. However, such differences would have to be considerable to have a significant effect.

Since relying on self-reports, this study is susceptible to bias resulting from inaccurate reporting. The questions concerned relatively regular and presumably long-standing behaviours and, when retrospective, did not go back to the distant past. Recall bias is therefore likely to be modest. However, people may either consciously or

unconsciously distort their answers in order to present themselves in a more flattering light, especially since many of the behaviours examined may be considered sensitive issues and subject to social approval or disapproval. Respondents may tend to report answers that are believed to be expected and accepted. Therefore, the results may underestimate the strength of the associations between the behaviours.

Follow-up data of the respondents to the surveys of 1989 and 1990 were used in study IV. Considering the length of the follow-up period the response rates were reasonable. With a follow-up data a twofold drop-out is experienced, but of primary interest is the change between the surveys. Respondents and non-respondents to the follow-up can be compared by their answers to the baseline measurement. Comparison of the background characteristics showed that the non-respondents were somewhat younger and less educated than the respondents to the follow-up. After adjusting for age, both male and female non-respondents had poorer diets than the respondents (p<0.001). Male non-respondents were also more often smokers (p<0.001) and inactive (p=0.003) than those who agreed to participate. Non-respondents did not differ from respondents with respect to alcohol use or body weight.

Table 13 shows baseline associations between the behaviours among those who responded to the follow-up and those who did not. In general, differences between the respondents and the non-respondents were quite small. Some of the associations observed among the respondents seemed to be slightly stronger among the non-respondents. When there was no association between the behaviours among the respondents, neither was such an association found among those who refused to participate in the follow-up. How these differences may influence the longitudinal findings of this study is doubtful, but possibly the associations of moderate strength are slightly underestimated.

Table 13. Baseline associations between health behaviours among the respondents and non-respondents to the follow-up by gender

	Men		Women	
	Respondents	Non-respondents	Respondents	Non-respondents
Smoking*Alcohol use	1.9 (1.55-2.34)	2.6 (1.97-3.50)	3.7 (3.02-4.53)	4.2 (2.81-6.24)
Smoking*Inactivity	2.0 (1.61-2.36)	2.2 (1.65-2.90)	1.8 (1.45-2.18)	1.7 (1.20-2.50)
Smoking*Diet	1.7 (1.39-2.09)	2.1 (1.56-2.78)	1.4 (1.11-1.73)	1.8 (1.22-2.62)
Smoking*BMI	1.0 (0.79-1.24)	1.0 (0.70-1.37)	1.1 (0.84-1.40)	0.7 (0.45-1.20)
Alcohol use*Inactivity	1.1 (0.85-1.30)	1.1 (0.82-1.51)	1.2 (1.01-1.51)	1.0 (0.65-1.46)
Alcohol use*Diet	1.1 (0.91-1.41)	0.9 (0.63-1.21)	0.9 (0.75-1.17)	1.1 (0.69-1.63)
Alcohol*BMI	1.3 (0.99-1.61)	1.1 (0.79-1.62)	0.8 (0.65-1.07)	0.8 (0.47-1.35)
Inactivity*Diet	2.0 (1.67-2.49)	1.8 (1.31-2.39)	1.5 (1.20-1.76)	1.9 (1.36-2.76)
Inactivity*BMI	1.2 (1.00-1.55)	1.6 (1.13-2.19)	1.3 (1.01-1.55)	1.7 (1.12-2.54)
Diet*BMI	1.4 (1.09-1.72)	0.9 (0.63-1.29)	1.3 (1.04-1.60)	1.1 (0.74-1.71)

The social desirability bias can be encountered also in a follow-up data. If those who distort their answers in one behaviour also do so in the other behaviours, this could attenuate the associations observed. However, in longitudinal studies the social desirability bias is likely to be smaller than in cross-sectional studies, as the bias has already been partly controlled in the initial survey (Stott and Pill 1992).

Overall, the indicators of the unhealthy behaviours were fairly general. Each behaviour was measured with one or a couple of simple questions. However, in epidemiological studies even simple measures of health behaviours have proved to be predictive of mortality from the chronic diseases (Wingard et al. 1982, Theobald et al. 1999). Moreover, although the view about people's health behaviour provided by postal surveys of this kind is necessarily rather crude, the data are adequate to examine differences between broad sociodemographic groups.

The validity of self-reports has often been questioned, especially as regards smoking, alcohol use and overweight. Self-reported smoking can generally be considered rather reliable (Patrick et al. 1994). The smoking questions used in this study have been validated with cotinine tests using data from North Karelia (Laatikainen et al. 1999). The underreporting of smoking proved to be only moderate. If all non-smokers with serum cotinine level exceeding 10 ng/ml were considered daily smokers, the prevalence of smoking increased from 29% to 32% among men and from 13% to 16% among women. Underreporters did not differ from accurate reporters with respect to the sociodemographic background variables examined. Also estimates from the present survey suggest a slight underestimation of the prevalence of smoking (Keski-Karhu 1998).

The amount of alcohol use may be considerably underestimated in self-reports. Postal surveys capture only a small proportion of the consumption recorded in the sales statistics. In accordance with other studies (Simpura et al. 1997), the consumption reported in the present survey was slightly less than half of the official consumption (Helasoja 1998). This is likely to mainly follow from two reasons. First, alcoholics and heavy drinkers, consuming approximately half of all alcohol in Finland (Mustonen et al. 1999), are presumably more likely not to respond at all. Second, those who participate tend to underestimate their consumption. In the present study the exact measurement of alcohol use was not crucial because the values were not used as such but people were only ranked according to their consumption. If the respondents at all levels of alcohol use underestimate their consumption similarly, the results will not be affected. There is some evidence, however, that heavier alcohol users tend to distort their answers more than moderate alcohol users (Poikolainen 1995). Nevertheless, this is unlikely to substantially alter people's relative standing regarding their alcohol use.

Since there has recently been much debate about the healthfulness of moderate alcohol consumption, underestimation of alcohol use is a particularly prominent issue. There is evidence that the risk posed by alcohol consumption would be J-shaped, at least concerning coronary hearth disease and stroke (Poikolainen 1995, Svardsudd 1998). However, some of the beneficial effect attributed to moderate alcohol use may be explained by other healthy habits of moderate drinkers (Andreasson 1998, Chick 1998). Unpublished analyses of the present data showed that, with the cut-off points used in study I and elsewhere (Luoto et al. 1998), the overall mortality was considerably higher among heavier alcohol users, whereas cardiovascular mortality, although based on relatively few cases, showed higher rates among lower alcohol users (Riitta Luoto, personal communication 26 March 1999). The cut-off points used for heavy drinking in the present study are within the safe limits. However, although moderate drinking may be beneficial to health compared with abstaining, heavier drinkers under focus here still have the greatest risk of all.

On average, relying on self-reports underestimates people's actual weight. The reporting bias may not be independent of the respondents' weight, however. What is called the flat slope syndrome suggests that overweight people tend to underreport their weights while the underweight may be inclined to overestimates (Kuskowska-Wolk et al. 1992). In a Finnish study (Jalkanen et al. 1987), women mostly underreported their weights whereas in men divergence from the accurate weight was observed in both directions. Underreporting was larger among women than men and more common among younger people than the older. Slight differences were also observed by family income, and by educational level and living area among women. Overall, however, differences between self-reported and measured weights were small. In the present study people belonging to the highest quartile of relative weight were considered being overweight. While not matching exactly with any of the various cut-points commonly used for overweight or obesity (Kuczmarski et al. 1994, WHO 1998), this classification provided a reasonable borderline for overweight. It is unlikely that differences in underreporting between lighter and heavier respondents are so large that those classified as being overweight would not represent heavier respondents.

With regard to physical activity and diet, the potential bias introduced by reliance on self-reports cannot be excluded, but in the measurement of these behaviours other limitations may be more prominent. Only free-time physical exercise was considered here. Several areas of activity equally or perhaps even more important for health, including work-related activity, activity earned in commuting to and from work, and other activities of lower intensity such as household work or gardening, were omitted. Concentrating exclusively on free-time physical activity is commonplace in health behaviour and health lifestyle research. This practice may be justified as free-time physical activity more clearly than some other forms of activity involves the element

of choice, but may be criticised for being based on middle class values and ways of life. The cut-off point for inadequate physical activity was again relatively low. In order to contribute to good health, physical activity has to be carried out regularly and with sufficient intensity. However, even moderate physical activity is beneficial compared with totally sedentary behaviour (European Heart Network 1999).

A sum index was used as an indicator of dietary behaviour. The index was based on the frequency of consumption of three selected foods that may contribute to chronic disease occurrence. Saturated fat use (Kromhout et al. 1995, Nelson 1998) was measured by the fat content of milk drank and the type of spread used on bread. Although the validity of these conventional indicators of dietary fat intake may have decreased since the consumption of cheese has increased and the sources of fat have become more versatile, they are still among the best indicators of saturated fat content of the diet (Roos et al. 1995). The intake of bread is related to the consumption of dietary fibre (Kritchevsky and Bonfield 1997) and that of vegetables to the intake of antioxidant vitamins (Steinmetz and Potter 1996, Ness and Powles 1997). Critique has been presented towards additive scoring of diverse health-related practices (Slater and Linder 1988, Dean and Salem 1998). However, as a measure of the overall quality of diet a combination of three components was preferred to the choice of any single food.

Health behaviours examined in this study were measured using different scales. In order to handle them uniformly, all health behaviour variables were dichotomised. A limitation that follows from this procedure is that some information is lost when categories are combined. Furthermore, the cut-off points could not be determined merely on the basis of the supposed health effects of engaging in these behaviours. With respect to the current recommendations, some of the cut-off points used in this study were relatively low. Nevertheless, the cut-off points are always somewhat conventional and there is no strict limit where the health risk associated with these behaviours would sharply increase.

The cut-off points were partly determined by practical reasons. It was necessary for the methods used that the proportion of those behaving unhealthily in each behaviour was roughly equal. Approximately one quarter of the respondents were classified as behaving unhealthily in each respect. Some cut-off points were different for men and women, making exact numerical comparison of the results between the genders unwarranted. The cut-off points also varied slightly between the studies. In studies I, III and IV pairwise associations between health behaviours were examined using slightly different cut-off points. The associations are broadly similar, suggesting that the results are not highly sensitive to the cut-off points used.

7.3 Towards health-related lifestyle

This study examined associations among health behaviours and sociodemographic differences in these associations relying on the health-related lifestyle concept. Here, the suitability of the concept for health behaviour research is viewed, especially as regards the data and the methods applied in the present study.

Four health behaviours were included in the study. As these behaviours are entwined with the daily routines and more or less spontaneously practised, they constitute a consistent and meaningful set. These behaviours also have well-established effects on the major chronic disease outcomes. However, considering the comprehensiveness of the notion of lifestyle, concentrating on only four behaviours may not be entirely satisfactory. This limitation may also affect the interpretations given to the associations observed. While health-related lifestyles may include components that have either adverse or beneficial consequences for health, they should nevertheless form coherent entities. As part of everyday life, health behaviours included in this study have several other meanings not related to health. The coherence and meaningfulness of the health behaviour patterns may spring from their other meanings, but examining only a few behaviours selected on the basis of their potential health effects may not reveal their meaningfulness in these other contexts.

In addition to behaviours, values, attitudes and orientations have sometimes been considered to be part of health-related lifestyle (Aarø et al. 1986, Abel 1991). These elements were not included in the present study. This is not to deny or underestimate their importance in explaining health behaviour or their potential as equally informative indicators of lifestyles as the actual behaviour. However, these factors can also be seen as intermediary factors between the social environment and behaviour, which get their ultimate expression at the level of behaviour (Veal 1993). Moreover, examining only sociodemographic background characteristics neglects a range of cultural and situational determinants of health behaviour. While these factors are undeniably important in explaining health behaviour and health behaviour patterns, this study followed the usual conceptualisations of health lifestyles that concentrate on their sociodemographic determinants.

All conceptualisations of lifestyles include the element of individual choice. One feature of the behaviours examined, especially smoking and drinking, that seems to contradict this element is their addictive nature. In the health-related lifestyle approach choices are not considered to be entirely free, but addiction is not usually included among the factors that constrain them. Addiction may make abandonment of these behaviours more difficult than it would otherwise be. Also illnesses and other "force majeure" factors may similarly influence the adoption or abandonment of one specific behaviour and thus interfere with the emergence of health behaviour patterns.

The concept of lifestyle is best suited to describe relatively stable and slowly changing phenomena. Health behaviours and their combinations are also assumed to be relatively stable and persistent over time. The concept of health-related lifestyle is often used to refer especially to long-term patterns of behaviour (Bruhn 1988, Green and Kreuter 1991, Abel and McQueen 1995). The stability of health behaviour is also supported by some empirical research (Breslow and Enström 1980, Stott and Pill 1992, Mulder et al. 1998). Differences observed between birth cohorts, for example in saturated fat use (Jousilahti et al. 1996) and smoking (Laaksonen et al. 1999), imply that generations may maintain typical features of health behaviour over time. However, sometimes people do change their health behaviours. The concept of health-related lifestyle is ill-suited to such situations, as it does not suggest what happens when changes take place in one health behaviour: should other behaviours change as well or should they remain unchanged? Longitudinal examination of the associations in study IV suggests that more theoretical attention should be paid to situations in which behaviours change. In study IV, pairwise associations between health behaviours were examined. Investigating the stability of multiple health behaviour patterns and whether longitudinal associations between health behaviours are influenced by other behaviours would have corresponded to the concept of lifestyle more fully. However, these findings are a step forward as they indicate that health behaviour changes are not independent of other behaviours.

As discussed above, the indicators of health behaviours used in this study were rather crude. The crudeness of the measurements may be seen to be problematic regarding the subject matter of this study, as differences in lifestyles may rest on subtle distinctions. Activities labelled here as health behaviours may be especially important for differentiation and integration owing to the high symbolic value attached to many of them. As traditional structural constraints may have weakened and identities based on them blurred, social distinctions increasingly derive from symbolic differences which, as it has been argued, have become finer and finer. It may be argued that tobacco brands rather than smoking as such makes the difference (Rahkonen 1994). Instead of the division between drinking and non-drinking the distinctions may be based on what you drink, and cross-country skiing may have entirely different social meaning than downhill skiing (Roos 1989), even if these activities were equally appraised in the health discourse. However, this may not be the only important level of distinctions. At a more general level, smoking itself continues to be an important symbol, and may even be growing in importance, especially when the public opinion about it seems to have turned more negative. Similarly, abstaining from drinking or exercise while commonly practised may be highly significant and distinctive. It is therefore reasonable to examine health-related lifestyles also at this level of these behaviours.

The sphere of the general lifestyle concept is broad. Because it has been used in several different and often unspecified meanings, even the need for the whole concept

has been questioned. What is essential in the concept is that it describes relatively stable and coherent patterns of behaviour influenced by external conditions. It may be argued that just the comprehensiveness is the strength of the concept. A concept that describes everyday life as a structured whole is needed (Sobel 1981, Allardt 1986, O'Brien 1995, Chaney 1996). The concept of health-related lifestyle faces similar problems. Most importantly, the number of possible behaviours to be included in its sphere is large and these behaviours can have several different meanings. Roos (1985, see Töttö 1997) has argued that the research on lifestyles should be based on qualitative methods, which may better grasp the specific meanings of actions and which do not have to be restricted to a predefined set of behaviours. However, the concept of lifestyle is equally valuable in quantitative studies that describe the whole of health-related behaviours. This study has shown that patterns of health behaviour exist and these patterns are in part socially structured.

7.4 Conclusions, implications and further research

Ever since chronic diseases replaced infectious diseases as the principal causes of morbidity and mortality, various forms of health behaviours have been important targets for public health efforts that are aimed at promoting health and preventing disease. During the last decades these efforts have gradually widened to encompass a broader and broader spectrum of activities. Although increasing attention has been paid to social, economic and environmental determinants of health, personal health behaviour remains a central target for health promotion (MacDonald and Bunton 1992, Downie et al. 1996).

Public health efforts that aim to increase healthy behaviours consist of activities undertaken at many levels, ranging from individual-level counselling to collective measures realised through health and social policies and working on the environmental determinants of these behaviours (Jones and Sidell 1997, Watson and Platt 2000). Viewing lifestyle as a socially structured whole would better seem to agree with the more comprehensive approaches in which administrative, legislative and other policy measures are used as the primary means of health promotion. When health behaviours are seen to be embedded in the routines of everyday life, promoting healthy behaviours will necessarily require attention to social norms, cultural values as well as socio-economic and environmental circumstances in which these behaviours are practised. However, although health behaviour of the population is affected primarily through health and social policies, also interventions that target health behaviours more directly can have their own influence (Green and Kreuter 1991).

The lifestyle approach implies that since health behaviours are not only individual choices but economically and culturally constrained and more or less routinised

practices, health behaviours and their patterns are maintained with some consistency over time. A change in health behaviour therefore requires sustained efforts and, in addition to providing cues for action, attempts to promote healthy behaviours should involve breaking the routine of already established behaviours (Hunt and Martin 1988, Bennett and Murphy 1997).

Several associations between health behaviours were observed in this study. The finding that health behaviours are not unidimensional in relation to health suggests that motives other than health concern also determine their patterning. For successful health promotion it is important to consider what the non-health-related motives for engaging in these behaviours are. Attempts to promote healthy behaviours will be more adequate if they do not counter the demands of the social environment. The concept of health-related lifestyle is useful in drawing attention to the other meanings that health behaviours may have as part of people's everyday activities.

This study found that people behaving unhealthily in one respect were spread to numerous categories according to their other behaviours. Therefore, public health programmes directed to the presumably uniform groups of smokers or physically inactive, for example, may have reduced effectiveness. More effort should be devoted to profiling those with unhealthy behaviours. As a midway between the population-based and the high-risk approaches (Rose 1992), identifying large population segments with unhealthy behaviours might be the most effective way of targeting public health programmes. Among the several kinds of correlates for health behaviours, sociodemographic characteristics have shown quite clear and consistent associations with various unhealthy behaviours. This study showed that while the associations between health behaviours were relatively similar across population groups, sociodemographic variation in their co-occurrence was also considerable. Even if sociodemographic differences in unhealthy behaviours are well-known, the use of this information in public health activities is limited (Prättälä et al. 1999). In spite of the favourable overall trends in many behaviours, differences between the population groups have not diminished. It seems that activities that have not been specifically targeted may not adequately benefit the population subgroups with the most need.

Since the risk of adverse health outcomes increases with the increasing number of unhealthy behaviours, those with multiple unhealthy behaviours form a particularly important target group for health behaviour interventions. Sociodemographic characteristics are relatively independent determinants of multiple unhealthy behaviours. Hence, in population groups with several unfavourable characteristics behaving unhealthily in several respects may be widespread. Special attention should be focused on these population groups and their social circumstances. However, as the effects of the sociodemographic characteristics are independent, decreasing the differences that exist with regard to any of the characteristics is already likely to reduce the risk associated with unhealthy behaviours in these subgroups.

Health behaviour interventions typically address health behaviours as separate entities. Since the behaviours are not practised independently of each other, the possibility of targeting several health behaviours at the same time is worth considering. Public health programmes might achieve greater benefits if interventions were purposefully tailored for specific health behaviour combinations.

There are arguments both in favour of and against multiple interventions. Some evidence suggests that the combined effect of at least some unhealthy behaviours would rather be synergistic than simply additive. Thus, larger reductions in morbidity and mortality might be achieved if those with several unhealthy behaviours would change their behaviour. The present study showed that the co-occurrence of several unhealthy behaviours was primarily determined by the prevalence of individual unhealthy behaviours and only slightly modified by how they were associated. This would render individual unhealthy behaviours the primary target for health promotion. However, associations between health behaviours may imply that these behaviours belong to larger combinations of behaviours that exceed the boundaries of sociodemographic groups. Also combinations of behaviours could therefore be targeted.

This study suggests a central role for smoking in the associations between health behaviours. Hence, by intervening in this behaviour we could possibly hope for favourable side-effects in other behaviours. In the forming of associations and lifestyle patterns one possibility is that one behaviour more or less directly leads to other behaviours. In this study many of the behaviours predicted other behaviours over seven years. As smoking played a primary role also as a predictor of other unhealthy behaviours, smoking could act as a behaviour that promotes the adoption or inhibits the abandonment of other health behaviours. However, other health behaviours also tended to predict smoking. Bidirectionality of the relationship may suggest that the behaviours result from common antecedents. In that case, prevention efforts would need to look beyond the immediate behaviours to address the factors that may initially predispose people to engage in them.

When one behaviour is changing, can we expect changes in other behaviours as well? Previous studies have provided contrasting findings. Furthermore, these findings often come from small-scale interventions implemented in a primary health care setting and may not apply to spontaneous changes in the general population. On the basis of the present study, certain changes in smoking and body weight can be expected to be accompanied by changes in other behaviours. However, these changes were not always parallel: positive changes were not necessarily associated with other positive changes and negative changes with negative ones. Concurrent changes found in this study to go together spontaneously should be taken into account in health

behaviour interventions by making efforts to support naturally occurring concurrent positive changes and to avoid negative changes related to them.

This study examined associations among health-related behaviours in Finland during the 1990s. Whether the findings are similar in other cultural settings or at some other point in time remains a question for further research. The present study concentrated on four behaviours practised on a daily basis. Among these behaviours, smoking seemed to play a primary role as a determinant of associations between and co-occurrence of the behaviours. The importance of smoking is prominent since it is the behaviour that poses the most explicit and definite risk to health. In future research and health promotion, special attention should be paid to the association between smoking and other health behaviours. Future research should also include a larger number of behaviours to further elucidate the interpretation of the associations among these behaviours within the health-related lifestyle approach.

ACKNOWLEDGEMENTS

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