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RESEARCH

Clarissa Bingham

Eating Habits of Young Men in Military Service

An Epidemiological and Intervention Study

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ACADEMIC DISSERTATION

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Department of Lifestyle and Participation
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Abstract

Bingham Clarissa. Eating habits of young men in military service. An epidemiological and intervention study. National Institute for Health and Welfare (THL). Research 95. 162 pages. Helsinki, Finland 2012.
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For young men, military service is a life phase between familiar life at home and an independent adult life. At that time, they are shifting from family conditions to self-contained decisions about their future and way of life. These choices include also eating habits with possible positive or negative health implications later in adulthood. In Finland, all men are liable to military service and a clear majority of them (ca. 80%) completes service. The increasing prevalence of overweight and obesity also in soldiers has raised concerns about conscripts' eating habits. The setting of this dissertation, i.e. the military environment, enables a unique opportunity to reach and impact the majority of healthy young men. This dissertation offers knowledge of conscripts' eating habits both in institutionalized conditions and during free-time.

The aims of this dissertation are to: 1) gather knowledge of young men's eating habits before and during military service 2) identify determinants of young men's healthy and unhealthy eating and associations of diet on health risk factors 3) conduct an intervention in the military setting to promote healthy eating and evaluate its effects.

The materials and methods of this dissertation are: 1) Conscripts in garrison, leave (n=47), and encampment (n=31) conditions, whose eating habits were explored by food diaries 2) Young men entering military service (n=2905) whose eating habits, sociodemographic background factors and health behaviours were explored cross-sectionally 3) Young men performing military service (n=256) who were followed six months. Data on them was collected by dietary food frequency questionnaires (FFQ) and by anthropometric and clinical health risk factor measurements 4) Men performing military service (n=604) who were divided into Intervention Group (n=362) and Control Group (n=242). For Intervention Group, healthy food supply was increased in military eating environments of garrison canteens and soldier's home cafeterias. Dietary data was collected by FFQ before/beginning of military service, at the 8th week and 6th month of military service. Datasets 2-4 belonged to the controlled two-phase DefenceNutri intervention study where main dietary outcome measures were food indexes. These were developed specifically for studying the diet of young men and to be applicable in the military setting.

Before military service the daily diet of conscripts contained mainly foods recommended for a healthy diet. Though, the consumption of fruit and vegetables was low. Less-nutritious foods were usually consumed at most once a week. Health behaviour indicators predicted eating habits so that already healthy habits associated

with healthy diet and vice versa. Education level was positively associated with eating habits and the diet was healthier in the summer than in the winter.

During military service, conscripts' energy intake was adequate and intakes of other nutrients met recommendations. Only fibre intake did not meet the recommendation and salt intake exceeded it clearly. Differences between military conditions manifested so that at garrison, proportions of energy-yielding nutrients were closest to recommendations and micronutrient intakes were high. Energy intake was high at physical encampment conditions. During free-times proportions did not respond to recommendations as well, micronutrient intakes were lower and sugar intake high.

Fibre-containing foods, specifically cereal foods, belonged to military eating and their consumption increased during six months of service. Use of nutrient-poor foods, such as soft drinks and pizza, prevailed during free-times.

Conscripts had only few health-threatening health risk factors. In the course of service, the proportion of overweight men decreased and body composition improved. Systolic blood pressure and HDL cholesterol improved but total cholesterol, triglyceride and glucose levels deteriorated. High consumption of fibre- and sugar-containing foods was associated with lean body composition and vice versa.

The controlled intervention to improve conscripts eating habits showed several positive changes. In Intervention Group, cereal foods were used more than in Control Group during follow-up. Also in Intervention Group, the consumption of several fat- and sugar-containing foods was lower compared to Control Group. The intervention did not increase fruit and vegetable consumption.

Results relieved both positive and negative findings on young men's diet and health. Their core diet contained several healthy foods which consumption increased during military service. Unfortunately, also the consumption of some unhealthy foods increased especially in free-time. During service, body composition improved but of clinical health risk factors some improved and others deteriorated.

Already in early adulthood, clustering takes place in young men's eating habits, other ways of life and health risk factors. Healthy food habits of conscripts' can be supported by promoting the food supply in garrison canteens and soldier's home cafeterias. Effective impacting of individual choices, such as low fruit and vegetable consumption, is more challenging as is measuring effect.

Keywords: dietary habits, nutrients, energy intake, young adults, men, soldiers, risk factors, intervention studies, nutrition index

Tiivistelmä

Bingham Clarissa. Eating habits of young men in military service. An epidemiological and intervention study. [Nuorten miesten ruokatottumukset varusmiespalvelusaikana – Epidemiologinen ja interventiotutkimus]. Terveyden ja hyvinvoinnin laitos (THL). Tutkimus 95. 162 sivua. Helsinki, Finland 2012.
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Varusmiespalvelus on nuorilla miehillä elämänvaihe tutun lapsuudenkodin ja itsenäisen aikuisuuden välissä. He ovat siirtymässä perheoloista tekemään itsenäisiä päätöksiä tulevaisuudestaan ja elintavoistaan. Päätöksiin sisältyvät myös ruokatottumukset, joilla voi olla myönteisiä tai kielteisiä vaikutuksia terveyteen myöhemmin aikuisuudessa. Suomessa kaikki miehet ovat asevelvollisia ja pääosa (n. 80 %) suorittaa varusmiespalveluksen. Ylipainon ja lihavuuden yleistyminen myös sotilaissa on herättänyt huolta varusmiesten ruokatottumuksista. Tämän työn kehys, armeijaympäristö, antaa ainutlaatuisen mahdollisuuden tavoittaa ja vaikuttaa valtaosaan nuorista terveistä miehistä. Tutkimuksella saadaan tietoa varusmiesten ruokatottumuksista sekä laitosoloissa että vapaa-aikoina.

Tämän työn tavoitteet ovat: 1) saada tietoa nuorten miesten ruokatottumuksista ennen varusmiespalvelusta ja sen aikana 2) tunnistaa varusmiesten terveelliseen ja epäterveelliseen syömiseen vaikuttavia tekijöitä ja ruokavalion yhteyksiä terveyden riskitekijöihin 3) toteuttaa terveellistä syömistä edistävä interventio armeijaolosuhteissa ja arvioida sen vaikutuksia.

Työssä käytetyt aineistot ja menetelmät ovat: 1) Varuskunta- ja loma- (n=47) sekä leirioloissa (n=31) olevat varusmiehet, joiden ruokatottumukset kartoitettiin ruokapäiväkirjoin 2) Varusmiespalvelukseen astumassa olevat nuoret miehet (n=2905), joiden ruokatottumuksista, sosiodemografisista taustatekijöistä ja terveyskäyttäytymisestä kerättiin tietoja kyselylomakkein poikkileikkausasetelmassa 3) Varusmiespalvelustaan suorittavat nuoret miehet (n=256), joita seurattiin kuuden kuukauden ajan. Heistä kerättiin tietoa ruokavalion frekvenssikyselyin (FFQ) ja antropometrisiä ja kliinisiä terveyden riskitekijöitä kuvaavin mittauksin 4) Varusmiespalvelusta suorittavat miehet (n=604), jotka jakautuivat interventioryhmään (n=362) ja vertailuryhmään (n=242). Interventioryhmällä lisättiin terveellisten ruokien tarjontaa armeijaruokailuympäristöissä eli muonituskeskuksissa ja sotilaskodeissa. Ruokavaliotiedot kerättiin FFQ:lla ennen varusmiespalvelusta/sen alussa sekä 8. palvelusviikon ja 6. palveluskuukauden aikana. Aineistot 2–4 kuuluivat kontrolloituun kaksivaiheiseen Varu-interventiotutkimukseen, jossa tärkeimmät ruokavaliotulosmuuttujat olivat ruokaindeksit. Ne kehitettiin erityisesti nuorten miesten ruokavalion tutkimista varten ja soveltuviksi armeijaympäristöön.

Ennen varusmiespalvelusta nuorten miesten päivittäiseen ruokavalioon sisältyi enimmäkseen terveelliseen ruokavalioon suositeltavia ruokia. Tosin kasvisten kulutus oli vähäistä. Vähemmän terveellisiä ruokia syötiin yleensä korkeintaan kerran

viikossa. Terveyskäyttäytymismittarit ennustivat ruokatottumuksia siten, että muutoinkin terveet elintavat olivat yhteydessä terveelliseen ruokavalioon ja päinvastoin. Koulutustaso oli myönteisesti yhteydessä ruokatottumuksiin ja kesällä ruokavalio oli terveellisempi kuin talvella.

Varusmiespalveluksen aikana varusmiesten energiansaanti oli riittävää ja saanti kattoi yleensä suositukset muidenkin tutkittujen ravintoaineiden osalta. Vain kuidun saanti ei yltänyt suositukseen ja suolan saanti ylitti selvästi suosituksen. Armeijaolojen välillä ilmeni eroja siten, että varuskunnassa energiaravintoaineiden osuudet vastasivat parhaiten suosituksia sekä vitamiinien ja hivenaineiden saanti oli runsasta. Energiansaanti oli runsasta fyysisissä leirioloissa. Vapaa-aikoina energiaravintoaineiden osuudet eivät vastanneet yhtä hyvin suosituksia, hivenaineiden saanti oli vähäisempää ja sokerinsaanti runsasta.

Kuitupitoiset elintarvikkeet, etenkin viljatuotteet, kuuluivat armeijaruokailuun ja niiden kulutus lisääntyi kuuden palveluskuukauden aikana. Ravintoköyhiä ruokia, kuten virvoitusjuomia ja pizzaa, käytettiin yleisesti vapaa-aikoina.

Varusmiehillä oli vain vähän terveyttä uhkaavia riskitekijöitä. Palveluksen kuluessa ylipainoisten miesten osuus pieneni ja kehonkoostumus parani. Systolinen verenpaine ja HDL-kolesteroli kohenivat, mutta kokonaiskolesteroli-, triglyseridi- ja glukoositasot heikentyivät. Kuitu- ja sokeripitoisten ruokien runsas kulutus oli yhteydessä edulliseen kehonkoostumukseen ja päinvastoin.

Kontrolloitu interventio varusmiesten ruokavalintojen parantamiseksi sai aikaan useita myönteisiä muutoksia. Interventioryhmässä viljatuotteita käytettiin seuranta-aikana enemmän kuin vertailuryhmässä. Lisäksi interventioryhmässä useiden rasva- ja sokeripitoisten elintarvikkeiden kulutus oli vähäisempää verrattuna vertailuryhmään. Interventio ei lisännyt kasvisten käyttöä.

Tulokset toivat esiin sekä myönteisiä että kielteisiä löydöksiä nuorten miesten ruokavaliosta ja terveydestä. Heidän perusruokavaliossaan oli monia terveellisiä ruoka-aineita, joiden käyttö lisääntyi varusmiespalveluksen aikana. Valitettavasti myös joidenkin epäterveellisten ruoka-aineiden käyttö lisääntyi erityisesti vapaa-aikoina. Palveluksen aikana kehonkoostumus parani, mutta kliinisistä riskitekijöistä osa muuttui terveyden kannalta edulliseen, osa epäedulliseen suuntaan.

Jo varhaisessa aikuisuudessa nuorten miesten ruokatottumukset, muut elintavat ja terveyden riskitekijät kasautuvat. Varusmiesten terveellisiä ruokavalintoja voidaan tukea edistämällä ruokatarjontaa muonituskeskuksissa ja sotilaskodeissa. Tehokas vaikuttaminen yksilöllisiin valintoihin, kuten vähäiseen kasvisten kulutukseen, on haasteellisempaa, samoin vaikutusten mittaaminen.

Avainsanat: ruokatottumukset, ravintoaineet, energiansaanti, nuoret aikuiset, miehet, varusmiehet, riskitekijät, interventio, ruokavalioindeksi

Contents

List of original publications

I Bingham CM, Ovaskainen ML, Tapanainen H, Lahti-Koski M, Sahi T, Paturi M. Nutrient intake and food use of Finnish conscripts in garrison, on leave and in encampment conditions. Military Medicine 2009;174(7):678-84.

II Bingham CM, Jallinoja P, Lahti-Koski M, Absetz P, Paturi M, Pihlajamäki H, Sahi T, Uutela A. Quality of diet and food choices of Finnish young men: A sociodemographic and health behaviour approach. Public Health Nutrition 2010;13(6A):980-6.

III Bingham CM, Lahti-Koski M, Absetz P, Puukka P, Kinnunen M, Pihlajamäki H, Sahi T, Uutela A, Jallinoja P. Food choices and health during military service: increases in sugar- and fibre-containing foods and changes in anthropometric and clinical risk factors. Public Health Nutrition 2012;15(7):1248-55.

IV Bingham CM, Lahti-Koski M, Puukka P, Kinnunen M, Jallinoja P, Absetz P. Effects of a healthy food supply intervention in a military setting: positive changes in cereal, fat and sugar containing foods. International Journal of Behavioral Nutrition and Physical Activity 2012 Jul 31;9(1);91.

Abbreviations

ANCOVA	Analysis of covariance
BIT	Behavioural internet therapy
BMI	Body Mass Index
CHD	Coronary heart disease
CVD	Cardiovascular disease
CFI	Core Food Index
DQI	Diet Quality Index
EFI	Extra Food Index
FLEX	Fat Loss and Exercise programme
FFQ	Food frequency questionnaire
GLM	General linear modelling
HEI	Healthy Eating Index
IDQ	Index of Diet Quality
LEAN	Lifestyles, Exercise and Emotions, Attitudes, and Nutrition programme
NRF	Nutrient Rich Food Index
RQ	Research question
SD	Standard deviation

1 Introduction

Adolescence is characterised by relatively structured life at childhood home and at school. Everyday life follows a regular pattern and often the level of individual responsibility is comparatively low. Progressively, adolescents become more independent and start making their own choices (Pérez-Rodrigo and Aranceta 2001). The choices cover multiple areas including future living conditions, further education and occupation. Importantly, also choices regarding lifestyle, health and more specifically food choices are made (Pérez-Rodrigo and Aranceta 2001).

Generally, adolescents' and young adults' health is good and they also perceive it so themselves (Mikolajczyk, Brzoska et al. 2008; Breidablik, Meland et al. 2009; Foti and Eaton 2010; Elinder, Sundblom et al. 2011; Xu, Su et al. 2011). The same applies in Finland with no major differences according to basic education i.e. elementary school, vocational school and upper secondary school (National Institute for Health and Welfare 2011).

Still, regardless of good overall health, the universal burden of increasing overweight and obesity (WHO/FAO 2003) concerns also adolescents and young adults (Mirmiran, Mirbolooki et al. 2002; Rye, O'Hara Tompkins et al. 2008; Vella-Zarb and Elgar 2009; Poobalan, Aucott et al. 2010). Research indicates that their prevalence has increased the most in these age groups (Huang, Harris et al. 2003; Mokdad, Ford et al. 2003). Also in Finland in 1977-1999, adolescents' overweight and obesity increased linearly, with the rise in obesity being steeper. Overweight and obesity increased more in males than females (Kautiainen, Rimpelä et al. 2002; Nissinen, Mikkilä et al. 2009) as boys' overweight more than doubled and obesity increased markedly (Kautiainen, Rimpelä et al. 2002). The increase has continued further in adolescents (Kautiainen, Koivisto et al. 2009) as well as in adults with striking increase in well-educated men (Lahti-Koski, Seppänen-Nuijten et al. 2010). Overweight and obesity in adolescence is associated with increased health risk factors (Raj and Kumar 2010; Lavrador, Abbes et al. 2011).

Later in adulthood, lifestyle choices stabilize and become more permanent. They affect health either positively or negatively. The association between diet and several chronic diseases is well established (WHO/FAO 2003) with a multitude of evidence on cardiovascular disease (CVD) (Roine, Pekkarinen et al. 1958; Keys 1970; Brunner, Thorogood et al. 2005; Mead, Atkinson et al. 2006). Finnish dietary patterns have connected with CVD risk factors. A traditional pattern, with rye, potatoes, butter, sausages and milk, was found more common for young men and positively associated with CVD risk factors. A more health-conscious pattern, with e.g. vegetables, legumes, nuts and cheese, was respectively associated with lower risk factor levels (Mikkilä, Räsänen et al. 2007). With a long follow-up of 27 years, high fruit

and vegetable consumption both in childhood and adulthood predicted lower CVD risk for men (Aatola, Koivistoinen et al. 2010).

Recent research has focused on the association of sugar with CVD and its risk factors. More precisely, the relationship may be connected to the current prevalent consumption of sugar-sweetened beverages such as soft drinks (Johnson, Segal et al. 2007; Brown, Dulloo et al. 2008; Johnson, Appel et al. 2009). Relating to this, snacking has been associated with adolescents' eating habits for a long time (Bull 1988) but has increased lately (Nielsen, Siega-Riz et al. 2002; Hoppu, Lehtisalo et al. 2010). Snacking happens commonly on sugary foods and drinks (Hoppu, Lehtisalo et al. 2010). Universally, soft drink consumption has been a dietary trend among adolescents (Moreno, Rodriguez et al. 2010), with consumption being higher among boys than girls (Hoppu, Lehtisalo et al. 2010).

Diet in adolescence is of importance because the CVD risk factor profile is regulated by early lifestyle factors such as healthy diet (Viikari, Niinikoski et al. 2004). Food choices are likely established in childhood and adolescence and result in consistent dietary patterns (Mikkilä, Räsänen et al. 2005). In Finland, there are comprehensive dietary monitoring systems covering the majority of dietary aspects of the adult population including the elderly. Still, a challenge is the restricted coverage of dietary data of especially young men (Männistö, Laatikainen et al. 2010) which this dissertation responds to.

The school environment is a place providing an opportunity to influence and improve eating habits, and it has been largely used as such (Pérez-Rodrigo and Aranceta 2001; Pérez-Rodrigo and Aranceta 2003; Malone 2005), also in Finland (Hoppu, Lehtisalo et al. 2010). The peer group is especially important in adolescence and it has major influence in developing both eating habits and lifestyles (Pérez-Rodrigo and Aranceta 2001). The role of the peer group may be even stronger in the military setting where the environment is controlled and actions are directed. The Finnish military system applies to all young men and 80% of each male age group complete military service (Public Information Division of the Defence Staff 2008). The military environment and military service act as interventions themselves differing significantly from civilian life. Military service is a period of institutional life when privacy is diminished and individual's possibility of making independent decisions is limited. This applies also to eating because complete freedom of dietary choices is unfeasible although some individual selection is possible in free-time eating.

Thus, the structured and controlled environment is unique in enabling reaching the majority of Finnish young men. It also offers a good setting for dietary intervening as it represents both institutionalized eating as well as eating based on free choices. Studying and intervening on young men's eating habits may have clear public health relevance later in adulthood.

2 Review of the literature

2.1 Time trends of the Finnish diet

First studies on Finnish diet showed that men's proportion of fat in the diet was as high as 39% (Keys 1970) of which over half constituted saturated fat (Roine, Pekkarinen et al. 1958). Procedures to address nutrition started in 1972 when men's diet contained still 39% of total fat and 21% of saturated fat in Eastern Finland (Pietinen, Vartiainen et al. 1996). In 25 years, the proportion of total fat decreased to 33% and of saturated fat to 13%. These represent national values with regional differences having levelled off (Anttolainen, Javanainen et al. 1998; Pietinen, Lahti-Koski et al. 2001). Nowadays at the population level, total intake of fat has levelled to 33% for men and 31% for women (Paturi, Tapanainen et al. 2008; Pietinen, Paturi et al. 2010). The respective figures for saturated fat are 13% and 12% with all figures still exceeding recommendations (Paturi, Tapanainen et al. 2008; Pietinen, Paturi et al. 2010; Valsta, Tapanainen et al. 2010). The same applies also to salt intake (Paturi, Tapanainen et al. 2008; Pietinen, Paturi et al. 2010) regardless of the reported decrease since the 1970s (Pietinen, Vartiainen et al. 1996; Pietinen, Lahti-Koski et al. 2001). At the same time, fibre and vitamin D intakes do not reach recommendations despite notable dietary improvements (Paturi, Tapanainen et al. 2008; Männistö, Laatikainen et al. 2010).

Regarding food use, important changes have taken place too. In the 1970s, use of high-fat milk (83%) and of butter on bread (85%) was common especially in Eastern Finland (Puska 2000). Since then and coupled with the decrease in fat intake, butter on bread has been replaced by margarines as well as vegetable oil has become frequently used in cooking. Also, high-fat milk has been replaced by low-fat milk (<2%) which has changed especially in mass catering such as schools (Puska 2000; Pietinen, Lahti-Koski et al. 2001). Currently, low-fat milk is used by 70% and margarines and low-fat cheese (≤17% fat) by 50% (Pietinen, Paturi et al. 2010). However, overall cheese consumption has doubled in 30 years (Männistö, Laatikainen et al. 2010).

Other significant changes are that in two decades fruit consumption has doubled and vegetable consumption tripled (Pietinen, Vartiainen et al. 1996; Pietinen, Lahti-Koski et al. 2001). Despite further increase in fruit and vegetable consumption, only 32% of men and 50% of women consume vegetables daily (Helakorpi, Pajunen et al. 2011). At the same time, consumptions of fruit juices and soft drinks, both drinks with high sugar content, have increased strongly since the 1980s (Männistö, Laatikainen et al. 2010). Evidence exists also for increased total sugar consumption (Tike Information Centre 2010).

In all, a shift away from the traditional diet has manifested with time as decreased milk, potato (Männistö, Laatikainen et al. 2010; Tike Information Centre 2010), bread (Helakorpi, Pajunen et al. 2011) and cereals consumption (Männistö, Laatikainen et al. 2010; Tike Information Centre 2010). These results connect with permanent and long-term dietary patterns emerging during a 21-year follow-up period (Mikkilä, Räsänen et al. 2005; Mikkilä, Räsänen et al. 2007; Mikkilä, Räsänen et al. 2009). The found traditional pattern was characterised by high consumption of rye, potatoes, butter, sausage, milk and coffee (Mikkilä, Räsänen et al. 2005).

Together with these changes regarding traditional diet, a new snacking-type eating pattern has arisen. The pattern can be defined as obtaining the majority of daily energy from snacks. Among men it increased significantly from 19% to 24% from 2002 to 2007. 30% of men consume more than four snacks daily with an overall average of 3.6 (Ovaskainen, Reinivuo et al. 2006; Ovaskainen, Tapanainen et al. 2010). The energy density was higher in snacks than in main meals (Ovaskainen, Reinivuo et al. 2006). Snacking-dominating eating was also related to lower intake of micronutrients together with higher intakes of sugar and alcohol (Ovaskainen, Reinivuo et al. 2006; Ovaskainen, Tapanainen et al. 2010).

2.1.1 Diet and nutrition-related risk factors

Within Europe, cardiovascular disease (CVD) incidence and mortality have been the highest in Finland especially among men (Keys, Anderson et al. 1957; Karvonen, Orma et al. 1970; Puska 2000). The longitudinal Seven Country Study (Keys 1970; Keys 1970; Keys 1970) affirmed the correlation between coronary heart disease (CHD) and fat content of the diet with serum cholesterol levels being a mediator (Keys, Anderson et al. 1957; Keys 1970). The elevated prevalence of CVD was largely due to high intake of fat and especially saturated fat (Roine, Pekkarinen et al. 1958; Keys 1970). This association has become established later too (Brunner, Thorogood et al. 2005; Mead, Atkinson et al. 2006).

The traditional Finnish dietary pattern, with high consumption of rye, potatoes, butter, sausage, milk and coffee, mentioned earlier (Mikkilä, Räsänen et al. 2005) as well as low lifetime fruit and vegetable consumption have been found to be determinants of CVD risk factors such as total and LDL cholesterol and carotid artery intima media thickness (Mikkilä, Räsänen et al. 2007; Mikkilä, Räsänen et al. 2009; Aatola, Koivistoinen et al. 2010). The inverse association between fruit and vegetable consumption and CVD risk factors has been largely shown elsewhere too (Rimm, Ascherio et al. 1996; Bazzano, Serdula et al. 2003; Alonso, de la Fuente et al. 2004; Hung, Joshipura et al. 2004; Martinez-Gonzalez, de la Fuente-Arrillaga et al. 2011).

The aforementioned findings regarding increased sugar consumption (Männistö, Laatikainen et al. 2010; Tike Information Centre 2010) are of relevance. Recently, research has revealed an association between sugar and CVD with its risk factors

(Johnson, Segal et al. 2007; Brown, Dulloo et al. 2008; Johnson, Appel et al. 2009). Attention has been paid to dietary sugars in general and to sugar-sweetened beverages (Bolton-Smith and Woodward 1994; Brown, Dulloo et al. 2008; Johnson, Appel et al. 2009). Evidence exists for an association between consumption of added sugars and CHD (Bolton-Smith and Woodward 1994). More precisely, the relationship may be connected to the current prevalent consumption of sugar-sweetened beverages such as soft drinks (Johnson, Segal et al. 2007; Brown, Dulloo et al. 2008; Johnson, Appel et al. 2009).

Regarding other chronic diseases, findings are relatively similar on beneficial and disadvantageous diet. In relation to preventing type 2 diabetes, a high-fat low-fibre diet was beneficial in achieving long-term weight loss (Lindström, Peltonen et al. 2006). By following this diet and increasing physical activity, the risk of type 2 diabetes was reduced by 58% (Tuomilehto, Lindström et al. 2001). Recent findings indicate that high carbohydrate intake was associated with decreased diabetes risk. The risk was decreased when fat or protein was replaced with carbohydrates (Similä 2012). It has been known for long that dietary complex carbohydrates of various type, including those rich in dietary fiber, such as fruits, vegetables and cereals, may slow the rate of absorption of glucose diets and contribute to a lowering of the post-prandial glucose peak (Levine 1986). Slowly absorbed, low glycaemic index foods are associated with reduced risk of type 2 diabetes (Wolever 2000). In Finland, glycaemic index was not associated with diabetes risk (Similä 2012). Recent data from prospective cohort studies suggest that sugar-sweetened beverages probably increase the risk of type 2 diabetes (Sonestedt, Overby et al. 2012). For several types of cancer, high fibre intake and fruit and vegetable consumption has proven to be protecting whereas high total and saturated fat intake can be detrimental (Gonzalez and Riboli 2006; Gonzalez and Riboli 2010). To conclude, evidence exist that certain eating habits, i.e. high fibre intake and fruit and vegetable consumption, help to reduce the risk of several chronic diseases. Also other habits, such as high total and especially saturated fat intake, are negatively associated with the risk of these diseases (WHO/FAO 2003).

2.1.2 Diet by sex and age

Gender differences in diet are well acknowledged. In general, women's diets are healthier than men's, and food choices differ by gender (Roos, Lahelma et al. 1998; Wardle, Haase et al. 2004; Westenhoefer 2005; Prattälä, Paalanen et al. 2007). Altogether compared to women, men consume less fruit, vegetables, chicken, cheese and sweets and more meat, potatoes, bread and alcohol (Donkin, Johnson et al. 1998; Milligan, Burke et al. 1998; Roos, Lahelma et al. 1998; O'Doherty Jensen and Holm 1999; Beer-Borst, Hercberg et al. 2000; Fraser, Welch et al. 2000; Groth, Fagt et al. 2001). Naturally, these differences reflect also into nutrient intakes: men have higher

energy intake but women's energy-adjusted micronutrient intake is higher (Zive, Nicklas et al. 1996; Subar, Thompson et al. 2001). Also, women's fibre intake is higher and fat intake lower than men's (Westenhoefer 2005).

Consistently, women consume more fruit and vegetables than men. This has been confirmed internationally (Wardle, Haase et al. 2004; Westenhoefer 2005; Prattälä, Paalanen et al. 2007) and in Finland (Prattälä, Paalanen et al. 2007; Roos, Talala et al. 2008; Lallukka, Pitkäniemi et al. 2010). In Finland, the gender difference and overall daily fruit and vegetable consumption have increased with time (1979-2002) (Roos, Talala et al. 2008). Otherwise, Finnish men consume more bread (Prattälä, Helasoja et al. 2001) and meat (Prattälä, Paalanen et al. 2007) than women. When combining food choice differences into food patterns, a traditional pattern characterised by high consumption of rye, potatoes, butter, sausage, milk and coffee, has been more predominant among men (Mikkilä, Räsänen et al. 2005). At the same time, a snacking-type eating pattern has increased especially in men and daily energy intake is higher for men with this eating pattern than for other men (Ovaskainen, Reinivuo et al. 2006).

Dietary gender differences are explained by several factors. Firstly regarding food perceptions, fruit and vegetables are associated with feminine attributes and meat respectively with masculinity (Roos, Prättälä et al. 2001; Roos, Sarlio-Lähteenkorva et al. 2007). Secondly, women's motivation for weight control is prominent and they are more likely than men to diet or restrain from eating. Thirdly, health consciousness is stronger in women than men resulting in women's healthier diet regarding for example fruit and vegetables, fibre, fat, and salt (Wardle, Haase et al. 2004; Westenhoefer 2005). Even though men's shift towards healthier food choices has been stronger, women have still stayed more health-orientated. Thus, the differences have diminished without disappearing completely (Prättälä, Berg et al. 1992). In all, women still have healthier food behaviour than men (Prättälä, Berg et al. 1992; Roos, Lahelma et al. 1998; Lallukka, Sarlio-Lähteenkorva et al. 2004; Wardle, Haase et al. 2004; Lallukka, Laaksonen et al. 2007).

Diet changes also with age as health beliefs and eating attitudes vary throughout the life span (Westenhoefer 2005). Food choices are likely established in childhood and adolescence and result in consistent dietary patterns (Mikkilä, Räsänen et al. 2005). With age, the energy proportions of meals and energy distribution change and meals are substituted by snacks (Vincent, Lauque et al. 1998). Despite this, the effect of age showed that among men, the youngest (20-29 years) ate unhealthily most often and 50-64-year-old men were assessed to have a good diet most frequently (Prattälä, Karisto et al. 1994).

2.1.3 Sociodemographic determinants of diet

The effect of sociodemographic determinants as a cause of differences in diet has been studied extensively (Giskes, Avendano et al. 2010). General lifestyle and socioeconomic situation are important determinants of diet and they change with age (Westenhoefer 2005).

Regarding energy intake, internationally reviewed results are inconsistent but show a tendency for socioeconomically disadvantaged groups having higher energy intake than other groups (Giskes, Avendano et al. 2010). In Finland, men with a high education had lower energy intake than less educated men (Roos, Prättälä et al. 1996). When moving on to fat, again lower socioeconomic groups tend to have higher fat intake (Giskes, Avendano et al. 2010). Domestically, already in the 1970s, major differences in saturated fat intake according to occupation and education were observed. Men with lowest occupation and education had highest baseline intake but despite biggest absolute 10-year reductions they did not reach levels of higher groups (Pietinen, Nissinen et al. 1988). Later in 1985-97, an overall decrease in animal fat intake was reviewed. This was coupled with socioeconomic status showing that men with higher education used significantly more cheese and less butter than men with lower education who consumed more animal fat in total. Similar results were also found in other countries indicating that higher social classes prefer modern foods such as cheese whereas lower classes traditional foods such as butter (Prattälä, Groth et al. 2003). These differences have remained to date as more educated men use more skimmed milk and oil in food preparation than less-educated men who have a diet with more total and saturated fat (Ovaskainen, Paturi et al. 2010). When summarizing fat intake by two indexes, an association was found between low intake and high education and vice versa (Roos, Prättälä et al. 1996).

In a recent review, fibre intake seemed to be lower in lower sociodemographic groups even though the differences were moderate (Giskes, Avendano et al. 2010). In Finland, consumption of rye bread, a major fibre source, has decreased in 20 years (1978-1998) but remained higher than white bread consumption. Eating rye bread was associated with low education and rural areas as an indication of traditional diet (Prattälä, Helasoja et al. 2001).

Associations between fruit and vegetable consumption and socioeconomic determinants have been studied widely. The strongest evidence exists that of food groups, lower socioeconomic groups have lower fruit and vegetable consumption when compared to higher socioeconomic groups (Giskes, Avendano et al. 2010). Despite socioeconomic differences (Ovaskainen, Paturi et al. 2010), fruit and vegetable consumption on the whole has increased with time in Finland (Roos, Lahelma et al. 1998). The increase in daily consumption was larger in those with lowest education and income implying that relative differences have decreased over time (Roos, Talala et al. 2008). Still of sociodemographic factors, gender differences seem to be the strongest determinant as women with lowest education and income

have higher consumption than men with highest education and income (Lallukka, Pitkäniemi et al. 2010). Daily consumption of vegetables was more common in urban areas and among non-manual workers with results applying also in other Western European countries (Prattälä, Hakala et al. 2009).

As for overall food consumption, higher socioeconomic groups favoured modern foods such as fruit, vegetables, berries, cheese and candies, and less milk, bread and butter (Roos, Prättälä et al. 1996). Also, men with high education consumed less butter, high-fat milk, and sugar in coffee than those in other education groups (Prättälä, Berg et al. 1992). Individual food items, such as fruit and vegetables and type of bread fat, have been combined several times to describe healthy eating as its entirety. When assessing "good diet", men showed a general shift towards healthier food consumption patterns combined with decreasing educational group differences (Prattälä, Karisto et al. 1994). Results with a slightly different indicator were constant: Levels of education and income were positively associated with following dietary guidelines especially among men (Roos, Lahelma et al. 1998). In addition to education and income, also people with higher occupational class, home ownership and not having economic difficulties reported more healthy food habits than other groups. When adjusting for all these factors, high education as well as not having economic difficulties was connected with healthy eating habits (Lallukka, Laaksonen et al. 2007).

Regional differences in food choices exist as some foods (e.g. cheese, fruit, pasta, pizza, cakes and pastry) are more common and respectively others (e.g. milk, potatoes, sugar, sausage) less common in the urban metropolitan area when compared to other regions (Männistö, Laatikainen et al. 2010). Also, meat has been consumed more in rural than urban areas (Prattälä, Paalanen et al. 2007). The recently discovered snacking-dominating eating pattern was associated with urbanization as it was more common in southern than in northern areas in Finland and among male manual workers than non-manual workers (Ovaskainen, Reinivuo et al. 2006).

Further when taking working conditions into account, working overtime was surprisingly associated with a healthy diet among men (Lallukka, Sarlio-Lähteenkorva et al. 2004). Urbanization (Raulio, Roos et al. 2005), high occupational class, (Raulio, Roos et al. 2012), non-manual work (Raulio, Ovaskainen et al. 2009), high education, and being normal weight (BMI <25 kg/m^2) increased men's likelihood to have lunch at worksite canteen, which for its sake predicted higher consumptions of vegetables, fish (Roos, Sarlio-Lähteenkorva et al. 2004), skimmed milk and salad dressings compared to those having a packed lunch (Raulio, Ovaskainen et al. 2009). Calculated as nutrient intake, energy, vitamin A and carotenoid intake was higher for men having lunch at the worksite canteen than other men (Raulio, Ovaskainen et al. 2009). Thus, those who had lunch at the canteen were more likely to follow recommended food habits in line with national dietary guidelines, the association being strong especially in men (Roos, Sarlio-Lähteenkorva et al. 2004). This finding has been confirmed recently and it applies

also to children having lunch at school as an indication of mass catering promoting healthy food habits in Finland (Raulio, Roos et al. 2010).

To sum up dietary sociodemographic differences, social class has proven to be a significant determinant of food consumption patterns. Upper social classes are trendsetters whom lower social classes follow with a time lag of ten years (Prättälä, Berg et al. 1992). Constantly, people with high education have shown healthier food behaviour compared to low education (Prattälä 2012). Finally, adults' health behaviours tend to cluster both positively and negatively. Healthy food habits relate to income and education as well as to nutrient intake, biomarkers and disease (Kant 2004). Furthermore, unhealthy eating clusters with other unhealthy behaviours such as smoking and physical inactivity (Laaksonen, Talala et al. 2008).

2.2 Diet and health of young men

In this chapter, general methodology on studying eating habits is presented. Otherwise, literature on young men, their eating habits and health is reviewed. The presented studies and their results focus on young men. To emphasize the specific characteristics of young men, some gender comparison is presented. The definition of young men covers adolescents and young men and is outlined to the age group of approximately 15-25-year-olds.

2.2.1 Methodological issues on studying eating habits

The well-known and most widely used methods to collect and measure dietary intake are food diaries, food frequency questionnaires (FFQ) and diet history recalls. Seven-day food diaries have been commonly used as the standard method (Willett 1998) but their use requires notable resources for recording and analysing. Also errors, such as under-reporting are related to this method (Hirvonen, Männistö et al. 1997) especially among overweight people (Weber, Reid et al. 2001). The use of the dietary index measures for studying eating habits is not standardized and the topic is presented in more detail.

No standard guidelines exist for the forming of dietary indexes. Several international diet quality scores exist some of which are widely used (Patterson, Haines et al. 1994; Kennedy, Ohls et al. 1995; Trichopoulou, Kouris-Blazos et al. 1995; Kant 1996; Haines, Siega-Riz et al. 1999; Lowik, Hulshof et al. 1999; Osler, Heitmann et al. 2001; Harnack, Nicodemus et al. 2002; Kim, Haines et al. 2003; Waijers, Feskens et al. 2007). The Diet Quality Index (DQI) (Patterson, Haines et al. 1994) was devised in the USA as an instrument to measure overall diet quality also in relation to risk of diet-related chronic diseases. It was based on eight dietary recommendations the meeting of which was scored inversely from 0 to 2 points. The points were summed to score the index from 0 to 16 with a low score indicating a healthy diet. It

was developed on scientific recommendations and followed the commonsense principle of total sum of food consumption equaling a healthy or unhealthy diet (Patterson, Haines et al. 1994). It is a real-world instrument (Patterson, Haines et al. 1994) because people consume a full set of foods and not isolated nutrients.

Later DQI has been revised and developed further. First, the Diet Quality Index-international was created for exploration of diet quality across countries. More precisely, it was developed as an overall measure of diet for comparison of diet quality between the USA and China (Kim, Haines et al. 2003). Then, DQI was developed specially for preschoolers with incorporating a component of energy balance to measure adequacy of nutrition for growth, development and disease prevention (Kranz, Hartman et al. 2006). Both these modifications served a specific purpose and the indexes were created for particular populations.

Another resembling dietary index also from the USA is the Healthy Eating Index (HEI) (Kennedy, Ohls et al. 1995). The aim was to create an index of overall diet quality incorporating both nutrient needs and dietary guidelines into one measure. It was to be a summary measure for monitoring food consumption patterns and to serve also as a tool for nutrition education and health promotion. Further, it aimed at assessing the whole diet and not simply isolated components. HEI was based on a 10-component system of five food groups, four nutrients and a measure of variety in food intake. Each of the components was given a score from 0-10, so the possible index score ranged from 0 to 100. None of the components of the index dominated the total score (Kennedy, Ohls et al. 1995).

AS DQI, also HEI has been developed further with time. First it was modified to assess diet quality in children and adolescents (Feskanich, Rockett et al. 2004). This was done by simplifying the original index and focusing on healthy and unhealthy foods as well as eating behaviours. Also the original HEI was updated according to more recent dietary recommendations. Both the components and their scoring were renewed with putting more emphasis on food choices. The updated index proved to be a valid measure of diet quality. It could be used for population monitoring, evaluation of interventions, and research. The developer assessed that both the total score and its component scores can provide essential dietary information (Guenther, Reedy et al. 2008).

A recent measure, the Nutrient Rich Foods Index (NRF), ranks and classifies foods based on their nutrient composition (Fulgoni, Keast et al. 2009) and it was validated against HEI. NRF is a formal metric of nutrient density and based on 9 nutrients to encourage and 3 nutrients to limit. It successfully ranks foods based on their nutritional value and can be applied to individual foods, meals, menus and also to the daily diet (Drewnowski 2009). When NRF was used in conjunction with a food prices database, it could identify foods that are both nutritious and affordable. It can thus be applied for consumers to identify foods which provide optimal nutrition at an affordable cost (Drewnowski 2010).

As mentioned earlier, other indexes of dietary quality exist from Greece (Trichopoulou, Kouris-Blazos et al. 1995), the Netherlands (Lowik, Hulshof et al. 1999), Denmark (Osler, Heitmann et al. 2001) and the USA (Harnack, Nicodemus et al. 2002). Application of these pre-existing international dietary indexes in Finland is not feasible as they do not take into account special characteristics of the Finnish diet e.g. use of rye bread and berries.

Some Finnish indexes also exist. Two have been used to evaluate intake of saturated fat (Roos, Ovaskainen et al. 1995) which offers a limited scope for studying quality of diet. Recently, a self-explanatory index for the evaluation of a health-promoting diet in adults was constructed (Leppälä, Lagström et al. 2010). It was developed in detail from a larger food consumption questionnaire from which key questions for health-promoting diet were identified and chosen and scored for the Index of Diet Quality (IDQ). IDQ was assessed to reflect dietary intake of key foods and nutrients associated with health and adherence to dietary recommendations. Also, it could be applicable in nutritional studies where diet in its entirety is of interest because it is fast in execution and free of complex calculations when analysing its results (Leppälä, Lagström et al. 2010).

2.2.2 Young men's eating habits

Eating habits and also nutrient intakes have been found relative similar throughout Western countries (Bull 1988). The overall nutritional status of male adolescents was studied in Central European countries. Similarities showed that universally diets were high in total and saturated fat, animal protein and respectively low in carbohydrates and fibre (Rolland-Cachera, Bellisle et al. 2000). In the USA, the percentage of energy derived from sucrose was as high as 18% (Nicklas 1995).

In Finland, there are comprehensive dietary monitoring systems covering the majority of different aspects of diet and eating habits. The systems comprise most geographical areas and the adult population including the elderly. Still, a challenge is the restricted coverage of dietary data of especially young people (Männistö, Laatikainen et al. 2010). Few detailed dietary assessments of Finnish adolescents have been conducted. In 1980, the Cardiovascular Risk in Young Finns Study (Räsänen, Ahola et al. 1985) found that adolescents' diet was relatively high in fat (38 E-%) and there were gender differences in fat intake as well as in other nutrients. In the 15-year and 18-year age groups, boys' diet contained relatively and significantly more fat and saturated fat whereas girls' contained more vitamin C and sucrose. Relative intakes of several nutrients such as vitamin C and sucrose decreased with increasing age (from 3 to 18 years) but diets of 15- and 18-year olds had the same composition in relation to energy intake. Also, children with less educated parents had higher intakes of total and saturated fat than children with higher parental education (Räsänen, Ahola et al. 1985). After six years follow-up, the diet of older male

age groups (18, 21 and 24 years) contained higher proportions of fat and saturated fat but a lower proportion of sucrose than the diet of females (Räsänen, Laitinen et al. 1991). Later studies have been in line with the previous ones because intakes of saturated fat and sugar have still been higher than nutrition recommendations and fibre intake respectively lower (Hoppu, Lehtisalo et al. 2010).

Regarding adolescents' food use, it is known that boys' consumption of fruit and vegetables is low (Räsänen, Ahola et al. 1985; Lee, Keenan et al. 2007; Mäki, Hakulinen-Viitanen et al. 2010; El, Stock et al. 2011). In Finland of 14-year old boys, 28% consumed vegetables daily and 23% fruit. As many as one in ten had not consumed either during the last week (Hoppu, Lehtisalo et al. 2010). Consumption of fruit juices was more common to fruit and berries (Mäki, Hakulinen-Viitanen et al. 2010). Skim milk was the most common type of milk. Pizza was consumed by one fifth and hamburgers by one third at least 1-2 times per week (Mäki, Hakulinen-Viitanen et al. 2010). When comparing food groups, the importance of fruit, berries and milk products as an energy source decreased with age when the proportions of cereal products and dietary fats increased (Räsänen, Ahola et al. 1985).

Sociodemographic differences have related to food consumption. In rural areas, more traditional foods as rye, potato, milk, and butter were consumed whereas cheese, margarine and oils, fruit and berries were eaten in urban areas. This was coupled with the social status of the family because children of less educated families consumed more traditional foods when consumption of especially fruit and berries increased with parental education (Räsänen, Ahola et al. 1985). Furthermore for fruit and vegetable consumption, parental consumption and parental occupational status have been positively associated with adolescents' consumption (Pearson, Biddle et al. 2009).

Snacking has been connected to adolescents' eating habits for a long time (Bull 1988) but has increased lately (Nielsen, Siega-Riz et al. 2002; Hoppu, Lehtisalo et al. 2010). In a recent Finnish study, a high proportion (41%) of daily energy was derived from snacks which contained twice the recommended amount of sugar (10 E-%). Snacking happens commonly on sugary foods and drinks. Sweets and chocolate are the most common snacks and they are consumed by 35%. Boys consume sugary soft drinks more often and girls fruit (Hoppu, Lehtisalo et al. 2010). Universally, soft drink consumption has been a dietary trend among adolescents (Moreno, Rodriguez et al. 2010). Also, energy drink consumption has become more frequent and it is more common among vocational school students than upper secondary school students (National Institute for Health and Welfare 2011). In all, one in ten consumed energy drinks, artificially sweetened soft drinks, chocolate and sweets at least on three days per week (Mäki, Hakulinen-Viitanen et al. 2010).

As for meals, a majority of adolescents and young adults have the possibility of having a lunch at school, college or other educational institution. Therefore, a large proportion of adolescents' dietary studies have been conducted in these settings (El, Stock et al. 2011; Gan, Mohd et al. 2011; Jones, Dailami et al. 2012; Moreno-

Gomez, Romaguera-Bosch et al. 2012; Ray, Udumyan et al. 2012). Results show that adolescents' energy intake from all daily meals is more constant than young adults' who obtain a large part of energy only from lunch and dinner leaving breakfast and snacks light (Nicklas 1995). In Finland, the school lunch provided 20% of daily energy but its nutrient density reached recommendations (Hoppu, Lehtisalo et al. 2010). In fact, having a school meal proved to be a nutritionally better choice than dinner served at home (Hoppu, Lehtisalo et al. 2010; Raulio, Roos et al. 2010). However, even though school lunch is rated well (Mäki, Hakulinen-Viitanen et al. 2010), only 10-35% eat all parts of the meal: main course, vegetables, bread, spread, and drink being usually milk (Raulio, Roos et al. 2010). Still, the vast majority (70-90%) of young people visit the school canteen daily (Raulio, Roos et al. 2010) but the frequency decreases with age (Hoppu, Lehtisalo et al. 2010). More precisely, drinking milk and eating bread at school lunch decreased with increasing age but extremely strongly this happened with vegetable consumption: Of 11-year-olds, 66% reported eating vegetables daily but only 34% of 14/15-year-olds did with boys' frequency being lower than girls' especially in the older age group (Mäki, Hakulinen-Viitanen et al. 2010). School meal frequency decreased for pupils who perceived themselves obese, smoked, drank alcohol and whose parents had low education. Furthermore, being bullied at school, not liking school, skipping breakfast, and not having dinner with the family, were also associated with less frequent school lunch. Still, having lunch had positive consequences because it related to higher consumption of vegetables, fruit, rye bread, milk, and cheese whereas skipping lunch related with higher consumptions of unhealthy foods such as French fries, chips, pizza, candy, and chocolate. This association was especially strong if the main course was skipped (Raulio, Roos et al. 2010).

In addition to school lunches, also other meals are skipped and daily meals become more irregular as adolescents grow older. Skipping breakfast seems to be a trend (Moreno, Rodriguez et al. 2010) as it increased from 4% to 35% between the ages of 7 and 14/15 years (Mäki, Hakulinen-Viitanen et al. 2010). Parental breakfast eating and living in two-parent families enhanced adolescents' breakfast eating (Pearson, Biddle et al. 2009). Also having dinner together with the family has become less frequent (Mäki, Hakulinen-Viitanen et al. 2010) even though the majority of adolescents have a hot dinner (Hoppu, Lehtisalo et al. 2010). Gender differences prevail as 14-15-year old boys had more frequently lunch, dinner, and an evening snack and less frequently an afternoon snack when compared to girls (Mäki, Hakulinen-Viitanen et al. 2010). This indicates a more regular meal pattern for boys than girls.

Some studies have explored diet and its stability from childhood to adulthood. In Finland after 21 years' follow-up, the diet had changed favourably. Contributions of total fat and saturated fat had decreased significantly and the consumption of fruit and vegetables had increased. Still, men's diet contained relatively more energy, fat, saturated fat, protein, alcohol and salt, while that of women had higher proportions

of carbohydrates, sucrose and fibre (Mikkilä, Räsänen et al. 2004). In the USA, however, nutrient composition was similar for the most part from childhood to adulthood (Nicklas 1995). Also, in Finland two dietary food consumption patterns, one with traditional foods and one with modern foods, emerged. They remained relatively stable with time indicating that food choices are established already in childhood or adolescence and track into adulthood (Mikkilä, Räsänen et al. 2005).

In conclusion, gender differences are important determinants of adolescents' eating habits. For young men, a masculine eating style concerns amount and type of food where as for women pressure to diet starts at an early age (Rolls, Fedoroff et al. 1991).

2.2.3 Young men's health

In general, young adults' overall health is good and they also rate it so themselves (Mikolajczyk, Brzoska et al. 2008; Breidablik, Meland et al. 2009; Foti and Eaton 2010; Elinder, Sundblom et al. 2011; Xu, Su et al. 2011). The high rating is universal in different contexts (Mikolajczyk, Brzoska et al. 2008; Foti and Eaton 2010; Elinder, Sundblom et al. 2011; Xu, Su et al. 2011) and longitudinally remains relatively stable with follow-up (Breidablik, Meland et al. 2009). The same applies in Finland and no major differences have been found in the health status of Finnish young men with different educational levels (elementary school, vocational school and upper secondary school) (National Institute for Health and Welfare 2011).

Regardless of good overall health, the universal burden of increasing overweight and obesity (WHO/FAO 2003) concerns also adolescents and young adults (Mirmiran, Mirbolooki et al. 2002; Rye, O'Hara Tompkins et al. 2008; Vella-Zarb and Elgar 2009; Poobalan, Aucott et al. 2010). Evidence exists that the increase in prevalence has been the highest in these age groups (Huang, Harris et al. 2003; Mokdad, Ford et al. 2003). Also in Finland in 1977-1999, adolescents' overweight and obesity increased linearly and obesity even more than overweight. Overweight and obesity increased more in males than females (Kautiainen, Rimpelä et al. 2002; Nissinen, Mikkilä et al. 2009) and boys' overweight more than doubled from 7% to 17% and obesity increased from 1.1% to 2.7% (Kautiainen, Rimpelä et al. 2002). The increase continued further to 2005 and was connected to sociodemographic factors (Kautiainen, Koivisto et al. 2009).

Overweight increased more in adolescents in rural areas and from families with lower socioeconomic status, with low school achievement, and low own education (Kautiainen, Koivisto et al. 2009). Furthermore, among boys, low socioeconomic status, economic problems in the family, and skipping school lunch were positively associated with obesity when good school performance and physical activity were negatively (Mikkilä, Lahti-Koski et al. 2003). On the whole, parental education was the strongest determinant predicting overweight and obesity in early adulthood (18-

29 years) (Kestilä, Rahkonen et al. 2009). Also, overweight boys showed an association with viewing television over 4 hours per day (Kautiainen, Koivusilta et al. 2005). At large, the prevalence of overweight and obesity have increased in the whole Finnish adult population in 20 years (Lahti-Koski, Seppänen-Nuijten et al. 2010).

Overweight and obesity are associated with health risk factors (Raj and Kumar 2010; Lavrador, Abbes et al. 2011). In relation to food habits, Bremer et al. (2009) found adolescents' increased consumption of sugar-sweetened beverages to be connected with systolic blood pressure and anthropometrics: waist circumference and relative body mass index.

Also, dietary patterns were found to be two-dimensionally connected with CVD risk factors. The traditional Finnish dietary pattern, with rye, potatoes, butter, sausages and milk, was more common for young men and positively associated with total and LDL cholesterol, apolipoprotein B, C-reactive protein, and homocysteine. It was also negatively associated with physical activity and smoking. At the same time, the more health-conscious pattern, with e.g. vegetables, legumes, nuts and cheese, was inversely associated with lower CVD risk factor levels (Mikkilä, Räsänen et al. 2007). The traditional pattern also predicted another CVD risk factor, carotid intima thickness, among men with the implication that long-term adherence to traditional foods might increase the risk of developing subclinical atherosclerosis (Mikkilä, Räsänen et al. 2009). In the same data but with a longer follow-up of 27 years, both childhood and adulthood vegetable consumption as well as persistently and increasingly high fruit and vegetable consumption predicted better pulse wave velocity as an indicator of lower CVD risk for men (Aatola, Koivistoinen et al. 2010). This is of importance because the CHD risk factor profile is regulated by early lifestyle factors such as healthy diet (Viikari, Niinikoski et al. 2004).

2.3 Interventions to promote healthy eating

When associations between health risks and behaviour have been determined, means for influencing the associations have been searched through different interventions. The ecological perspective to behavioural interventions covers two main approaches: 1) to promote change in people or 2) to change the environment. Also, combining both and using them together offers a powerful approach (Glanz, Lewis et al. 1997). The focus of an intervention to improve health outcomes can be on the individual, interpersonal, organizational, community or societal level (Bartholomew, Parcel et al. 2011). A differentiation can be made if the intervention targets the overall population or segments of it based on age, gender, ethnicity etc., or more specific population groups defined by health risks. Multiple complex interventions may target several behaviours and operate on different levels simultaneously.

2.3.1 Using theories in intervention research

Interventions based on theory have been shown to be more effective in changing health behaviour than interventions that are not (Ammerman, Lindquist et al. 2002; Noar and Zimmerman 2005; Noar, Benac et al. 2007; Glanz and Bishop 2010; Spahn, Reeves et al. 2010). Glanz and Bishop (2010) suggested that strongest interventions are built from multiple theories. Theories can be used to explain the structural and psychological determinants of behaviour and to guide the development and refinement of health promotion and education efforts (Painter, Borba et al. 2008). The multitude of health behaviour theories and their classification by intervention approach and level is presented in the table 1 below. When health behaviour interventions were reviewed, the following theories were used most often: social cognitive theory, the transtheoretical model/stages of change, the health belief model, and theory of planned behaviour (Glanz and Bishop 2010).

Table 1. Health behaviour theories by intervention approach and level. Adopted from (Glanz, Lewis et al. 1997; Bartholomew, Parcel et al. 2011)

Intervention Approach	Intervention Level	Theories
People	Individual	Learning theories; Theories of information processing; Health Belief Model, Protection-Motivation Theory and Extended Parallel Process Model; Theories of Reasoned Action, Planned Behavior and the Integrated Behavioral Model; Goal-Setting Theory; Theories of goal-directed behavior; Theories of automatic behavior, impulsive behavior, and habits; Transtheoretical model of behavior change; Precaution Adoption Process Model and risk communication; Attribution Theory and Relapse Prevention; Communication-Persuasion Matrix; Elaboration Likelihood Model; Theories of self-regulation
People/ Environment	Interpersonal	Social Cognitive Theory; Theories of Stigma and Discrimination; Diffusion of Innovations Theory; Social networks and social support theories
Environment	Multilevel	Systems Theory
	Organization	Stage Theory of Organizational Change and Diffusion of Innovations Theory; Stakeholder Theory
	Community	Coalition Theory; Social Capital Theory; Social norms Theory; Conscientization; Community Organization Theory
	Society and government	Agenda-building theory; Multiple Streams Theory; Advocacy Coalition Framewok

Conceptual theories identify determinants of behaviour that need to be addressed as targets for change, and action theories point at methods for achieving the changes required. For example, methods or strategies such as self-monitoring, goal setting, and problem solving make people more aware of internal and external cues and their response. Strategies can be taught to promote behaviour change (Spahn, Reeves et al. 2010). Further, theories help to identify outcome measures and appropriate study methods. At times, health promotion actions and interventions are based primarily on existing tradition, intuition, or principles (Glanz, Lewis et al. 1997). The use of theory ranges along a continuum from no theory, "informed by theory", to applying, testing, or building theory (Painter, Borba et al. 2008). Theory, research, and practice fall on another continuum, i.e. understanding determinants of behaviour, testing strategies for change, and disseminating effective interventions (Glanz and Bishop 2010).

2.3.2 Planning and evaluating interventions

Common factors to be taken into consideration in planning, conducting, reporting as well as assessing and reviewing interventions are: size of study sample; description of subjects/participants including target population inclusion criteria and use of control group; the aim of study both as target behaviour and as outcome measures; the underlying health behaviour theory with behaviour change strategy/techniques; the used behaviour change method; study design and study setting. Also these should be featured: description of the intervention; mode of delivery; duration of intervention/follow-up; outcome measures; baseline values; results and attrition rate.

The methodological quality of the intervention and how it is reported should be evaluated and several guidelines for this exist (Ammerman, Lindquist et al. 2002; Engbers, van Poppel et al. 2005; Noar and Zimmerman 2005; Norman, Zabinski et al. 2007; Spahn, Reeves et al. 2010; Greaves, Sheppard et al. 2011). When assessing effectiveness of intervention components, taxonomies for classifying are helpful (Hardeman, Griffin et al. 2000; Abraham and Michie 2008). Still, there is lack in accurate reporting (Hardeman, Griffin et al. 2000; Ammerman, Lindquist et al. 2002; Painter, Borba et al. 2008) and use (Lombard, Deeks et al. 2009; Greaves, Sheppard et al. 2011; Thomson and Ravia 2011) of theoretical background and techniques (Painter, Borba et al. 2008) of interventions.

2.3.3 Intervening on eating and health

Behaviour change theories provide the framework or rationale for nutrition interventions to meet the needs of people demonstrating varying degrees of motivation, confidence, environmental support, and skills. Theories suggest strategies that leverage components of the change process to promote desired behaviour change. Behav-

ioural theories and strategies to facilitate health and food behaviour change through nutrition counselling have been reviewed earlier (Spahn, Reeves et al. 2010). The strongest evidence supported cognitive behavioural therapy in facilitating modification of targeted eating habits. The same applied also to reducing health risk factors, and the results did not depend on duration. Regarding strategies, self-monitoring, motivational interviewing, meals replacements, and structured meal plans were most effective (Spahn, Reeves et al. 2010). Also, goal setting seemed effective especially among adults (Ammerman, Lindquist et al. 2002; Shilts, Horowitz et al. 2004).

A multitude of health behaviour interventions have been conducted at workplaces. Offering structured programmes, such as scheduled sessions, seemed to be more effective than unstructured approaches (Anderson, Quinn et al. 2009). Importantly, the workplace enables a favourable setting for environmental intervening. Interventions can involve physical and informational environments with the twofold aim of increasing the availability of healthy foods and providing education and support by point-of-choice labelling (Sorensen, Linnan et al. 2004). Environmental modifications have shown to improve worksite health promotion programmes when reviewed. Effective modifications were labelling, campaigns with posters and bulletins as well as promoting healthy food choices in worksite canteens/cafeterias and vending machines (Engbers, van Poppel et al. 2005).

Environmental worksite modifications have shown strong evidence for a positive effect on dietary intake. Significant effects were on fat, fruit and vegetable intake (Engbers, van Poppel et al. 2005). In a worksite intervention with product information to facilitate healthier food choices, environmental changes had modest effect on changing behavioural determinants towards eating less fat but no effect on actual consumption of fat, fruit and vegetables (Engbers, van Poppel et al. 2006). Importantly however, with the aim of increasing fruit and vegetable consumption at the worksite, programme effectiveness was enhanced when using social ecological approaches, including employee participation in planning and implementation, and integrating employees' broader social context such as families and neighbourhoods. Also, identifying and reducing barriers to organizational and environmental change and addressing social differences in fruit and vegetable consumption have been priorities for worksite-based interventions (Sorensen, Linnan et al. 2004).

Outside the worksite setting, community-based multicomponent interventions have shown positive findings. Still, despite being effective, behavioural interventions on individual or group-level are not enough to achieve and sustain recommended fruit and vegetable intake at the population level. Interventions should be combined with other approaches such as social marketing (Thomson and Ravia 2011). Otherwise, to increase dietary behaviour changes, group counselling is supported to individual counselling (Ammerman, Lindquist et al. 2002; Spahn, Reeves et al. 2010). Intensive and long-term implementation with group sessions to promote behaviour change has been effective (Lemmens, Oenema et al. 2008). Face-to-face counselling, telephone contacts and computer-tailored information were all found

effective (Pomerleau, Lock et al. 2005). Recently, electronic technology has been applied to promote healthy diet. These applications can be effective in influencing positively dietary changes although evidence is limited (Norman, Zabinski et al. 2007).

Dietary interventions have appeared to be more successful among at-risk-populations than among general healthy populations (Ammerman, Lindquist et al. 2002). The same applies to increasing fruit and vegetable consumption in at risk populations (Pomerleau, Lock et al. 2005). In populations with higher risk of type 2 diabetes, effectiveness of dietary interventions is increased by: using well-established behaviour change techniques, engaging social support, and using specific self-regulatory strategies such as goal setting and self-monitoring (Greaves, Sheppard et al. 2011).

With regard to health, when diet and physical activity efforts have been specified, weight gain prevention also in the healthy population has been successful (Hardeman, Griffin et al. 2000). Low-fat diets have shown long-term weight loss. When added to diet, behavioural therapy and exercise improved weight loss (Avenell, Broom et al. 2004). At the worksite, informational and behavioural strategies have been combined to promote healthy weight through nutrition and physical activity. This conferred more benefit than providing information alone (Anderson, Quinn et al. 2009).

Finland has a long tradition of successful community based interventions targeting healthy eating. The North Karelia project was the first significant study to intervene on the Finnish population's eating with the initial aim of reducing local CVD mortality through decreasing risk factor levels (Puska, Koskela et al. 1976; Puska, Vartiainen et al. 2009). First, it utilized media campaigns, involved community organizations and health services, and mobilized lay leaders and the public. Later it continued with community structure activities and was enlarged to the population level to reduce other major chronic diseases. Also, it acted as a nationwide model programme for the whole country to promote health. The project applied a multidisciplinary and behaviour change approach and formed a large community-based intervention with: media activities, preventive services by training of health professionals and other workers, environmental changes and monitoring (Puska, Vartiainen et al. 2009).

The study showed significant results also on diet. In five years, men's estimated risk for CHD had decreased by 17% (Puska, Tuomilehto et al. 1979). After 25 years, adult men's age-adjusted CHD mortality had decreased by 72% in North Karelia and by 64% in the whole country (Puska 2000). By 1997, men's cholesterol levels had decreased by 18% and diastolic blood pressure by 5% (Pietinen, Vartiainen et al. 1996). These results are coupled with decreases of total fat intake from 39% to 33% and of saturated fat from 21% to 13% (Pietinen, Vartiainen et al. 1996; Pietinen, Lahti-Koski et al. 2001). Skim milk became as common as high-fat milk (16% and

17%, respectively), the use of vegetable oil in cooking increased substantially (from 1% to 33%) as the use of butter on bread decreased from 85% to 10% (Puska 2000).

When considering Finnish at-risk populations, the Diabetes Prevention Study (DPS) was a major intervention to prevent onset of type 2 diabetes in middle-aged overweight people with impaired glucose tolerance (Tuomilehto, Lindström et al. 2001; Lindström, Louheranta et al. 2003). The study showed significant positive results in dietary intake, physical activity, and clinical and metabolic parameters in the intervention group compared to the control group. In summary, participants following a high-fibre low-fat diet lost more weight in the long-term than those with a high-fat low-fibre diet (Lindström, Peltonen et al. 2006). After three years, the risk of diabetes had decreased by 58% in the intervention group compared to the control group (Tuomilehto, Lindström et al. 2001). Further, the Good Ageing in Lahti Region (GOAL) Lifestyle Implementation Trial (Absetz, Valve et al. 2007) followed the lifestyle objectives of DPS. It was designed for the primary health care setting and participants were middle-aged people screened to have elevated type 2 diabetes risk. At one year of the study, 20% of participants had reached four out of five lifestyle objectives, with dietary objectives more often attained than those concerning physical activity (Absetz, Valve et al. 2007).

2.3.4 Nutrition interventions for young men

A setting where the diet of young people has been intervened on is the school environment. Nutrition education is a key element to promote lifelong healthy eating and should thus be started early. Also, peers are very important for adolescents and have major influence in developing food habits. Several school-based trials suggest that nutrition education is effective in health promotion programmes with the focus of development of healthy eating practices. Still, improving implementation and ensuring maintenance of achievements is of importance (Pérez-Rodrigo and Aranceta 2001). School-based nutrition education should consider the needs and interests of students and the school. With regard to successful school-based nutrition education programmes, the following factors have been acknowledged: behavioural focus, theory-driven strategies, adequate time and intensity, multicomponent strategies, developmental appropriateness, self-assessment elements, self-efficacy, modifying school environment with regard to access to healthy food, and evaluation (Pérez-Rodrigo and Aranceta 2003). Goal setting may be an effective strategy for improving nutrient intake in adolescents (Shilts, Horowitz et al. 2004).

When looking more precisely at fruit and vegetable consumption, strongest positive evidence has been for multicomponent interventions (Knai, Pomerleau et al. 2006). Short-term environmental interventions increasing availability of fruit and vegetables have shown positive results (French and Wechsler 2004). While taking obesity reduction as a target, young males represent a population subgroup where

interventions and evidence of effectiveness is limited. Still, schools are a critical setting where also health status can be positively impacted (Flynn, McNeil et al. 2006).

Large-scale dietary interventions allocated specifically to young men have not been carried out in Finland. Still, young men have been targeted in connection with some adolescents' interventions. The North Karelia Project contained two family studies and two youth projects. The family studies were relatively small-scaled as they involved only 16 and 36 children. They aimed at decreasing serum cholesterol and blood pressure through dietary modification of the families. The first objective was achieved temporarily but cholesterol levels rose back to initial level after the intervention period (Vartiainen, Puska et al. 1986; Puska, Vartiainen et al. 2009). The first youth project (Puska, Vartiainen et al. 2009) was a community- and school-based educational intervention with the same aims as in the family studies. The specific dietary aim was to reduce serum cholesterol by: reducing total fat consumption, increasing polyunsaturated fatty acid consumption, reducing dietary cholesterol, and increasing fibre content of the diet. Several actions were taken in the intervention schools, for example replacing butter with soft margarine, replacing whole milk with skimmed milk or water, use of vegetable oils in salad dressings and in cooking, and promoting use of vegetables and salads. The changes were also recommended for meals at home. Further, healthy diet was discussed during school lessons and behaviour change was promoted by parent gatherings, leaflets and a project magazine among others. The project was not successful in reducing boys' cholesterol levels although daily milk fat consumption decreased significantly (Puska, Vartiainen et al. 2009).

The second youth project (Puska, Vartiainen et al. 2009) targeted 8000 adolescents. Dietary aims were to: decrease total fat intake, increase polyunsaturated fat intake, decrease salt and sugar intake. Again it included modification of school lunches, nutrition education in home economics classes, health screening, and mass media campaigns. Eating habits achieved a positive trend in intervention schools and school lunch nutrient content was improved as proportion of total fat decreased. An overall decrease in serum cholesterol levels was achieved but it was similar in intervention and control schools (Puska, Vartiainen et al. 2009).

More recently, a study with similar elements was conducted with the objectives of decreasing sucrose intake as well as increasing fibre intake and fruit and vegetable consumption among secondary school pupils (Hoppu, Lehtisalo et al. 2010). The study involved 12 schools with half taking part in the intervention and half acting as control schools. The intervention was based on social cognitive theory according to which behavioural, cognitive and other internal factors interact with environmental factors. Actions focused on development of a healthy food environment and on nutrition education. A healthy food environment was attained by: impacting food-related attitudes of pupils, parents and school personnel by drama workshops, discussions, meetings and a magazine all dealing with healthy eating. Also, it included improvement of the supply of healthy snacks available at schools. Sugary

snacks were restricted by replacing soft drink and sweets in vending machines by healthier options. As for school lunch, its appreciation was increased and its content modified by increasing the supply of fresh bread. Finally, a large set of material (pictures, posters, brochures, games, tests) was provided for teachers to use in nutrition education both as separate ready-planned lessons and in connection with normal lessons. Regarding results, the intervention had more effect in girls, whose rye bread consumption increased and sweets consumption decreased. At baseline, daily consumption of vegetables was infrequent (40% of girls, <30% of boys) and it as well as fruit consumption did not increase with the intervention while consumption decreased in control schools. Additionally for boys, soft drink consumption remained constant in intervention schools while it increased in control schools (Hoppu, Lehtisalo et al. 2010).

A major combined cohort and intervention trial in Finland is the STRIP Study (Special Turku Coronary Risk Factor Intervention Project) (Simell, Niinikoski et al. 2009). It was designed to examine influences of saturated fat -oriented counselling on dietary intakes, serum lipids, growth and development of infants and children. The study has followed children from 7 months of age to early adulthood either belonging to the intervention (n=540) or control (n=522) group. The dietary intervention was continued to the age of 20 years after which the study population is still followed as a cohort. Individualized dietary counselling was given at different intervals throughout the intervention period. Intervention aims were: limiting fat intake to 30-35 E-%, favourable proportions of mono- and polyunsaturated fatty acids, and limiting cholesterol intake to maximum 200 mg/day. Also, the use of soft margarine, oils, vegetables, fruit, and berries was encouraged. Dietary intake was measured using food records, and clinical examinations were performed (Simell, Niinikoski et al. 2009).

Reviewed results show that the STRIP intervention has been successful. In all, intervention children had lower fat and saturated fat intake and higher protein and carbohydrate intake than control children. The intervention decreased serum cholesterol values throughout childhood. In general, the intervention effect has been stronger in boys than in girls (Magnussen, Niinikoski et al. 2011). As the study is still ongoing, only published results of older adolescents (≥15 years) are presented here. Both at 16 and 19 years, participants of the intervention had lower saturated fat intake than control participants (Karjalainen, Söderling et al. 2011; Niinikoski, Pahkala et al. 2012). At the older age, serum LDL levels were also lower in the intervention group (Niinikoski, Pahkala et al. 2012).

2.3.5 Nutrition interventions in the military

The military environment acts as intervention itself as it differs substantially from the civilian world. Schedules and actions are commanded and freedom of choice is restricted. Regarding eating, planned main meals are provided regularly to meet

performance needs in the military. Furthermore, the structured and controlled environment offers a good setting for formal intervention trials. There have been relatively few scientifically reported nutrition interventions, mainly from the USA.

Three studies have aimed to impact the military eating environment. In the United States, new recipes for healthier food items were developed in order to decrease soldiers' fat, cholesterol and sodium intake. Acceptability was rated positively for these new foods developed specifically for institutional catering services at an army garrison canteen (Champagne, Hunt et al. 2001). At a Danish military base canteen, serving fruit and vegetables was successfully increased during a three-week intervention (Lassen, Thorsen et al. 2004). The intervention used a participatory and empowering approach, self-monitoring and networking among the canteen staff and management. Intervention methods focused on providing ideas for serving more fruit and vegetables for lunch, making environmental changes in the canteens by giving access to tasteful and healthy food choices and reducing the availability of unhealthy options. The positive result of increased fruit and vegetable consumption sustained as it remained after one-year follow-up (Thorsen, Lassen et al. 2010). In the USA, Sproul et al. (2003) found that it is challenging to influence soldiers' food choices with nutrition labelling of healthy foods at point-of-purchase. Healthy food labeling was reinforced with promotional posters but still sensory attributes such as taste, quality and appearance influenced meal selection most.

In general, military populations are relatively healthy due to physical activity levels and demands of service. However, similar patterns of increased overweight and obesity are taking place in armed forces as in civilian populations (Sanderson, Clemes et al. 2011). With these grounds, interventions have been directed increasingly to individuals with high-risk measured by overweight.

In the USA, as a response to the demand of military weight control programmes, the FLEX (Fat Loss and Exercise) programme was designed (Davis 1996). It was a three-phase programme consisting firstly of an inpatient programme. In an outpatient follow-up setting, the second phase included behaviour modification, aerobic exercise, support systems development for the social environment, and dietary modification with nutritional education. The third phase focused on relapse prevention, social support, and dietary review. Results showed that both weight and body fat decreased in the course of the inpatient phase and further during the 6-month follow-up (Davis 1996).

Again in the USA, obesity in the military has been treated by a three-tiered programme: Level I programmes were command-directed programmes relying primarily on group exercise. The two other level (II and III) programmes relied on group discussions, behaviour modification, and nutrition education (Trent and Stevens 1993). All tiers showed significant and sustained reduction in percentage body fat with a 12-month follow-up. Still, Level III tier with its multidimensional approach to treat was most effective and thus the development of a supportive, long-

term, behaviourally based aftercare programme was recommended (Trent and Stevens 1995).

An important model for obesity treatment, strongly comprising nutrition, has been the LEAN (Lifestyles, Exercise and Emotions, Attitudes, and Nutrition) programme (James, Folen et al. 1997; James, Folen et al. 1997). Later, another element (Expectations) was added to the intervention protocol (James, Folen et al. 1999). The programme was based on cognitive behavioural theory and applied a wide multidisciplinary approach. The programme protocol consisted of an intensive first phase (James, Folen et al. 1997; Earles, Kerr et al. 2007) and a 1-year follow-up programme. In the follow-up, weekly sessions with weighing, cognitive interventions, behaviour-modification techniques, guidance on low-intensity exercise, and nutrition counselling was provided (James, Folen et al. 1997).

In the programme, a major emphasis was that the individual has control over food and the capacity to live a healthy lifestyle. Also, it stressed that a healthy lifestyle, rather than fad or starvation diets, provide healthy control over maladaptive eating behaviours. Central aspects were healthy nutrition, portion control, and especially making healthy balanced food choices. Having control over food choices, food-related thoughts, and participants' own bodies was also taught. Reading food labels, meal planning, food preparation, and healthy cooking were covered in addition to learning excursions in grocery shops and restaurants (James, Folen et al. 1997).

Results of the programme indicated it to be successful in reduction of body weight. Men had lost 4.2-6.3% of weight after the first intensive period, 8.5-10.8% after six months and 6.8% after 18 months' follow-up (James, Folen et al. 1997; James, Folen et al. 1997; James, Folen et al. 1999; Sanderson, Clemes et al. 2011). An overall evaluation of clinical effectiveness of the LEAN programme among all participants confirmed a significant Body Mass Index (BMI) decrease at one year of follow-up (Earles, Kerr et al. 2007).

Later within the same programme, being deployed on military missions was taken into account by incorporating also electronic applications to follow-up. The group receiving interactive guidance ended up having a lower BMI than the "regular" group (James, Folen et al. 2001). Also, a 6-month internet-based programme was developed for weight-loss and weight-gain prevention in the military setting. The so-called behavioural internet therapy (BIT) included behavioural, dietary, and exercise recommendations through weekly internet lessons. Diet was reported through self-monitoring by online food diaries. Participants were indicated an evidence-based behavioural modification approach to weight management. The programme was successful in reducing weight, BMI, percent body fat, and waist circumference when compared to the control group (Hunter, Peterson et al. 2008).

Another American programme resembling LEAN was LIFE, a military weight reduction programme promoting healthy lifestyle change and concentrating on total well-being through a multidisciplinary approach. Completers of the whole pro-

gramme achieved significant reductions in weight and BMI and improvements in behavioural and personality measures. Their quality of life increased as did cognitive restraint of eating, ability to control hunger, control over problematic eating and self-esteem measures (Bowles, Picano et al. 2006). Weight control with dietary education has also been conducted through a shipboard programme in the Navy (Dennis, Pane et al. 1999).

2.3.6 Policy-level interventions through mass catering

Policies and national programmes provide a strong means of intervening on the population level. Finland has a long history of mass catering which originates from institutional mass catering such as in the military, prisons, schools, and hospitals. It is guided by both legislation and national level healthy food recommendations. Already at the end of the 19th century, industrial employers were recommended to keep canteens for their workers. Worksite eating was included in legislation in 1930 and nation-wide free school lunches started the next decade followed by the development of mass catering legislation (Ministry of Social Affairs and Health 2010).

The National Nutrition Council, the expert body under the Ministry of Agriculture and Forestry, has since 1954 monitored nutrition and health of Finnish people and issued nutritional recommendations. Initially the Council focused on eliminating nutritional deficiencies. In recent decades, the major challenge has changed into reducing health problems caused rather by overabundant consumption of food or food of the wrong type. At the moment, the greatest challenges in public health are associated with the prevalence of overweight and type 2 diabetes in both adults and children of ever younger age. The prevention of cardiovascular diseases through nutritional means is also still one of the most important objectives (National Nutrition Council 2012).

Then latest national nutrition recommendations date from 2005 (National Nutrition Council 2005) with the aims of promoting the nutritional status of Finnish people and prevention of nutrition-based disease through the balance of nutrition of physical activity. They are also meant for use in planning mass catering. Nutrition quality requirements have been set separately for different organizations delivering mass catering covering most age phases (Ministry of Social Affairs and Health 2010). These requirements act as policy-level interventions impacting the population's eating.

The youngest age group for which nutrition quality requirements exist is kindergarten children. Food served at kindergartens should cover one third of nutritional requirements. Food should be varied, tasting new foods encouraged and snacking avoided. For food in schools, healthy, varied and attractive options should be served. School lunches should offer rest and recreation and strengthen social contacts. Higher education includes colleges and universities. The student meal should cover

one third of daily energy intake. The amount of salt and type of fat need to meet recommendations. Food served at worksite canteens should be nutritionally planned, varied and healthy. Focal elements are saturated fat, salt, fibre and vegetables. Nutrition recommendations have also been compiled to the age group of elderly people and not specifically to mass catering services. Still, they should be taken into account in old people's homes and respective facilities. Specific requirements exist also for hospitals and prisons which represent institutional eating in distinct conditions (Ministry of Social Affairs and Health 2010).

Finally as for military recommendations, the aim is to offer varied and healthy food meeting nutrition recommendations and adequate for military conditions. The regulations are given by the Defence Command and the recommendations are in line with national ones. A balance between energy intake and expenditure as well as a nutritionally balanced diet are pursued. Different phases of military service and specific conditions, such as combat training, with their differing requirements should be taken into account (Ministry of Social Affairs and Health 2010).

2.4 Military environment

2.4.1 Finnish military context

In Finland, compulsory military service applies to all men aged 18-29 years and service is usually entered at 19-20 years. Military training is given in three defence branches: Army, Air Force and Navy. Arrivals enter twice a year in January and in July. The duration of service is 6, 9 or 12 months depending on military training so that length of service increases with more demanding and specialized training. Yearly 25 000 men, equalling nearly 80% of each age cohort, complete service (Public Information Division of the Defence Staff 2008). The rest either apply for non-military service for ethical or religious reasons or are exempted. Approximately 10% of men are exempted because of medical reasons (Multimäki, Parkkola et al. 2005). Also, a small number of females serve voluntarily (Public Information Division of the Defence Staff 2008). The progression of military service is presented in Figure 1.

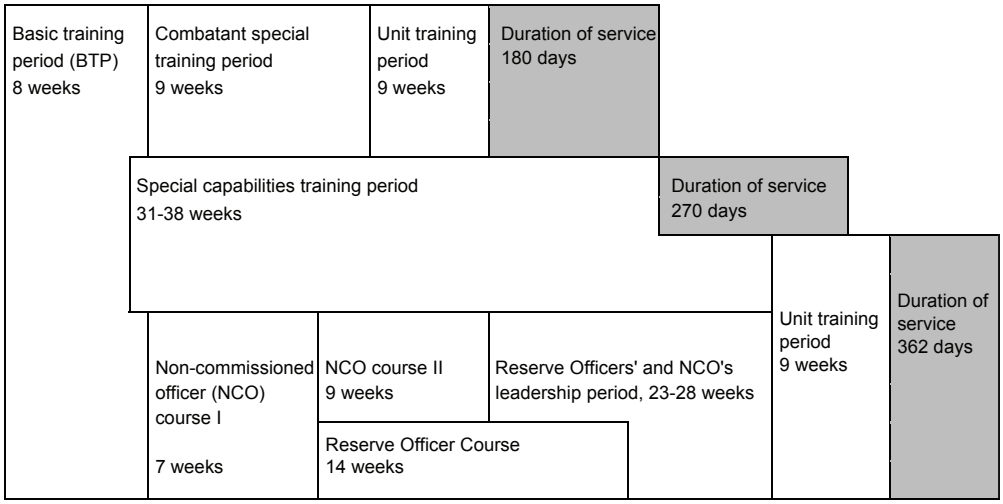

Figure 1. Training phases of military service (Public Information Division of the Defence Staff 2008)

Military training contains a considerable amount of exercise and the general physical activity level is at least moderate. Training takes place in garrison and encampment conditions. At garrison, daily service lasts approximately 10 hours. Usually, in their evening free-time, conscripts can exit the garrison area. At encampment, service is intensive and may take place around the clock. Conscripts are generally entitled to a leave at least every second weekend.

Military service represents a particular phase of life for the majority of Finnish young men in a transition between structured life at childhood home and independent adulthood. It is also a period of controlled life where actions are externally directed and schedules ordered. Individual's possibilities of making independent decisions are limited. Free-time in the evenings and weekend leaves represent relaxation, freedom of orders and of strictly structured life. In all, military service is a unique period where the structured and controlled environment offers a good setting for intervening in the lives of the majority of Finnish young men.

2.4.2 Eating in the military

In Finland, as for eating at military service, daily breakfast, and two main meals i.e. lunch and dinner, are part of compulsory service and they are served at the garrison canteen. Also a voluntary evening snack is available on most days at garrison can-

teens. The meals are planned and prepared according to specific military nutrition recommendations, which are based on the national nutrition recommendations (National Nutrition Council 2005), as described earlier. Typically, lunch and dinner contain a main dish served with fresh or cooked vegetables. Bread, especially rye crisp bread, is always available. Desserts, such as fruit soup and pudding, are served daily at meals. Drink alternatives include milk, sour milk, juice, and water. The canteen has self-service and hence conscripts may choose the components and quantity of their meals. During free-time, conscripts can buy subsidized affordable snacks from soldier's home cafeterias located in garrison areas. They may also exit the garrison and purchase food from surrounding grocery shops and restaurants or order delivered food. Thus complete freedom of dietary choice is unfeasible but soldiers are offered regular nutritionally-planned main meals comprising a varied diet (Bingham, Ovaskainen et al. 2009). Still, some individual selection is possible in free-time eating and this opportunity is also utilized (Hoikkala, Salasuo et al. 2009).

The importance of adequate healthy nutrition in the military setting is well recognized (Meiselman and Schutz 2003; Montain and Young 2003). Nutritional requirements are to be met to keep performance and combat levels high (Guezennec, Satabin et al. 1994) in all climates (Campbell 1982; Burstein, Coward et al. 1996) and circumstances. Still, prior to this dissertation, reported information on Finnish soldiers' nutrition has been scarce. During military service, a limited conscript study population showed self-reported increases in snacks (doughnuts, confectionary and soft drinks) purchased in free-time (Tähtinen, Vanhala et al. 2001). Regarding nutrient intake, conscripts' energy intake was calculated to be 15.5 MJ/day with some underreporting. This constituted 58% of carbohydrate, 14% of protein and 27% of fat (Tanskanen, Uusitalo et al. 2008).

Elsewhere too, nutrition in military settings is an under-researched area. In Norway, recruits' vegetable consumption has been found to be low and below recommendations (Uglem, Frolich et al. 2007; Uglem, Frolich et al. 2008). Consumption correlated with occupational status of parents, vegetable consumption at home, social influence, preference for cooked vegetables, weight beliefs, daily number of hot meals, and smoking habits (Uglem, Frolich et al. 2007). American soldiers' nutrition has been studied largely (Meiselman and Schutz 2003) but it is out of the focus of this dissertation because especially the military system as well as the catering services differ from Finnish respective.

2.4.3 Soldiers' health risk factors

In the military, soldiers need to meet fitness and body composition standards to achieve required good health and physical demands of service (McLaughlin and Wittert 2009). However, similar patterns of increased overweight and obesity are

taking place in armed forces as in civilian populations (Sanderson, Clemes et al. 2011). For all men entering military service in Finland, average body weight has increased from 71 to 77 kg between 1993 and 2009, while height has remained constant (Santtila, Kyröläinen et al. 2006; Finnish Defence Forces 2010). Although the majority of conscripts are normal weight, one third has a BMI of over 25 kg/m^2 (Mousavinasab, Tähtinen et al. 2005; Mikkola, Keinänen-Kiukaanniemi et al. 2007; Jallinoja, Sahi et al. 2008; Tanskanen, Uusitalo et al. 2008). A similar pattern has been shown in other countries: In USA, depending on age and military branch, even more than half of men are overweight for enlistment (Yamane 2007). Also among Air Force recruits, the prevalence of overweight and obesity increased by 24% in 1996-2000 (Poston, Haddock et al. 2005). The proportion of men in all active duty service with a BMI of over 30 kg/m^2 has almost tripled between 1995 and 2008 (Department of Defense 2009). In the UK, 14% of soldiers in armed forces had a BMI of over 30 kg/m^2 (Sundin, Fear et al. 2011).

In the course of military service, anthropometric changes have been indicated: During the 8-week basic training period, waist circumference (Santtila, Häkkinen et al. 2008) and body fat (Santtila, Häkkinen et al. 2008; Santtila, Kyröläinen et al. 2009) were found to decrease. As for the remaining service (6-12 months), results are inconsistent some indicating decrease (Tähtinen, Vanhala et al. 2001; Mousavinasab, Tähtinen et al. 2005; Mikkola, Jokelainen et al. 2009; Cederberg, Mikkola et al. 2011) and others increase of body weight (Tähtinen, Vanhala et al. 2000; Mattila, Tallroth et al. 2009), BMI and waist circumference (Tähtinen, Vanhala et al. 2000). Regarding body composition, percentage body fat and visceral fat area decreased when fat-free mass, lean body mass and skeletal muscle mass increased (Mikkola, Jokelainen et al. 2009; Cederberg, Mikkola et al. 2011). Moreover, a study of a 20-day field exercise showed decreases of body weight, lean body mass and percentage body fat (Kyrölainen, Karinkanta et al. 2008).

Regarding clinical risk factors, systolic blood pressure of conscripts was found to decrease and total, HDL and LDL cholesterol, triglycerides, and blood glucose to increase (Tähtinen, Vanhala et al. 2000; Tähtinen, Vanhala et al. 2001; Mousavinasab, Tähtinen et al. 2005) during military service in the 1990s. These last-mentioned results were confirmed in general in conscripts 10 years later (Cederberg, Mikkola et al. 2011).

3 Aims

The dissertation focuses on young men in the life phase of military service which is a transition period between a relatively structured life at childhood home and at school, and an independent adult life. They are shifting from conditions somewhat controlled by parents to self-contained decisions about future and way of life. These choices affect also eating habits as well as health in general with possible positive and negative implications later in adulthood. The setting of this dissertation, i.e., the military environment, is unique in that it enables reaching the majority of Finnish young men, and represents both institutionalized eating as well as eating based on free choices.

The overall aims of this dissertation are: 1) to explore the eating habits of young men, 2) to identify determinants of young men's healthy and unhealthy eating and effects of eating habits on health risk factors; and 3) to conduct and evaluate an intervention to promote healthy eating. The dissertation comprises of four Studies (I-IV), which are numbered according to their chronological order and which are referred to with Roman numbers. The Studies have several research questions (RQ) falling under each aim, as follows:

Aim 1. What are young men's eating habits like?

RQ1: What are eating habits like prior to military service? (II)

RQ2: In the course of military service, what happens in men's eating habits with regards to nutrient intake, especially in different environments, and food consumption? (I, III)

Aim 2. What are the determinants of young men's healthy and unhealthy eating and effects of eating habits on health risk factors?

RQ3: What sociodemographic and health behaviour factors associate with eating habits (II)?

RQ4: What are young men's anthropometric and clinical risk factor levels like and what happens to them during military service (III)?

RQ5: How do eating habits associate with health risk factors during military service (III)?

Aim 3. Can conscripts' eating habits be influenced by promoting changes in the available food supply?

RQ6: What is the effect of an intervention promoting healthy food supply in terms of young men's eating habits (IV)?

4 Materials and Methods

4.1 Data collection and participants

This dissertation consists of two principal datasets which were collected chronologically. The first dataset was used in Study I and the second in Studies II-IV. The complete data used in the dissertation in relation to Studies I-IV is illustrated Figure 2. The use of each dataset for Studies I-IV is highlighted in illustrations 3-6.

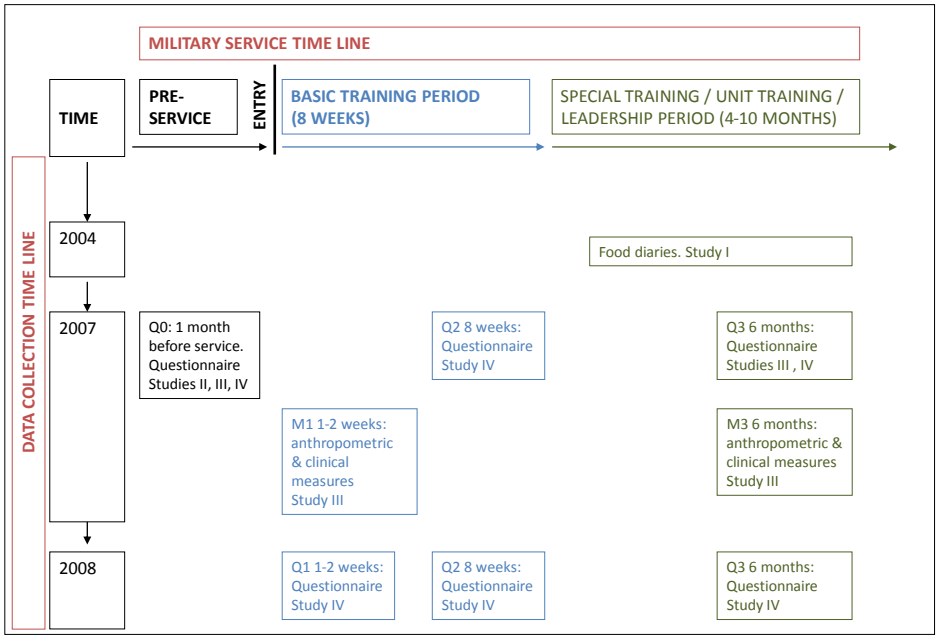

Figure 2. Data used in dissertation. Q – questionnaire, M - measurement

4.1.1 Study I

Study I was conducted in March 2004 to determine the nutritional content of conscripts' diet. The data and its results acted also as needs assessment for the second data source. The study design was a cross-sectional survey.

The study site was a military garrison, Armoured Brigade, chosen as representative as regards to location and size and giving standard military training. Armoured Brigade is situated in Southern Finland, and conscripts serving there live mostly in cities and towns in Southern and central Finland. Two service units (i.e. companies,

each comprising 80-150 men) took part and formed unit-separated samples for examining eating habits in different conditions: garrison and leave (Sample 1) and encampment (Sample 2). A recruiting event was organised where information on the study was given and participation offered to all conscripts serving in the companies. In total, 85 conscripts volunteered to participate and gave their informed consent. However, 4 dropped out (3 in Sample 1 and 1 in Sample 2) and 3 females were excluded to have a homogeneous study sample. Thus, the total number of participants in this study was 78. In Sample 1, participants (n=47, all male) served in Signal Company and in Sample 2 (n=31, all male) in Second Tank Company. The data used in Study I is illustrated in Figure 3.

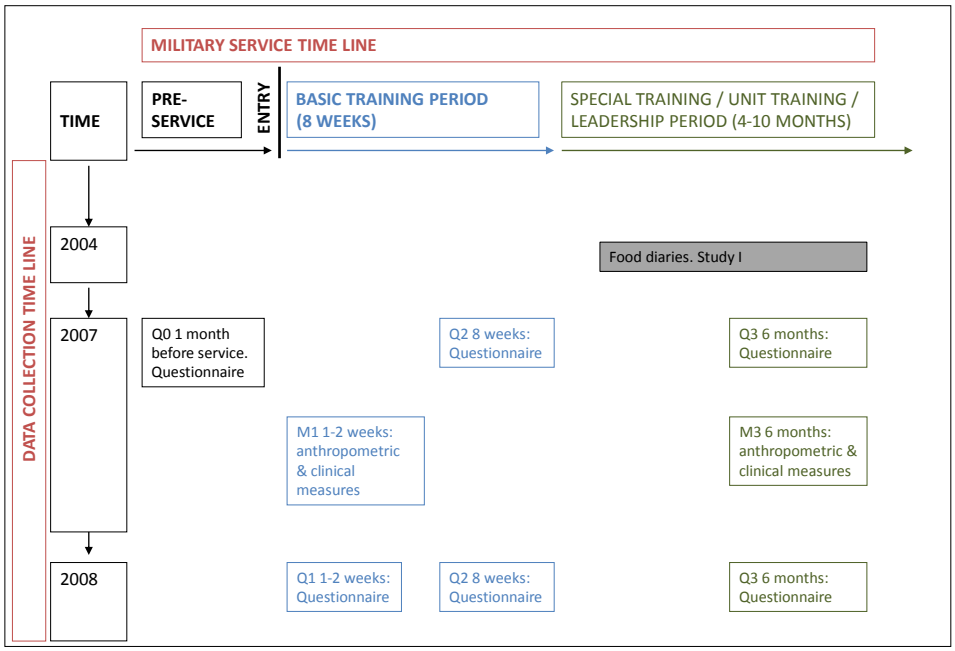

Figure 3. Data used in Study I

4.1.2 Studies II-IV

For the large part (Studies II, III, IV), this dissertation was conducted as part of the DefenceNutri study which is a controlled two-phase intervention trial aiming at improving conscripts' eating habits (Jallinoja, Sahi et al. 2008). DefenceNutri took place during three years, in 2007-9. Control group data was collected in 2007 and the data served also as a needs' assessment data for the intervention taking place in 2008 and 2009. This dissertation concentrates on the first intervention year. The study sites were two military garrisons which, as well as in Study I, were chosen to

represent average size, location and military training. The first study site was the same garrison as in Study I, Armoured Brigade, and it is described above. The second study site was Kainuu Brigade in North-Eastern Finland. It recruits men from Western, central and Northern Finland and the majority live in rural or semi-urban areas.

Several data of the DefenceNutri study were used. Only participants aged less than 22 years were included to have a sample with a homogenous age range. The few men aged 22 years or more were discarded from final datasets as being "over-aged".

Study II was a cross-sectional survey where baseline data on eating habits of two cohorts of men entering military service in January 2007 and July 2007 were presented. One month prior to the start of service, study questionnaires were sent home to all men (n=6605) starting military service at the study garrisons. Responding to the questionnaire was possible by Internet or by returning it when entering service. Altogether 3034 men replied (46%). Incompletely filled questionnaires (n=23) as well as respondents who were over-aged (n=70) or whose basic education could not be classified (n=36) were discarded. The final number of respondents was 2905. Data used in Study II is presented in Figure 4.

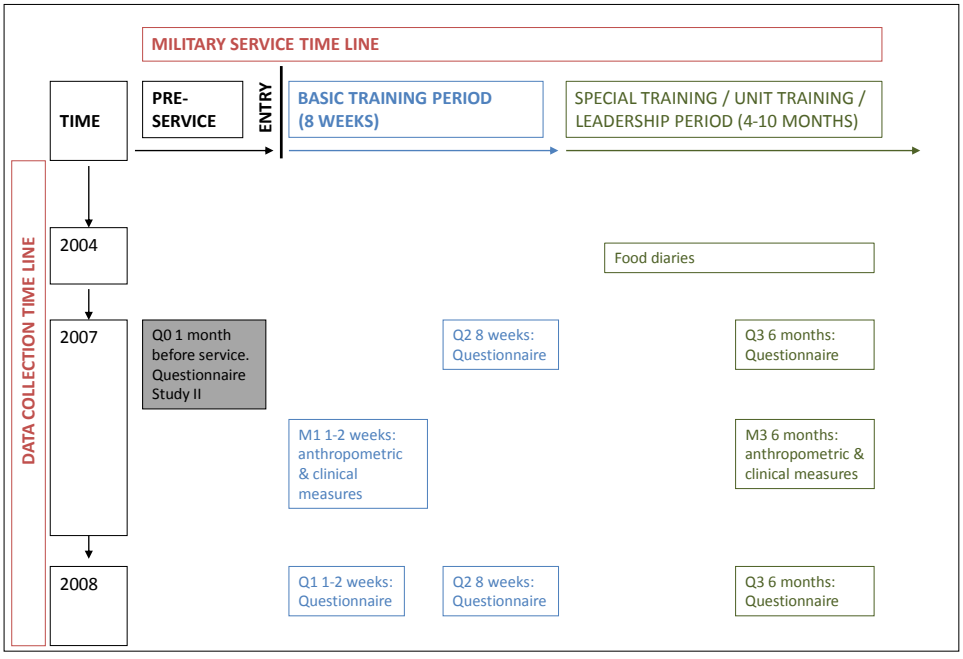

Figure 4. Data used in Study II

In Study III (Figure 5), with the design of longitudinal cohort, men entering service in both garrisons in three selected military units (companies) in January and July 2007 were involved (n=1430). As in study II, one month prior to service a questionnaire was sent to the men's home address. They responded by Internet or by returning the questionnaire when entering service at a rate of 46%. A follow-up questionnaire was filled in at 6 months of service. Also, anthropometric and clinical measurements were conducted at the first week and the sixth month of service. After discarding four men ≥ 22 years of age, there were 256 men for whom follow-up data existed, i.e. who had filled in properly both questionnaires and were measured at both time points.

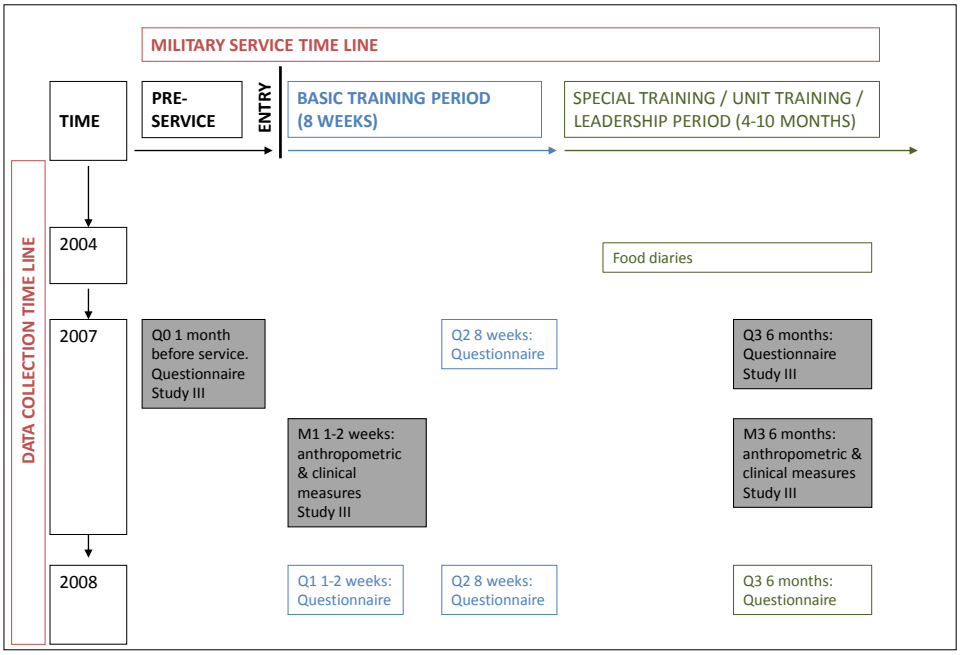

Figure 5. Data used in Study III

Study IV was a two-arm non-randomized controlled intervention with three measurement points where two longitudinal cohort data sets (Control Group and Intervention Group) were used. Control Group data was collected among men entering military service in three service units (companies) in the study garrisons in January and July of 2007. Participants filled in questionnaires at three time points. The first questionnaire was sent to the men's home address one month prior to service

(Q0). They responded by Internet or by returning the questionnaire when entering service. The second questionnaire was filled in at the end of the basic training period at 8 weeks of service (Q2). The last follow-up questionnaire was filled in at six months of service (Q3). The data used in Study IV is presented in Figure 6.

Intervention Group data was collected from men entering military service in two service units in January and July of 2008. For them, the study protocol was modified slightly due to changes in available study resources. Participants filled in the first questionnaire during the first week of military service but were instructed to answer questions on eating habits retrospectively according to civilian life (Q1). The second (Q2) and third (Q3) questionnaires were filled in at the same time points as in Control Group.

In all, Study IV comprised the follow-up data of 604 men who filled properly in study questionnaires at all three time points. Drop-out between the time points was due to: interruption of service, being on encampment, on leave or ill during measurements, military transfers to other units or garrisons, and refusals to attend the study. The last-mentioned applied particularly to the first questionnaire (Q0) of Control Group which was sent home. 11 over-aged men in Control Group and 13 in Intervention Group were discarded.

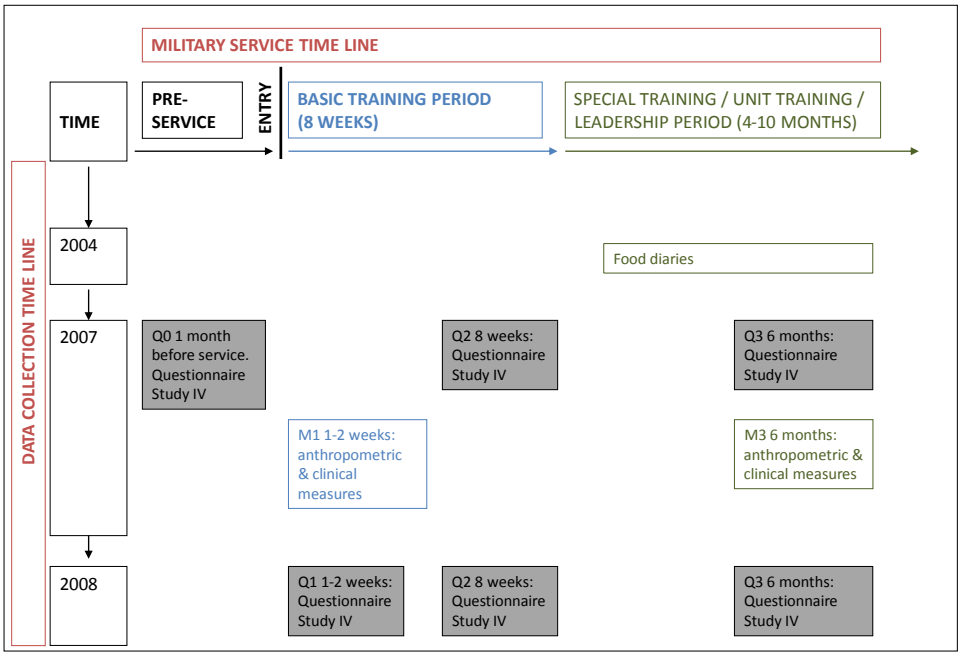

Figure 6. Data used in Study IV

The characteristics of the participants are presented in Table 2.

Table 2. Characteristics of participants

		Study I*	Study II	Study III	Study IV
Participants, n		47	2905	256	604
Age, mean		20.7	19.8	19.7	19.8
Basic education, %	Comprehensive school	45**	12	6	8
	Vocational school		42	50	47
	Upper secondary school or higher	55	46	44	45
Marital status, %	Single	87	91	92	91
	Married or co-habiting	13	8	8	9
	Other		0.4		0.2
Living condition, %	With parents	66	80	80	81
	Alone	11	11	12	9
	With spouse	13	7	7	7
	Other	11	2	1	23
Garrison, %	Armoured Brigade	100	38	30	52
	Kainuu Brigade		62	70	48
Arrival, %	January	72	52	56	59
	July	28	48	44	41

* Only participants of Sample 1.

** Combined percentage of comprehensive school and vocational school

4.1.3 Ethical issues

For Study I, the implementation and protocol of the study were approved by the Chief of Logistics of the Finnish Defence Forces. For studies II-IV, the study protocol was approved by the ethics committee of the Hospital District of Helsinki and Uusimaa. All participants gave their informed consent in written.

4.2 The DefenceNutri intervention

During the first intervention year (2008) the overall objective was to increase the supply of healthy foods at the two main places of food consumption in the military setting, garrison canteens and soldier's homes. Specific nutritional goals were to:

- Increase fruit and vegetable consumption
- Increase fibre intake
- Decrease the intake of fat and especially saturated fat
- Decrease sugar intake.

Guided workshops for core personnel of garrison canteens and soldier's homes were carried out at both garrisons during autumn 2007. The aim of the workshops was to motivate the personnel to take action for increasing availability of healthy food options, to help them generate action plans for developing the food supply to reach the nutritional goals of the intervention. The 4-6 participants, selected by each organization to participate in the workshops, were experts of their operational environment and thus well suitable for development work. The participants of the garrison canteen included supervisors, cooks and members of catering staff, while participants of the soldier's homes were the manager and staff members as well as voluntary workers who are active members in the local Soldier's Home Associations.

The flow of the intervention protocol is presented in Figure 7.

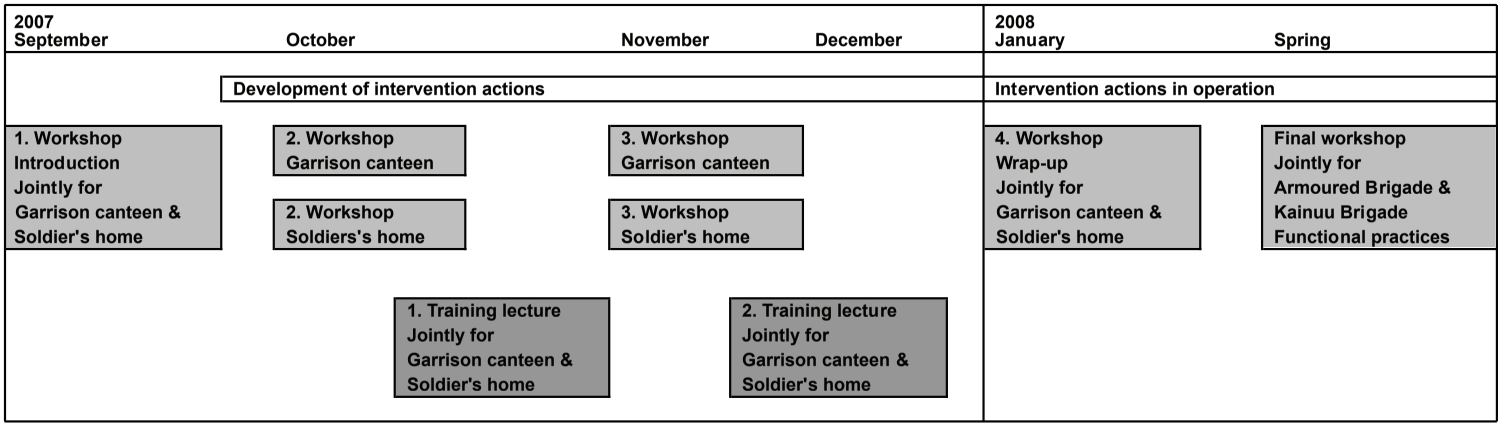

Figure 7. The intervention protocol flow. Workshops 1-4 and both training lectures were held locally at each garrison. Final work shop was held jointly for both garrisons.

The first workshop was arranged jointly for garrison canteen and soldier's home personnel for orientation and co-operation between the two organizations. The second and third workshops were organized separately for the two organizations in order to maximize feasibility of the developed action plans in their respective operational environments. Two sets of training lectures were organized close to these workshops to support the development work and to increase personnel's motivation in health promotion. The first training lectures focused on promoting conscripts' health and covered the meaning of healthy eating in the military setting, increasing attractiveness of healthy food, and profitability calculations. The second lectures focused on promoting health of the personnel of garrison canteens and soldier's homes. Finally, a fourth workshop was organized jointly for both personnel for evaluation of action plans, implementation of successful plans, and establishing further developmental work. The last-mentioned was monitored by regular follow-up telephone calls which acted also as a motivating factor for sustaining interest. Experiments of improving the food supply were conducted in the course of the workshops but full-scale implementation of actions took place as the supply intervention in 2008. Intervention actions contained apparent actions which could be measured quantitatively as well as less-visible actions to improve the quality of the food supply. As a multitude of intervention actions was developed and experimented, presenting all of them is not feasible and examples of both types of realized intervention actions are listed in Table 3.

Table 3. Examples of realised actions for developing the healthy food supply

Apparent quantitatively measurable actions	**Less-visible actions to improve quality of food supply**
Garrison refectories	**Garrison refectories**
Serving fruit (apples and oranges) cut into slices instead of whole ones	Eliminating all usage of butter except in one traditional meat dish
Stopping serving sugar-sweetened juice at all meals	Replacing white pasta and rice with dark fiber-rich varieties
Increasing serving selection of fiber-rich bread such as rye bread	Adding bran to porridges
Soldier's home cafeterias	**Soldier's home cafeterias**
Replacing normal and big bags of sweets by small ones and dried fruit near cashier	Converting white bread dough of own bakery into more fiber-rich by adding e.g. bran, seeds
Including fresh vegetables in all sandwich, bun etc. fillings	Replacing sandwich fillings from fatty meat e.g. sausage to lean meat cuts
Developing small sweet pastries to be sold	Replacing full-fat yoghurt by fat-free alternatives

Outside of the focus of this dissertation, in 2009, the intervention targeted conscripts, with the objective of increasing the demand of healthy food choices and especially vegetable consumption. In summary, the DefenceNutri intervention design has two arms with 3 measurement time points each.

4.3 Measures

The detailed measuring protocols are presented in connection with the respective Studies (I-IV). In Study I, nutritional data of the study was gathered using food diaries. For Sample 1, food use was recorded during weekdays (garrison days) and weekend days (leave days). Food diaries were kept for four consecutive days of which the proportion of garrison and leave days varied between zero and four. For Sample 2, food diaries were kept on three consecutive days of encampment. Additionally, participants of Sample 1 filled in a questionnaire on sociodemographic and lifestyle factors. They were also weighed and their waist circumference measured.

In the DefenceNutri study, participants filled in questionnaires on sociodemographic background, eating habits, health behaviours and psychosocial factors. Participants' anthropometric and clinical risk factors were measured as well. Details of risk factor measurements have been presented earlier (Jallinoja, Sahi et al. 2008) and measurements were conducted by trained personnel.

4.3.1 Dietary measures

In Study I, food diary data was recorded to dietary databases by in-house software Finessi. It uses the Finnish food composition database (FCDB) Fineli (National Institute for Health and Welfare 2012). Quantities were entered in grams by standard coding rules. Quality of food and drink, date, day of the week, day type, meal type, meal site and meal time were entered. Intakes of total energy and 21 nutrients were calculated as well as food use (g/day) of 37 food groups.

In the study questionnaires of the DefenceNutri study, the purpose was to identify overall quality of diet and eating habits of young men performing military service. Eating habits were explored by questions on food choices and a 36-item food frequency questionnaire (FFQ) in which consumption was reported as number of days during the previous week. The FFQ items represented all major food groups of the Finnish diet. Background information on the garrison canteen menus and results from Study I (Bingham, Ovaskainen et al. 2009) was used in designing it.

Dietary indexes were formed to serve as main dietary outcome measures of this dissertation and to characterize important dimensions of the diet of these young men. Detailed descriptions of formation and justification of indexes are presented in respective Studies (II-IV). Study II employed two indexes one of which was formed

to measure daily healthy eating habits (Core Food Index, CFI) and the other (Extra Food Index, EFI) consumption of food items not recommended for daily use.

CFI included five dietary factors (type of milk and bread fat; weekly consumption frequencies of rye bread, fresh vegetables and fruit and berries). EFI included four factors (monthly consumption frequency of all fast food and weekly consumption frequencies of soft drinks, chocolate, sweets). Type of milk fat and bread fat were scored qualitatively and all food items describing weekly consumption were given one point for each day the food item was used per week (range 0-7). For the overall monthly consumption of fast food, all values > 9 were combined into one category, resulting in a scale of 0-10 points. In total, the score of CFI ranged between 0-30 and of EFI between 0-31. Scoring of the indexes gave a high value for CFI when the diet consisted of healthy food choices and a high value for EFI when the diet included plenty of extra foods.

Studies III and IV used partly mutual indexes based on weekly food consumption frequencies. In Study III overall fibre intake was assessed by Fibre Index. It was the sum of four food items: weekly consumptions of rye bread, mixed bread, fresh vegetables, and fruit and berries. To evaluate accurately effects of the healthy food supply intervention and to assess reaching its aims, Fibre Index was divided into two indexes in Study IV. Fruit & Vegetable Index was the sum of two items: fresh vegetables, and fruit and berries. Cereal Index was the sum of three food items: rye bread, mixed bread, and porridges and cereals. The remaining two food indexes were mutual in Studies III and IV. Fat Index was the sum of five items: meat pies and pastries, pizza and kebab, hot dogs and hamburgers, French fries, and potato crisps. Sugar Index was the sum of five items: desserts, sugar-sweetened soft drinks, sweet pastries, chocolate and sweets. The index items were given one point for each day the food was used during the previous week (range 0-7). The indexes were scaled by dividing the sum scores by the number of food items in each index and the total score of all indexes ranged between 0-7. The contents of all food indexes in relation to their use in Studies I-IV are summarised in Table 4.

Table 4. Summary of food indexes, their contents and Studies (II, III, IV) in which they were used

Food Index	Contents	Nr. of food items	Range	Used in Study
Core Food Index	Fresh vegetables* Fruit and berries* Rye bread* Type of milk Type of bread fat	5	0-30	II
Extra Food Index	Fast food Soft drinks* Sweets* Chocolate*	4	0-31	II
Fibre Index	Rye bread* Mixed bread* Fresh vegetables* Fruit and berries*	4	0-7	III
Fruit & Vegetable Index	Fruit and berries* Fresh vegetables	2	0-7	IV
Cereal Index	Rye bread* Mixed bread* Cereals and porridges*	3	0-7	IV
Fat Index	Meat pies and pastries* Pizza and kebab* Hot dogs and hamburgers* French fries* Potato crisps*	5	0-7	III, IV
Sugar Index	Desserts* Soft drinks* Sweet pastries* Chocolate* Sweets*	5	0-7	III, IV

* Consumption frequency measured as number of days during previous week

4.3.2 Background and health behaviour measures

In Study II, the following background and health behaviour measures were used: basic education (comprehensive school, vocational school, upper secondary school), self-reported weight and height to compute BMI, smoking habits (regular/occasional/non-smoker); frequencies of physical exercise and eating breakfast (both two variables measured as times per week).

4.3.3 Risk factor measures

In study III the following anthropometric and clinical measurements were conducted to the men at the first week and during the sixth month of service: weight, height, waist circumference, lean body mass, fat mass, percentage body mass, systolic and diastolic blood pressure, serum total, HDL and LDL-cholesterol, triglycerides and fasting plasma blood glucose. BMI was calculated by dividing weight by height squared. Blood pressure was measured with automatic oscillometric blood pressure monitors (Omron M6). Serum HDL and total cholesterol as well as triglyceride levels were measured by enzymatic photometric test and plasma LDL cholesterol levels were calculated by the Friedewald formula. Fasting blood glucose was measured by enzymatic hexokinase test. Lean body mass, fat mass and percentage of body fat were determined by body composition measurement using bioelectric impedance analysis (InBody720, Biospace) measuring opposition to the flow of electric current through body tissues. All measurements followed standardized protocols and they have been presented in more detail elsewhere (Jallinoja, Sahi et al. 2008).

4.4 Statistical analyses

As participants were only male, gender adjustment was not needed. Also the study populations were homogenous with regard to age distribution. The first step of statistical analyses in all Studies was examination of the data by reviewing descriptive statistics as minimum and maximum values, means, standard deviations and distributions of variables as well as correlations between them. Basic descriptive results were presented as proportions (%), mean values and standard deviations (SD). Regarding food indexes, analyses were conducted separately for them and Cronbach's alpha values were calculated to assess internal reliability of these summed variables. The critical p-value for significance was set at 0.05 when Bonferroni corrections were not used.

In Study I, food use and nutrient intake were calculated. Nutrient intakes were not normally distributed and thus non-parametric tests were used. Differences in mean nutrient intakes between garrison and leave days were tested using Wilcoxon's signed rank test if the distribution of intake difference was symmetric. If it was skewed, the sign test was used. Differences between encampment days and both

garrison and leave days were tested using Mann-Whitney's U-test. When comparing nutrient intakes on different day types, Bonferroni corrections were made by multiplying p-values by the number of comparisons. For Sample 1, differences in nutrient intakes by educational groups were tested using Mann-Whitney's U-test. Finally, differences in energy-adjusted nutrient intakes according to meal site were tested similarly as nutrient intake differences on garrison and leave days without Bonferroni corrections.

In Study II, general linear modelling (GLM) was used first for analysing univariate associations between food indexes and background and health behaviour factors. Categorical variables were inserted as fixed factors and continuous variables as covariates. Then in multivariate GLM analyses, all statistically significant variables from univariate analyses were first incorporated as independent variables with the food index as dependent variable (Model 1). Finally, non-significant variables were dropped and only significant variables retained (Model 2).

In study III, food indexes and the 14 food items included in them as well as 13 health risk factors (weight, BMI, waist circumference, lean body mass, fat mass, percentage body fat systolic blood pressure, diastolic blood pressure, total cholesterol, HDL cholesterol, LDL cholesterol, triglycerides and fasting blood glucose) were analysed at two time points: (1) before/beginning of military service and (2) 6 months of service. For each variable, differences in mean values were tested for both with pair-wise t-tests and non-parametrically using Wilcoxon's test because variables were not normally distributed in full. Both tests gave similar results, so only the first-mentioned were presented.

Associations between food index changes and risk factor changes were explored univariately by correlation analysis. Pearson correlations were calculated for all variables and additionally Spearman correlations for non-normally distributed ones. As both gave similar results, Pearson correlations were presented. Correlations were calculated as follows: (1) between baseline food indexes and risk factors (2) between six-month-follow-up food indexes and risk factors (3) between food index changes and risk factor changes.

Multivariate analyses were performed for combined effects of food index changes on risk factor changes. These were done by hierarchical linear regression modelling accounting for food index and risk factor baselines and using food index changes as explanatory variables. As few associations were found, the results were used limitedly.

In Study IV, for outcome variables (food items and the four food indexes), differences in mean values between study groups were tested parametrically with independent samples t-tests at the three study time points (T0, T1, T2). Then within study groups, differences in mean values between time points (T0-T1, T0-T2) were tested parametrically with paired-samples t-tests. To analyse intervention effect, repeated-measures analysis of covariance (ANCOVA) was conducted for each outcome variable separately. Food consumption frequency and food index values at

each time point (T0, T1, T2) were inserted as dependent variables as within-subject factors and the number of levels was set at 3. Study group (Control Group, Intervention Group) was entered as between-subject factor and garrison as covariate. Adjustment for baseline value of each dependant variable was systemically performed (Committee for Proprietary Medicinal Products 2004). Significant main effects for time and intervention as well as time-intervention interactions were analysed and profile plots with estimated marginal means drawn.

In Study I, statistical analyses were conducted with SAS software (version 8.2). Studies II, III and IV used statistical software package PASW (versions 15, 16 and 17, respectively).

5 Results

The results of Studies I-IV are presented under the following topics. Only main results are presented. More detailed results and analysis can be found in the original manuscripts.

5.1 Young men's eating habits before military service (II)

Of core foods, milk and sour milk, cheese and rye bread belonged to the daily diet of young men as 66%, 40% and 30%, respectively, consumed them daily. In proportion, daily consumption of fruit and berries (8%) and fresh vegetables (13%) was infrequent. On a scale of 0-30, the mean value for Core Food Index (CFI) was 14.4±5.3. The consumption frequencies of selected core foods are presented in Figure 8.

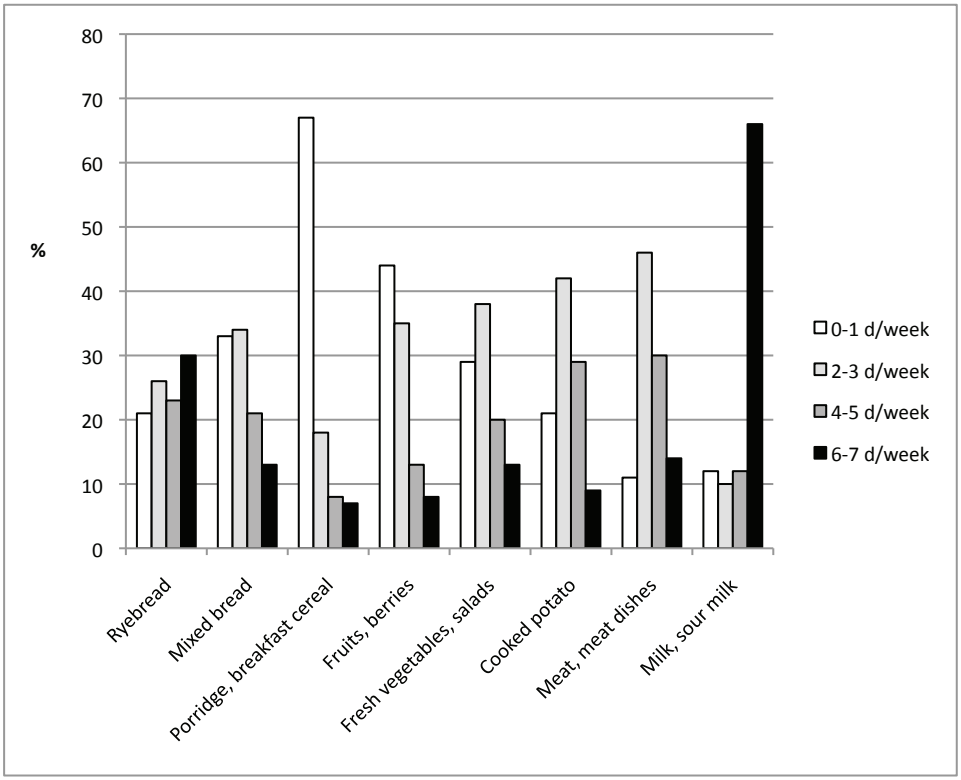

Figure 8. Consumption frequencies of selected core foods in men (n=2905) entering military service. Consumption frequency measured as days per week.

As for extra foods (Figure 9), sugar-sweetened soft drinks were favoured to artificially sweetened ones and sweets to chocolate. A clear minority consumed fast foods more than once a week and consumption frequencies of all fast foods were relatively similar. The mean value for Extra Food Index (EFI) was 9.1±5.1 with a scale of 0-31.

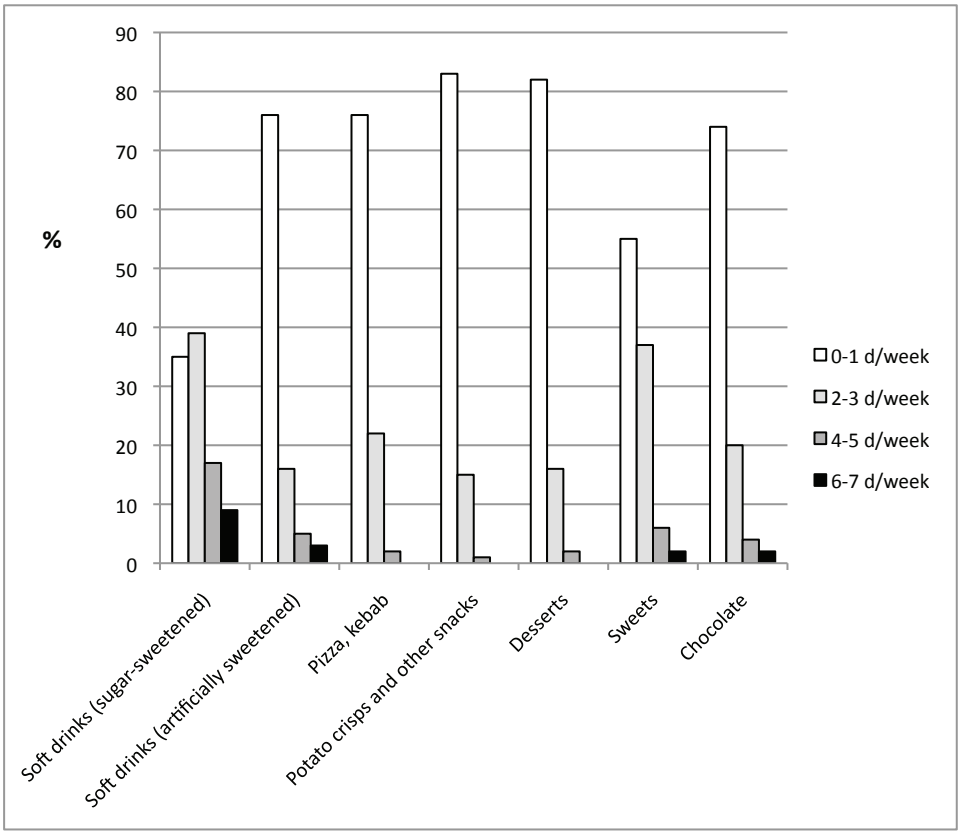

Figure 9. Consumption frequencies of selected extra foods in men (n=2905) entering military service. Consumption frequency measured as days per week.

5.2 Sociodemographic and health behaviour determinants of pre-service eating habits (II)

Seasonal differences in young men's eating habits indicated a healthier diet with a higher CFI and lower EFI in the summer compared to winter. Basic education level explained eating habits and especially CFI also when combined with other determinants ($p<0.001$ for univariate and multivariate models) so that eating was healthier for those having completed at least upper secondary school.

As an indication of clustering, health behaviour factors were found to be important determinants of young men's eating habits. Smoking status, physical activity, beer-drinking frequency and eating breakfast explained both CFI and EFI significantly. CFI was highest and EFI lowest for those men who had never smoked, exercised 4-7 times per week, drank beer on 0-1 days per week and ate breakfast daily. Respectively index values were the opposite (low CFI and high EFI) for regular smokers, the physically inactive (exercise max. once a week), more frequent beer drinkers (2-7 days per week) and men eating breakfast seldom (≤4 times per week). BMI was inversely associated with both CFI and EFI.

5.3 Eating habits and nutrient intake during military service (I, III)

5.3.1 Nutrient intake

In all, nutrient intakes during military service were reasonably in accordance with contemporary national nutrition recommendations (National Nutrition Council 1998). Vitamin and mineral intakes met and fibre intake did not meet recommendations in all conditions. Salt intake exceeded recommendation two-to-threefold being especially high at garrison and on encampment.

Differences in nutrient intake existed between distinct military conditions. At garrison in general, nutrient intakes, especially when energy-adjusted, were high. Regarding energy-yielding nutrients, the proportions of sucrose, total and saturated fat were low and respectively those of carbohydrate and protein were high. Regarding nutrient intake according to meal site, all vitamin and mineral intakes were significantly higher ($p<0.001$) at the garrison canteen indicating that food consumed there is nutrient-rich compared to other meal sites. Proportions of carbohydrate (68.6 E-%) and sucrose (34.8 E-%) were high at other meal site than the garrison canteen.

Energy intake (3786 kcal/d) was the highest on encampment which is the environment with the highest physical activity level and thus energy consumption. Sucrose intake was high (17.7 E-%) due to high consumption of juices in order to keep hydration levels up in winter time. Interestingly, energy-adjusted vitamin C intake was high in conditions where storage possibilities of fresh foods and the available selection of foods are limited.

On leave, nutrient intake was separate from the two other environments. Energy intake (3009 kcal/d) was the lowest as was the proportion of carbohydrate (45.2%). Fibre, vitamin C and salt intakes were the lowest and alcohol was naturally consumed only on leave. Nutrient intakes in different environments are shown in Table 5.

Also, intake differences according to basic education prevailed. Proportions of total ($p=0.02$) and saturated fat ($p<0.01$) were lower for those having completed at least upper secondary school. Respectively, proportions of monounsaturated fat ($p=0.02$) and carbohydrate ($p=0.04$), intakes of vitamin C ($p=0.01$) and B_{12} ($p=0.02$) were higher.

Table 5. Intakes of central nutrients in different military environments.

	Sample 1		Sample 2	Energy-adjusted difference in intake between environments
	Garrison (n=45)*	Leave (n=47)*	Encampment (n=31)	
Nutrient	**Mean (*SD*)**	**Mean (*SD*)**	**Mean (*SD*)**	**Significant difference**
Energy (kcal)	3401 (*744*)	3009 (*924*)	3786 *(596)*	a, b, c
Carbohydrate Energy-	50.0 (*5.9*)	45.2 (*9.5*)	49.8 *(3.8)*	a, c
Protein Energy-%	16.9 (*1.7*)	14.8 *(4.2)*	13.7 *(1.4)*	a, b
Fat Energy-%	32.9 (*5.6*)	36.5 *(7.1)*	36.5 *(3.1)*	a, b
Saturated Fat Energy-	12.5 (*2.8*)	15.3 *(3.3)*	15.0 *(1.8)*	a, b
Sucrose Energy-%	11.0 (*4.5*)	13.0 *(8.1)*	17.7 *(2.9)*	b, c
Fibre (g)	23.6 (*5.6*)	14.4 *(8.2)*	25.1 *(5.8)*	a, c
Salt (g NaCl)	13.4 *(3.2)*	10.0 *(5.3)*	15.2 *(3.0)*	a, c
Vitamin C (mg)	131 *(100)*	86 *(118)*	167 *(84)*	a, b, c
Vitamin D (µg)	14.1 *(5.9)*	7.2 *(7.0)*	4.9 *(1.5)*	a, c
Iron (mg)	20.7 (*30*)	16.7 *(29)*	18.9 *(3.7)*	a, c
Calcium (mg)	1964 (*712*)	1504 *(623)*	1321 *(276)*	a, b, c

SD = Standard Deviation

* Calculated for participants having kept food diary on respective day type

a = p-value <0.05 for difference in mean nutrient intake between garrison and leave days. Test performed for those having both garrison and leave days (n=45)

b= p-value <0.05 for difference in mean nutrient intake between garrison and encampment days

c= p-value <0.05 for difference in mean nutrient intake between leave and encampment days

5.3.2 Food consumption

Differences in nutrient intake in the distinct environments reflected respective food consumption patterns (Study I). In general, garrison conditions followed core eating manifesting for example as high consumptions of fibre containing foods. Vegetables, fruit, porridge, muesli and breakfast cereals were consumed mostly at the garrison canteen. Interestingly, consumption of fresh fruit and berries was high (101 g/day) on encampment. Otherwise, food use reflected field conditions with restricted food storage and preparation facilities. Thus the selection of foods used and avail-

able was limited. Snacking-type extra eating prevailed on leave where consumptions of pizza (mean 185 g/day) and soft drinks (mean 633 g/day) was abundant. Regarding drinks, milk and sour milk were primarily used in the garrison environment, juices at encampment, and soft drinks and beer on leave.

Results of differences in eating habits in the course of military service (Study III) are summarized in Figure 10. Fibre Index increased significantly ($p=0.011$) and when viewed through food indexes of Study IV, this was due to an increase in Cereal Index (from 3.64±1.98 to 4.47±1.92, $p<0.001$, unpublished data) and consumption of porridges and cereals (from 1.37±2.01 to 2.41±2.02, $p<0.001$, unpublished data) and rye bread (Figure 10). The change in Fruit & Vegetable Index was not significant. Sugar Index increased significantly ($p<0.001$) owing to increased consumption of all sugar containing foods except soft drinks. Of these, the consumption of desserts increased the most, by 1.1 days/week. Fat Index remained stable although consumptions of two items, French fries and hamburgers and hot dogs, decreased.

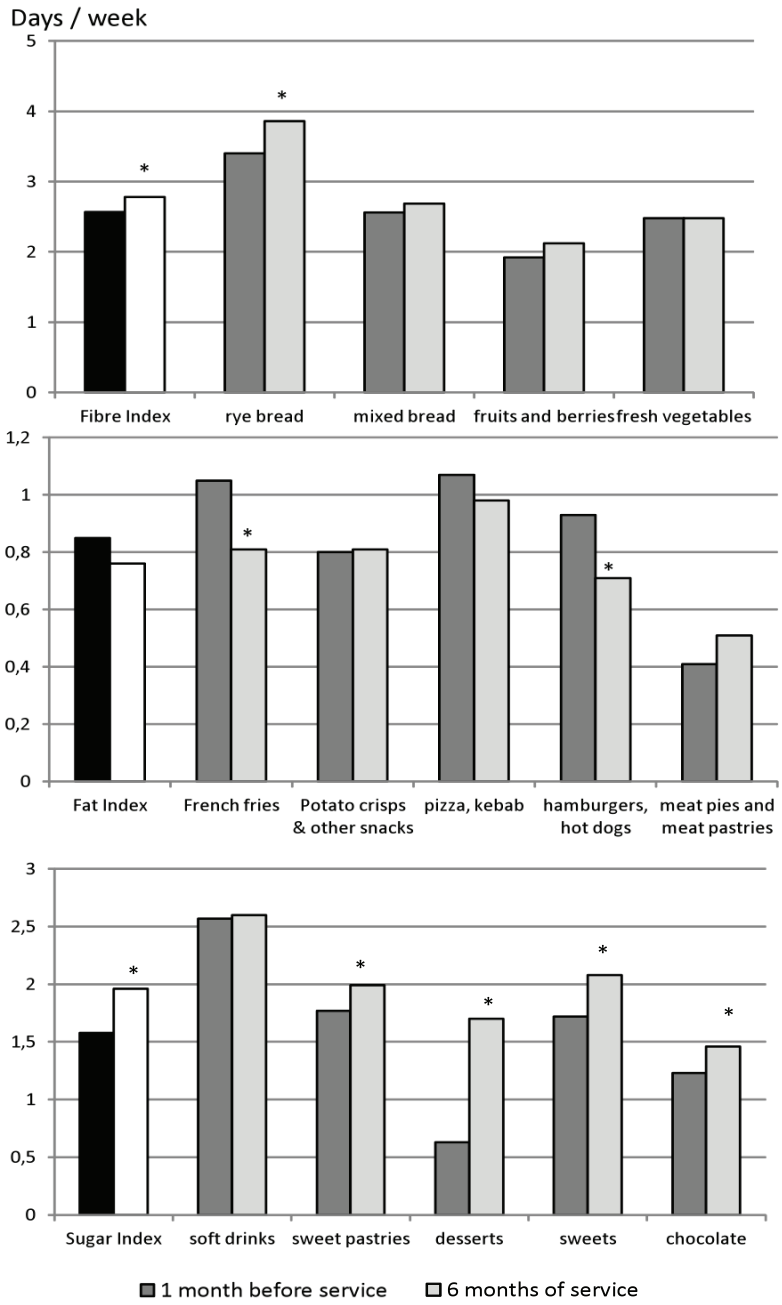

Figure 10. Three food indexes and mean weekly consumption frequencies (days/week) of selected foods 1 month prior to service and at 6 months of service (n=256). * Difference between time points statistically significant ($p<0.05$).

5.4 Eating habits in relation to risk factors (III)

At baseline, 68% of the conscripts were normal weight (BMI 18.5-24.9 kg/m^2), 22% overweight (BMI 25.0-29.9 kg/m^2) and 6% obese (BMI > 30.0 kg/m^2). At 6 months follow-up, 77% were normal weight, 19% overweight and 2% obese. Positive risk factor changes covered improved body composition as mean BMI, waist circumference, fat mass, and percentage body fat decreased and lean body mass increased. Also, systolic blood pressure decreased and HDL cholesterol increased. However, also negative changes took place in clinical indicators as total cholesterol, triglycerides and blood glucose increased. Anthropometric and clinical risk factors and changes in them are summarized in Table 6.

Table 6. Anthropometric and clinical risk factors at the beginning and six months of military service and changes in them (n=256)

	1 month before service	6 months of service	Change	
Risk factor	**Mean *(SD)***	**Mean *(SD)***	**Mean *(SD)***	**P-value**
Weight (kg)	74.4 *(12.8)*	74.0 *(9.97)*	-0.46 *(4.78)*	0.129
BMI (kg/m2)	23.4 *(3.70)*	23.0 *(2.77)*	-0.35 *(1.53)*	<0.001
Waist circumference (cm)	83.7 *(10.4)*	82.0 *(7.72)*	-1.72 *(5.60)*	<0.001
Lean body mass (kg)	34.7 *(4.31)*	35.2 *(3.94)*	0.44 *(1.47)*	<0.001
Fat mass (kg)	13.1 *(7.90)*	12.2 *(5.22)*	-0.94 *(3.83)*	0.001
Percentage body fat (%)	16.8 *(6.92)*	16.0 *(4.97)*	-0.76 *(3.52)*	0.003
Systolic blood pressure (mmHg)	126 *(10.6)*	123 *(10.6)*	-3.03 *(10.2)*	<0.001
Diastolic blood pressure (mmHg)	68.5 *(6.91)*	68.4 *(7.36)*	-0.01 *(6.26)*	0.983
Total cholesterol (mmol/l)	3.74 (0.77)	3.93 *(0.68)*	0.20 *(0.55)*	<0.001
HDL cholesterol (mmol/l)	1.25 *(0.26)*	1.28 *(0.24)*	0.04 *(0.16)*	<0.001
LDL cholesterol (mmol/l)	2.17 *(0.67)*	2.15 *(0.56)*	-0.02 *(0.49)*	0.444
Triglycerides (mmol/l)	0.70 *(0.25)*	1.11 *(0.58)*	0.41 *(0.55)*	<0.001
Fasting blood glucose (mmol/l)	5.24 *(0.38)*	5.65 *(0.44)*	0.41 *(0.54)*	<0.001

Correlation analysis revealed that at baseline, Fibre Index was inversely associated with BMI (r=-0.155, p=0.015), waist circumference (r=-0.148, p=0.019) and percentage body fat (r=-0.146, p=0.044). Also, Sugar Index was inversely associated with these measures (BMI: r=-0.245, p<0.001, waist circumference: r=-0.244, p<0.001, percentage body fat: r=-0.202, p=0.005), and in addition with weight (r=-0.215, p=0.001) and fat mass (r=-0.220, p=0.002). The findings indicate that less frequent consumption of fibre-rich foods was associated with a fattier and more frequent consumption with a leaner body composition. Surprisingly, the same pattern was evident for consumption of sugar-rich foods. Fat Index had no significant associations with risk factors at baseline.

At follow-up, Fibre Index was inversely associated with fat mass (r=-0.150, p=0.017) and percentage body fat (r=-0.174, p=0.005). Sugar Index correlated negatively with weight (r=-0.184, p=0.003), BMI (r=-0.203, p=0.001), waist circumference (r=-0.158, p=0.011), lean body mass (r=-0.155, p=0.013), fat mass (r=-0.150, p=0.016), and diastolic blood pressure (r=-0.170, p=0.006). As at baseline, less frequent consumption of fibre-rich foods was associated with a fattier body composition and vice versa. Again, the same pattern was evident for sugar-rich foods and body composition. The only significant association of Fat Index was a positive correlation with triglycerides (r=0.168, p=0.007) which can be an indication of high saturated fat intake.

As risk factors can also be associated with other health behaviours than eating habits, risk factor changes were additionally analysed according to physical activity drinking beer and smoking status, measures used Study II. Low levels of physical activity prior to military service associated with larger decrease in waist circumference (p=0.048), diastolic blood pressure (p=0.008), LDL cholesterol (p=0.008), fat mass (p=0.004), and percentage body fat (p=0.002). These results indicate that physical military service itself acts as an intervention and has effect on especially physically inactive young men. Drinking beer frequently associated with bigger decrease in weight (p=0.049) and waist circumference (p=0.049) but smaller increase in lean body mass (p=0.02) compared to rare drinking. Smoking status did not associate with risk factor changes.

5.5 Intervening on young men's eating habits (IV)

Study IV showed that in the non-randomized control design, food consumption differed between Intervention Group and Control Group at baseline (T0). Fibre Index and Fruit and Vegetable Index as well as all food items in them except porridges and cereals were higher in Intervention Group than in Control Group ($p \leq 0.001$ for all). In Intervention Group mean T0 values for Fat Index (p=0.016) were higher, due to more frequent consumption of pizza and kebab (p=0.036) and meat pies and pastries (p<0.001). Furthermore, although Sugar Index did not differ between study groups, the consumption frequency of sweet pastries was lower in Intervention Group (p=0.028). Baseline

differences were taken into account in statistical analyses as in analysis of covariance, adjustment of baseline values helps to account for coincidental baseline imbalances between study groups (Committee for Proprietary Medicinal Products 2004).

Effects of the DefenceNutri intervention were reviewed with significant intervention main effects and time-intervention interactions indicating differing food consumption patterns in the course of follow-up between the study groups. Several positive effects for Intervention Group were seen in individual food items: Porridges and cereals were consumed more frequently throughout follow-up ($p=0.006$ for intervention effect, $p=0.044$ for time-intervention interaction). From T0 to T1, consumption frequencies increased especially for crisps ($p=0.01$ for intervention effect, $p<0.001$ for time-intervention effect) and soft drinks ($p=0.042$ for intervention effect, $p=0.024$ tor time-intervention interaction) and also for desserts ($p=0.001$ for intervention effect, $p<0.001$ for time-intervention interaction) in Control Group when compared to Intervention Group (Figure 11).

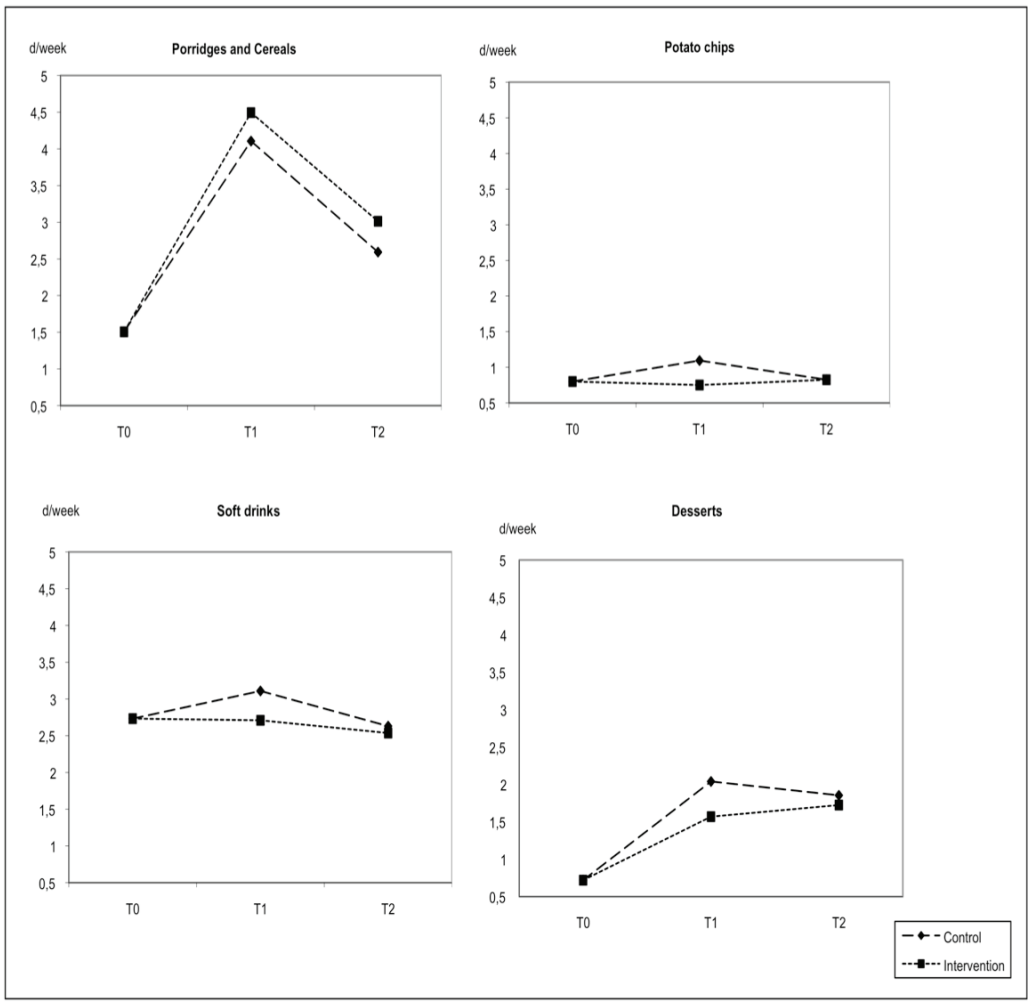

Figure 11. Profile plots of food items with positive significant intervention main effects and time-intervention interactions. T0 - first measurement point: before military service (Control Group)/beginning of military service (Intervention Group); T1 – second measurement point: 8 weeks of military service; T2 – third measurement point: 6 months of military service.

Regarding food indexes, a main intervention effect was found for Fat Index (p=0.016), indicating a lower consumption level of fatty foods in Intervention Group. Cereal Index (p=0.006) and consumption frequency of fresh vegetables and salads (p=0.014) was higher in Intervention Group than Control Group at T2. The intervention was not effective in increasing fruit and vegetable consumption when measured by Fruit and Vegetable Index and consumption frequency of fruit and berries.

6 Discussion

6.1 Main findings

6.1.1 Summary of main findings

Studying eating habits before military service showed that several core foods belonged to the daily diet of young men as an indication of healthy everyday eating. However, consumption of fresh vegetables, fruit and berries was infrequent. Extra foods, food items not recommended for daily use, were seldom consumed more than once a week. Basic education was a strong sociodemographic determinant of core eating. Seasonal differences indicated a healthier diet in summer than in winter. Health behaviour indicators predicted eating habits so that healthy habits were coupled with healthy eating and vice versa. So, already in early adulthood, young men's health behaviours including eating habits accumulate.

In general during military service, conscripts' nutrient intakes, especially for vitamins and minerals, met national nutrition recommendations of that time (National Nutrition Council 1998) although salt intake was clearly high. Differences between military conditions indicated that at garrison proportions of energy-yielding nutrients were favourable and micronutrient intakes highest. Food at the garrison canteen was the main source of micronutrients. These differences were especially clear when compared to free-time eating. At encampment with high physical activity, energy and sugar intake were highest the latter due to juice consumption for hydration. Nutrient intake was healthier for those having completed at least upper secondary school compared to lower basic education. Similar environmental differences were found also for food consumption. Food indexes were used for studying quality of diet and dietary changes during service. Fibre-containing, especially cereal, foods were typically eaten at the garrison canteen and values of Fibre and Cereal Index increased. The food selection consumed at encampment was more confined representing field conditions. In all, food provided by the military, especially at the garrison canteen, was nutrient-rich and offered a balanced diet. At free-time, snacking-type eating with less nutritious and sugar-rich foods prevailed and Sugar Index increased.

Overall health risk factor levels were relatively low for conscripts. During military service, the proportion of normal weight men increased and of overweight decreased. Other positive changes occurred for body composition measures but negative changes concerned clinical risk factors. Less frequent consumption of fibre-rich foods was associated with a fattier and more frequent consumption with a leaner body composition. The same pattern arose surprisingly for consumption of sugar-rich foods.

Finally, the real-world non-randomized intervention to improve conscripts eating habits by increasing healthy choices in the main military eating environments was assessed. Despite baseline differences, several positive changes were found in Intervention Group compared to Control Group. The level of Cereal Index ended up being higher and the overall consumption of porridges and cereals was higher during follow-up. Also, overall levels were lower for Fat Index and consumptions of crisps, soft drinks and desserts during follow-up. At the same time, Fruit and Vegetable Index and consumption level of fruit and berries were lower in Intervention Group than in Control Group during follow-up. So in all, Intervention Group showed more healthy changes except for fruit and vegetables.

6.1.2 Young men's eating habits before and during military service

Prior to military service, young men's consumption of fruit and vegetables was infrequent and far from the recommended 400 g/day (National Nutrition Council 2005). This finding in not surprising with regard to prior studies on boys (Räsänen, Ahola et al. 1985), school and college students (Lee, Keenan et al. 2007; Hoppu, Lehtisalo et al. 2010; Mäki, Hakulinen-Viitanen et al. 2010) and men in general both domestically (Prattälä, Paalanen et al. 2007; Roos, Talala et al. 2008; Lallukka, Chandola et al. 2010; Helakorpi, Pajunen et al. 2011) and internationally (Wardle, Haase et al. 2004; Westenhoefer 2005; Prattälä, Paalanen et al. 2007; Lallukka, Chandola et al. 2010). Moderate consumption of fruit and vegetables remained in the course of military service as has been the case in other military populations (Williamson, Martin et al. 2002; Uglem, Frolich et al. 2007; Uglem, Frolich et al. 2008).

The frequent consumption of core foods, such as cereal and milk products, found before military service, was observed in Finnish young men already some three decades ago (Räsänen, Ahola et al. 1985; Räsänen, Laitinen et al. 1991). It is known from the same study that eating habits remain relatively stable with time and that food choices are established already in childhood or adolescence tracking into adulthood (Mikkilä, Räsänen et al. 2005). In connection with this, two stable dietary patterns were identified: a traditional and a modern one. The traditional pattern was characterised by high consumption of rye, potatoes, butter, sausage, milk and coffee whereas the modern contained vegetables, legumes and nuts, tea, and cheese. The first-mentioned traditional pattern was more common among men (Mikkilä, Räsänen et al. 2005). Still, a change away from the traditional diet has emerged with decreased milk, potato (Männistö, Laatikainen et al. 2010; Tike Information Centre 2010), bread (Helakorpi, Pajunen et al. 2011) and cereals consumption (Männistö, Laatikainen et al. 2010; Tike Information Centre 2010). Simultaneously, consumption of modern foods (Roos, Prättälä et al. 1996; Prattälä, Groth et al. 2003; Mikkilä, Räsänen et al. 2005) has increased. An example of this is the doubling of cheese

consumption in 30 years (Männistö, Laatikainen et al. 2010). All this represents a transition between traditional and modern diet with some foods, such as rye bread and milk, belonging constantly strongly to the Finnish diet (Paturi, Tapanainen et al. 2008) while other foods, such as cheese, becoming more popular. These dietary trends reflect directly to young men's eating habits found in this dissertation. The core daily diet contained traditional elements such as the mentioned rye bread and milk as well as more modern foods such as cheese.

Another dimension of the same transition relates to snacking-type eating which consists often of extra foods, for example fast food, sweets and soft drinks, which are not recommended in the daily diet. Prior to military service, consumption of these foods was relatively moderate with soft drinks and sweets being the most popular food items. Snacking has been associated with adolescents for long (Bull 1988) but it has increased recently (Zizza, Siega-Riz et al. 2001; Nielsen, Siega-Riz et al. 2002; Bellisle, Dalix et al. 2003; Hoppu, Lehtisalo et al. 2010). In Finland, it has increased particularly in men of whom at one third consume more than four snacks daily (Männistö, Ovaskainen et al. 2003; Ovaskainen, Reinivuo et al. 2006; Ovaskainen, Tapanainen et al. 2010) with an overall average of 3.6 (Ovaskainen, Reinivuo et al. 2006; Ovaskainen, Tapanainen et al. 2010). Men with this eating pattern have higher energy intake than other men and the energy density of snacks is higher than in main meals (Ovaskainen, Reinivuo et al. 2006). This snacking-type eating associates with conscripts' free-time eating. In military conditions, main meals are served regularly at the garrison canteen as a part of compulsory scheduled service and they are nutritionally-planned to cover energy and nutrient requirements of service. However, the diet can be supplemented with foods from soldier's home cafeterias or elsewhere.

Moreover, snacking happens commonly on sugary foods (Bellisle, Dalix et al. 2003): on sweets and on soft drinks especially among boys (Hoppu, Lehtisalo et al. 2010). Of school students aged 11-15 years, one in ten consumed energy drinks, soft drinks, chocolate and sweets at least on three days per week (Mäki, Hakulinen-Viitanen et al. 2010). Consumption of soft drinks also in connection with snacking (Zizza, Siega-Riz et al. 2001; Bellisle, Dalix et al. 2003) has been an increasing dietary trend among adolescents universally (Moreno, Rodriguez et al. 2010).

Earlier findings on snacking on sugary foods are in line with the results of free-time eating during military service. Free-time eating resembles snacking-type eating manifesting as consumption of less nutritious extra foods such as pizza and soft drinks which has been found in the school environment as well (Mäki, Hakulinen-Viitanen et al. 2010). Snacking was characterised by high sugar intake especially during free-time in the garrison environment. The high percentage of energy derived from sugar has been reported earlier too (Nicklas 1995). Also in the course of military service, the outcome measure of Sugar Index and most of its food items, i.e. sweet pastries, desserts, sweets and chocolate, increased. This could be difficult to influence because the military affects also food attitudes as craving for sweet foods

and using food as a reward and a source of pleasure increase (Jallinoja, Tuorila et al. 2011). Earlier in the 1990s, it was also reported that conscripts' consumptions of desserts, doughnuts, and confectionary increased during military service compared to pre-service levels (Tähtinen, Vanhala et al. 2001). Elsewhere, snacking-dominating eating was related to higher intake of carbohydrates (Bellisle, Dalix et al. 2003) and sugar as well as to lower intake of micronutrients (Ovaskainen, Reinivuo et al. 2006; Ovaskainen, Tapanainen et al. 2010). Furthermore, soldiers' frequent choices for sugar-rich foods such as soft drinks (Katz, Gordon et al. 1991; Hart and Morrison 1992; Wisloff, Vassend et al. 1995; Johansson, Johansson et al. 1996; Myklebust, Espelid et al. 2003) and sweet pastries (Tähtinen, Vanhala et al. 2001) have been documented earlier.

In contrast, main meals with core foods are served at the garrison canteen explaining the increase in fibre-containing foods during military service. Conscripts' diet was varied especially when eating at the garrison canteen. Food provided by the military was nutrient-rich and offered a balanced diet. Eating at the garrison canteen is of importance because skipping meals increases with age from childhood to adolescence (Hoppu, Lehtisalo et al. 2010). This happens to eating breakfast (Moreno, Rodriguez et al. 2010), lunch (Hoppu, Lehtisalo et al. 2010; Mäki, Hakulinen-Viitanen et al. 2010) and dinner (Mäki, Hakulinen-Viitanen et al. 2010). Having the main course at a meal associates with healthier food consumption and skipping it associates respectively with consumption of unhealthy and snacking-type foods (Raulio, Roos et al. 2010). Also, men who had lunch at a worksite canteen were more likely to follow recommended food habits in line with national dietary guidelines (Roos, Sarlio-Lähteenkorva et al. 2004). Thus, eating regular main meals at the garrison canteen is beneficial with mass catering promoting healthy food habits (Raulio, Roos et al. 2010).

Finally, conscripts' nutrient intake is considered. Proportions of energy-yielding nutrients were similar to those reported among young men in Finland (Räsänen, Ahola et al. 1985; Räsänen, Laitinen et al. 1991) and generally in Western Europe (Rolland-Cachera, Bellisle et al. 2000): relatively high total and saturated fat intake and respectively low carbohydrate intake. Still, considerably lower carbohydrate intakes have been reported among soldiers in the USA (Singh, Deuster et al. 1988; Hart and Morrison 1992). Also, high sucrose intake has been found earlier (Nicklas 1995; Hoppu, Lehtisalo et al. 2010). Of other nutrients, fibre intake was low on leave as is the case already at school age (Hoppu, Lehtisalo et al. 2010). In general, nutrient intakes were adequate, especially at the garrison, and vitamin and mineral intakes reached national nutrition recommendations (National Nutrition Council 2005). Salt intake was clearly high especially in military conditions where intake exceeded recommendations nearly threefold. A possible explanation for this is that military service is physical leading to high energy requirements. So, consumption of large amounts of food may result unavoidably in high salt intake. Also, the reasonable level of physical activity can lead to higher salt excretion. Methodological is-

sues can relate to measuring salt intake. 24-hour urinary excretion has been defined as the gold standard method (Sutton, Emmett et al. 2008) but it was not feasible in this study setting. At large, the best method should depend on research questions as well as characteristics of the study population (Bentley 2006). In Study I, the original standardised recipes used for food preparation at garrison canteens were obtained and used in analyzing food diary data.

In all, clear changes in eating were found as an indication of military service being a powerful intervention in itself. During service, healthy eating habits were enhanced as increased consumption of fibre-containing foods. On the other hand, free-time eating was related to increased consumption of sugar-rich foods.

6.1.3 Determinants of young men's eating habits and effects of eating habits on health risk factors

Prior to military service, seasonal differences in eating habits existed in core eating habits with the diet being healthier in the summer than in the winter. Generally, consumption of fruits, berries and vegetables is more frequent in the summer due to better availability. Regional dietary differences could not be detected here but in the general population some foods (cheese, fruit, pasta, pizza, cakes, pastries i.e. modern foods) are more common and other more traditional foods (e.g. milk, meat potatoes, sugar, sausage) less common in urban areas when compared to other regions (Prattälä, Paalanen et al. 2007; Männistö, Laatikainen et al. 2010). Also, the snacking-dominating eating pattern associates with urbanization as it was more common in southern than in northern areas in Finland (Ovaskainen, Reinivuo et al. 2006).

Higher socioeconomic groups have a healthier diet measured as low energy and fat intake and high fibre intake (Giskes, Avendano et al. 2010) as well as high fruit and vegetable consumption (Giskes, Avendano et al. 2010; Ovaskainen, Paturi et al. 2010). Also food consumption patterns have been defined according to socioeconomic groups (Roos, Prättälä et al. 1996). The findings that higher socioeconomic groups have a healthier diet can not be confirmed in this study population. As for socioeconomic determinants, conscripts are a challenging group to study in the transition between life at childhood home and independent adult life. Also, with the specific and limited phase of military service, many of the commonly used socioeconomic measures do not apply. Among others, occupation, living conditions, own and family income and working conditions are difficult to define in these circumstances and susceptible to change.

At this age, young men's own basic education can be used as a determinant of diet and it can be classified into three: secondary school, vocational school and upper secondary school. Choosing and attending further education, such as college or university, is still to come for these young men. Still, healthier core eating was associated with higher basic education in the results of this dissertation. Later in

adulthood, men with a high education have been reported to have lower energy intake than less educated men. Regarding fat, more educated men show lower total and saturated fat intake (Roos, Prättälä et al. 1996; Ovaskainen, Paturi et al. 2010) as well as higher consumption of skimmed milk and oil in food preparation as an indicator of better quality of fat (Ovaskainen, Paturi et al. 2010). Also, men with high education consumed less butter, high-fat milk, and sugar in coffee than those in other educational groups (Prättälä, Berg et al. 1992). Among men, level of education was positively associated with following dietary guidelines (Roos, Lahelma et al. 1998). To summarize, men and also women with high education have constantly shown healthier food behaviour compared to low education (Prattälä 2012).

Health behaviour indicators, smoking, physical activity, drinking beer and eating breakfast, predicted eating habits so that other healthy behaviours were coupled with healthy eating and vice versa. Thus, already in early adulthood, young men's health behaviours including eating habits cluster and accumulate. The same continues later in adulthood as health behaviours tend to cluster both positively and negatively. Healthy food habits relate to income and education as well as to nutrient intake, biomarkers and disease (Kant 2004). Furthermore, unhealthy eating clusters with other unhealthy behaviours such as smoking and physical inactivity (Laaksonen, Talala et al. 2008).

Conscripts' overall health risk factor levels were relatively low. At baseline, men's weight (74.4 kg) was slightly lower compared to conscripts nationwide in 2004 (Santtila, Kyröläinen et al. 2006). However, average body weight of new conscripts has increased from 71 to 77 kg between 1993 and 2009, while height has remained constant (Santtila, Kyröläinen et al. 2006; Finnish Defence Forces 2010). The proportion of normal weight conscripts was higher and of overweight lower than reported earlier when one third had a BMI of over 25 kg/m^2 (Mousavinasab, Tähtinen et al. 2005; Mikkola, Keinänen-Kiukaanniemi et al. 2007; Jallinoja, Sahi et al. 2008; Tanskanen, Uusitalo et al. 2008). Internationally, increasing overweight and obesity has been a trend in military populations (Poston, Haddock et al. 2005; Yamane 2007; Department of Defense 2009; Sanderson, Clemes et al. 2011; Sundin, Fear et al. 2011).

Similarly to eating habits, also health risk factors showed both positive and negative changes during military service. Regarding the first-mentioned, anthropometrics and body composition of conscripts improved. This in line with the majority of previous studies: Waist circumference (Santtila, Häkkinen et al. 2008) and body fat (Santtila, Häkkinen et al. 2008; Santtila, Kyröläinen et al. 2009) decreased during the 8-week basic training period. During remaining service (6-12 months), stronger evidence is for improved anthropometrics (Tähtinen, Vanhala et al. 2001; Mousavinasab, Tähtinen et al. 2005; Mikkola, Jokelainen et al. 2009; Cederberg, Mikkola et al. 2011) and body composition (Mikkola, Keinänen-Kiukaanniemi et al. 2007; Mattila, Tallroth et al. 2009; Mikkola, Jokelainen et al. 2009) than for deteriorated anthropometrics (Tähtinen, Vanhala et al. 2000; Mattila, Tallroth et al. 2009).

Body composition improvements have been reported also internationally in military studies (Patton, Daniels et al. 1980; Lee, Kumar et al. 1994; Croteau and Young 2000; Lieberman, Kellogg et al. 2008).

For negative changes, conscripts' blood sample results showed deteriorating lipid profiles and blood glucose in the course of military service. Similar findings have been found in Finland earlier in the 1990s (Tähtinen, Vanhala et al. 2000; Tähtinen, Vanhala et al. 2001) as well as more recently (Mousavinasab, Tähtinen et al. 2005). Elsewhere, military training had positive effects on female recruits' blood lipid concentrations (Lieberman, Kellogg et al. 2008) but the finding can not be extrapolated automatically to male soldiers. High refined carbohydrate intake, as found in Study III with increased consumption of sugar-containing foods, has been reported to associate with increased triglycerides (Siri-Tarino, Sun et al. 2010). The same may apply also for the observed blood glucose levels. A possible explanation for the observed increase in blood glucose is failure to comply with the required fast although duration and compliance were checked prior to taking blood samples. At both measurements, conscripts and military personnel were informed strongly about the importance of the fast. At six months of service (T2), military control has reduced somewhat as training is not as intensive and the proportion of free-time is bigger than at 8 weeks of service (T1). It is also possible that conscripts may not perceive drinking for example soft drinks as non-compliance.

Associations of diet and risk factors indicated that less frequent consumption of fibre-rich foods was related to a fattier and more frequent consumption with a leaner body composition both at the beginning of military service and at six-month's follow-up. A similar inverse association between fibre density and BMI has been reported elsewhere too (Howarth, Huang et al. 2005; Gaesser 2007; Howarth, Huang et al. 2007). The results presented earlier showed differences in quality of diet when entering military service. These differences remain in military service as differences in food choices which can reflect to risk factor changes.

The same association of body composition and consumption of fibre-rich foods was evident also for consumption of sugar-rich foods. The associations applied at the two study time points, beginning of service and six months of service. This suggests that among young healthy men, the increase of unhealthy food choices does not have significant short-term effects on the studied risk factors. The level of physical activity of service and the young age of men may compensate for potential negative effects of unhealthy food choices as does the balanced food provided by the military. Among Finnish men, soft-drink and sweet consumption was unrelated to BMI or being overweight (Nissinen, Mikkilä et al. 2009). Adolescents' increased consumption of sugar-sweetened beverages has shown a positive association with anthropometrics, systolic blood pressure and a negative association with HDL cholesterol (Bremer, Auinger et al. 2009). Otherwise, recent research has revealed an association between sugar and CVD with its risk factors (Johnson, Segal et al. 2007; Brown, Dulloo et al. 2008; Johnson, Appel et al. 2009). Attention has been paid to

dietary sugars in general and to current prevalent and frequent consumption of sugar-sweetened beverages (Bolton-Smith and Woodward 1994; Johnson, Segal et al. 2007; Brown, Dulloo et al. 2008; Johnson, Appel et al. 2009).

Finally, other lifestyle factors may affect risk factor changes. Results found in this dissertation indicated that physical military service itself acts as an intervention and has effect on especially physically inactive young men. Physical exercise contributes to a healthier lifestyle including weight loss and improved anthropometrics (Psaltopoulou, Ilias et al. 2010). Sport activities improve blood lipid profile by increasing HDL cholesterol levels (Hata and Nakajima 2000; Gupta and Rajagopal 2007; Banfi, Colombini et al. 2012) and lowering triglyceride levels (Hata and Nakajima 2000; McBride 2008). In all, a multitude of evidence from meta-analyses exists for the beneficial effect of physical activity on lipid profile. Positive results have been reported for overweight/obese children and adolescents (Kelley and Kelley 2007), healthy adults (Kelley and Kelley 2009), women separately (Kelley, Kelley et al. 2004), overweight/obese adults (Kelley, Kelley et al. 2005), and adults, especially men, with CVD (Kelley, Kelley et al. 2006). The effect is amplified further if physical activity is combined with a prudent diet (Kelley, Kelley et al. 2011; Kelley, Kelley et al. 2012).

Physical activity may prevent metabolic syndrome and have positive effects on its individual risk factor components (Laaksonen, Niskanen et al. 2004). This finding has been supported by both randomised controlled trials and epidemiological studies. As same risk factors predict several lifestyle-related diseases, such as CVD and type 2 diabetes, increased physical activity can help prevent these and improve overall health (Lakka and Laaksonen 2007). Strong evidence exists that physical exercise can both prevent and delay type 2 diabetes. When exercise is combined with dietary modification, even a 50% long-term reduction in type 2 diabetes incidence can be achieved (Tuomilehto, Lindström et al. 2001; Laaksonen, Lindström et al. 2005; Sanz, Gautier et al. 2010; Thomas, Jiang et al. 2010). Physical activity itself contributes to the lower incidence and to lower blood glucose levels (Psaltopoulou, Ilias et al. 2010). In addition to glucose levels, physical activity improves lipid levels and insulin resistance as well as reduces weight in type 2 diabetics (Chimen, Kennedy et al. 2012). With regard to type of exercise, aerobic interval training can be superior to continuous moderate-intensity training in decreasing blood glucose (Hwang, Wu et al. 2011). The last mentioned is also more common in the military setting with long marches and drills. Also, half an hour of daily moderate- to high-level exercise, which takes place in military service, is effective in preventing type 2 diabetes in all populations (Hu, Rico-Sanz et al. 2006; Hu, Lakka et al. 2007) and thus being beneficial for health.

Epidemiological and clinical studies have shown that alcohol consumption increases HDL cholesterol levels (Choudhury, Ueshima et al. 1994; Koppes, Twisk et al. 2005; Brinton 2010). In this data, frequency and quantity of drinking beer decreased in the course of military service ($p<0.001$ for both, unpublished data). Sec-

ondly, alcohol consumption is not considered to have affected clinical risk factors as associations were found only for anthropometrics. However elsewhere, possibly due to different alcohol consumption patterns, results on the direction of association of alcohol consumption on weight and triglycerides are somewhat inconsistent (Koppes, Twisk et al. 2005). Alcohol intake may associate also with higher triglyceride levels even though HDL increases generally associate with lower triglyceride levels (Brinton 2010). Still, misreporting is a challenge when studying health effects of alcohol (Koppes, Twisk et al. 2005). Furthermore, other lifestyle factors, such as smoking and physical activity may act as confounders in cross-sectional relationships between alcohol and blood lipids (Koppes, Twisk et al. 2005).

A U-shaped relationship between alcohol consumption and type 2 diabetes has been reported (Koppes, Twisk et al. 2005; Baliunas, Taylor et al. 2009) thus probably affecting blood glucose levels too. The mechanisms behind this relationship are not fully known (Koppes, Twisk et al. 2005; Pietraszek, Gregersen et al. 2010) but BMI may be a mediating factor (Seike, Noda et al. 2008). Some misclassification may occur because all studies have not applied the gold standard of oral glucose tolerance test as outcome measure (Seike, Noda et al. 2008; Baliunas, Taylor et al. 2009; Pietraszek, Gregersen et al. 2010). Alcohol consumption may associate with greater glucose variability in young type 1 diabetics and health-compromising behaviours can have negative impact on metabolic control despite apparent diabetes mismanagement (Barnard, Sinclair et al. 2012).

In this dissertation, smoking status did not associate with health risk factors. Still in men, smoking can increase triglycerides, total and LDL cholesterol as well as lower HDL cholesterol (Whitehead, Robinson et al. 1996) also regardless of drinking habits (Imamura, Tanaka et al. 1996). The last-mentioned association appeared also among male adolescents (Glueck, Heiss et al. 1981) and smoking even small amounts can negate protective effect of alcohol on HDL cholesterol. Non-smoking is thus beneficial in achieving a desirable lipid profile (Whitehead, Robinson et al. 1996). Joint exposure to smoking and drinking may predict blood lipid levels (Wu, Pai et al. 2001). Smoking has been associated with increased blood glucose levels for long (Sandberg, Roman et al. 1973; Janzon, Berntorp et al. 1983; Tonstad 2009). Despite diet acting as confounding factor, smoking has been found to have long-term effects on glucose homeostasis among healthy subjects (Sargeant, Khaw et al. 2001). Finally, due to the complex interactions between lifestyle factors (physical activity, alcohol consumption and smoking) and health risk factors, residual confounding of the first-mentioned on the last-mentioned can not be completely excluded in the results of this dissertation.

6.1.4 Improving conscripts' eating habits by promoting changes in the available food supply

The real-world non-randomized intervention to improve conscripts eating habits by environmental intervening indicated several positive outcomes. These covered subject conscripts' higher consumption of fibre-containing and especially cereal foods and lower consumption of some fat- and sugar-containing foods comparing to controls. A multitude of concrete actions were developed by the core personnel of both organizations, who are the foremost experts of the military eating environment. The actions were creative and covered a wide spectrum as well as being diverse: some were visible and obvious whereas some were invisible and nearly hidden. In the garrison canteens, where the majority of military eating takes place, development of activities was somewhat limited because operations are centrally governed nationwide. In practice, recipes are fixed but still some modifications were made to them. Also, the focus was on serving in order to improve attractiveness. In soldier's homes, actions were multifold and comprised nearly the whole supply. Sweet and savoury pastries, sandwiches, pizza and other fast food, drinks and confectionery were all impacted.

Other dietary environmental interventions in the military setting can be considered with regard to these results. In USA, new recipes for healthier military foods were developed to decrease soldiers' fat, cholesterol and sodium intake. This was successful as acceptability was positive for the new foods developed specifically for institutional eating at an army garrison canteen (Champagne, Hunt et al. 2001). Experimenting nutrition labelling of healthy foods at point-of-purchase revealed that it is challenging to influence soldiers' food choices. Labelling was reinforced with promotional posters but still sensory attributes like taste, quality and appearance influenced selection most (Sproul, Canter et al. 2003). Otherwise, reported military interventions have focused on individual dietary education while tackling overweight and obesity. With them, increased fibre intake (Gambera, Schneeman et al. 1995) and decreased snacking (Hunter, Peterson et al. 2008) have been achieved.

Environmental dietary interventions can be conducted at the workplace setting. Intervening can involve physical and informational environments with the twofold aim of increasing the availability of healthy foods and providing education and support for healthy choices (Engbers, van Poppel et al. 2005). Environmental modifications have shown to enhance worksite health promotion programmes. Labelling, product information, campaigns with posters and bulletins as well as promoting healthy food choices in worksite canteens/cafeterias and vending machines have been used. These modifications have shown strong evidence for a positive effect on dietary intake and more precisely fat intake (Engbers, van Poppel et al. 2005; Engbers, van Poppel et al. 2006).

Another setting for dietary interventions before full adulthood is the school environment. A recent Finnish dietary intervention was conducted in the school setting in order to decrease sugar and increase fibre intake among secondary school students (Hoppu, Lehtisalo et al. 2010). Intervention actions focused on both developing a healthy food environment and nutrition education. The first included improvement of the supply of healthy snacks available at schools. Sugary snacks were restricted by replacing soft drink and sweets in vending machines by healthier options. Also, school lunch was modified by increasing serving fresh bread. A large set of material was provided for teachers to use in nutrition education. The intervention was more effective for girls, whose rye bread consumption increased and sweet consumption decreased. Among boys, soft drink consumption remained constant in intervention schools while it increased in control schools (Hoppu, Lehtisalo et al. 2010). These findings and the aforementioned reasoning together with the results of this dissertation indicate that intervening on young men's eating habits has its challenges.

Earlier Finnish youth interventions (Vartiainen, Puska et al. 1986; Puska, Vartiainen et al. 2009) were community and school-based using both dietary modification to improve school lunch composition and education through parent gatherings, leaflets, home economics classes, health screening, and mass media campaigns. The actions resulted in a positive trend in eating habits of intervention schools students. Also, school lunch nutrient content was improved as the proportion of total fat decreased (Vartiainen, Puska et al. 1986; Puska, Vartiainen et al. 2009). In the STRIP intervention described earlier, individualized dietary counselling was given to children/adolescents and their families throughout 20 years of childhood and adulthood. The intervention was successful and the intervention effect was stronger in boys than girls. Altogether, intervention children had lower fat and saturated fat intake and higher protein and carbohydrate intake than control children (Magnussen, Niinikoski et al. 2011). Later, both at 16 and 19 years, intervention subjects had lower saturated fat intake than control participants (Karjalainen, Söderling et al. 2011; Niinikoski, Pahkala et al. 2012).

In a Danish military base fruit and vegetable consumption was successfully and sustainably increased during an intervention (Lassen, Thorsen et al. 2004). There too, intervention methods focused on providing ideas for serving more fruit and vegetables for lunch, making environmental changes in the canteens by giving access to tasteful and healthy food choices, and reducing the availability of unhealthy options (Lassen, Thorsen et al. 2004). Another military intervention managed to increase fruit and vegetable consumption and decrease snacking in connection with successful weight loss (Hunter, Peterson et al. 2008). These results are contrary to this dissertation where the important intervention goal of increasing reported fruit and vegetable consumption was not met. Further, the consumption frequency was low already at baseline. Still many of the realized intervention actions, for example adding vegetables to hot dishes and sandwiches, can have hidden influence which is not manifested by self-reported measures. To increase fruit and vegetable consump-

tion among young people, strongest positive evidence has been for multicomponent interventions (Knai, Pomerleau et al. 2006). Short-term environmental interventions increasing availability of fruit and vegetables have shown positive results too (French and Wechsler 2004).

At the worksite setting, effectiveness of fruit and vegetable interventions is enhanced when using social ecological approaches, including employee participation in planning and implementation, and integrating employees' broader social context such as families and neighbourhoods. Also, identifying and reducing barriers to organizational and environmental change and addressing social differences in fruit and vegetable consumption are priorities (Sorensen, Linnan et al. 2004). Environmental modifications, such as labelling, campaigns with posters and bulletins, have shown positive effects on fruit and vegetable intake. Promoting healthy food choices in worksite canteens/cafeterias and vending machines have proven successful in worksite health promotion programmes when reviewed (Engbers, van Poppel et al. 2005).

Otherwise with regard to increasing fruit and vegetable consumption, interventions with goal setting and small groups, have achieved dietary behaviour changes (Ammerman, Lindquist et al. 2002). Still, it has been suggested that behaviour-based interventions are not enough to achieve and sustain recommended fruit and vegetable intake at the population level and interventions should be combined with other approaches (Thomson and Ravia 2011).

To conclude, dietary interventions appear to be more successful among at-risk-populations than healthy populations (Ammerman, Lindquist et al. 2002) such as conscripts. Interventions have been successful in improving eating habits (Lindström, Louheranta et al. 2003; Lindström, Peltonen et al. 2006; Absetz, Valve et al. 2007; Puska, Vartiainen et al. 2009) and more specifically increasing fruit and vegetable consumption (Pomerleau, Lock et al. 2005).

6.2 Methodological considerations

6.2.1 Military setting

The military environment was used for the setting of this dissertation. In general, actions and schedules are controlled in the military. The majority of training takes place in garrison conditions i.e. inside the garrison or nearby, and lodging is at garrison quarters. There conditions are relatively homogenous regarding also eating as well as sleep and physical activity. Encampments are an important part of the military training protocol. Aims, contents and durations of camps vary as do their intensity and level of physical training. Days are long and training takes place at any time of the day and night. Therefore, schedules can be irregular which applies to eating as well.

Thus, military service is a period of institutional life where actions are externally directed and individual's possibilities of making independent decisions are limited. Regarding eating, complete freedom of dietary choices is unfeasible. At the garrison canteen, dietary choices include meal components and amount of food. Therefore, a unifying effect of diet is likely to appear and military service acts as a dietary intervention in itself. During leisure-time, some individual choices are available e.g. in terms of snacking at the soldier's home cafeteria or buying food from the outside. Still, soldiers are offered regular nutritionally-planned main meals in a controlled environment with also a high physical activity level. The structured and controlled environment offers a good setting for intervening. There have been only a few scientifically reported dietary interventions targeting the eating environment (Champagne, Hunt et al. 2001; Sproul, Canter et al. 2003; Lassen, Thorsen et al. 2004; Thorsen, Lassen et al. 2010) and obesity (Sanderson, Clemes et al. 2011) in military populations.

Finally, the studies of this dissertation were conducted at garrisons representing average size, location and military training. This fact and the above-mentioned reasoning of controlled environment imply the military to act as a favourable study setting.

6.2.2 Conscripts as a study population of young men

Finnish military is based on conscription so all men are eligible for military service from the age of 18 to 29. Service is usually entered at 19-20 years and completed before turning 21. Yearly, ca 25 000 men, equalling nearly 80% of each age cohort, complete service (Public Information Division of the Defence Staff 2008). The rest either apply for non-military service for ethical or religious reasons or are exempted. Approximately 10% of men are exempted temporarily or permanently because of medical reasons at call-up. Exemption has been found to associate with problems with peers and family (Multimäki, Parkkola et al. 2005). Also, military fitness class correlates with sociodemographic and psychosocial factors. In addition to exemption, service is further interrupted for 6-7% (2150 men) (Multimäki, Parkkola et al. 2005) on medical grounds mostly at the beginning of service. Still these unique circumstances allow for reaching, studying and intervening on the majority of an age group of young men.

20% of young men do not complete military service (Multimäki, Parkkola et al. 2005) as exemption and interruption of service is allocated on medical grounds as a response of the minimum physical and mental requirements set for military service (Mattila, Tallroth et al. 2007). Until now, there have been no strict BMI or body fat limits for military service health requirements. Morbidly obese persons with a BMI of over 40 may have been exempted, mainly on the basis of their subjective perception on passing through military service (Mattila, Tallroth et al. 2007). Thus, con-

scripts continuing and finishing service are physically and mentally healthy and fit which shows also as relatively low risk factor levels. Conscripts represent healthy young adult Finnish males rather well (Mattila, Tallroth et al. 2007) although they form a slightly selected study population. Therefore, it is probable their eating habits as well as health status represent those of healthy young men and not the overall young men population. These young men in military service are in a specific institutional phase of life. Free-time in the evenings and on weekends represents relaxation, freedom of orders and of strictly structured life. Therefore, young men enjoy rest and indulgence which is reflected in eating habits too.

The studied military units give different training with distinct military branches and physical activity levels. These units were selected for the study for better representativeness of military training at large. The characteristics of the studied men resembled those of the general population. Participants had similar educational distribution as all conscripts of the study units (Salmenpohja 2009). The mean BMI of studied men was lower than the corresponding value of 25-34 old Finnish men (Lahti-Koski, Harald et al. 2012). Regarding findings, health behaviours tend to cluster both positively and negatively from childhood to adulthood. Also, healthy food habits relate to education (Kant 2004; Lallukka, Laaksonen et al. 2007; Lallukka, Chandola et al. 2010) but the association was not fully confirmed in this specific subpopulation of young men.

6.2.3 Representativeness and applicability of the study population

Data of Study II was collected by mailed questionnaire before military service. The response rate was 46% which is higher than the current response rate of 15-24-year old Finnish men in an annual health behaviour population survey (Helakorpi, Pajunen et al. 2011). In 35 years, the response rate of this male age group has decreased from 85% to 36% (Helakorpi, Pajunen et al. 2011). This trend is part of a larger phenomenon over the past decades of clearly dropping response rates from over 90% to 70% and often still lower for epidemiological studies (Galea and Tracy 2007; Laaksonen, Talala et al. 2008). The two main reasons behind this are increased difficulty to locate eligible participants and increased likelihood that they are not willing to take part. A general decrease in so-called volunteerism and social participation, distrust of science and research, and complexity of life have been stated as contributing to decreased participation rate (Galea and Tracy 2007; Laaksonen, Talala et al. 2008).

Strategies to increase participation rate need to be highly specific to both the study population context and research area. Still, they have often evolved of necessity rather than systematic reviews of what works in particular population contexts (Laaksonen, Talala et al. 2008; Morton 2008). Further, the impact of these diverse strategies seems to be minor as there are few strategies to employ and to counteract

the broader social reasons for downward trends in study participation (Laaksonen, Talala et al. 2008; Morton, Bandara et al. 2012).

Morton et al. have proposed that there is not a direct correlation between response rate and study validity. This is supported by research evidence when studies with low response rates (even 20%) could yield more accurate results than studies with response rates of 60-70% (Visser, Krosnick et al. 1996). Also, evaluations of national surveys, with response rates of 5-54% have indicated that studies with lower response could be more accurate than those with higher response rates (Holbrook, Krosnick et al. 2007). In an Australian cohort with differing response rates (18% and 60%) and data collection methods, relative risk estimates of exposure and outcome relationships were highly consistent (Mealing, Banks et al. 2010). These assessments may determine that a low response rate does not automatically mean study results have low validity but a potentially greater risk of this. In addition to reporting response rates, stating in detail methods of recruitment helps to assess the risk (Morton, Bandara et al. 2012). However, low response rates may affect the accuracy of a survey estimate through a decrease in the sample and potential self-selection bias (Patterson, Haines et al. 1994).

The data used in Studies I, III and IV were collected in the military setting which has its specific characteristics. The environment is controlled and most actions are based on orders. Thus it was important to ensure that participation was truly voluntary. This was ascertained by researchers organizing information and study recruitment events where conscripts gave their voluntary informed consent. Voluntariness of study participation was also stressed to collaborating military personnel.

Constrains around recruiting participants seem to become more challenging and complex so there is not necessarily a single simple definition of participation rate that can be applied to all studies (Morton, Bandara et al. 2012). This applies also to the military environment where the number of individuals in study units can differ daily. This is due to being hospitalized, leaves, transfers to other units and garrisons, and also some interruptions of service.

The same reasons apply also to drop-out during different phases of the study. Others include being on encampment or ordered to conduct service elsewhere on mission. However, study days in military garrisons were planned in co-operation with military personnel to find the most suitable time and to minimize absence. Health studies can demand considerable time from participants and involve invasive assessments resulting in increased perception of participation burden combined with an expectation of compensation. These factors contribute to a general decline in recruitment as well as retention of participants particularly in longitudinal studies (Morton, Bandara et al. 2012).

It has been proposed that participation rates alone are not sufficient evidence to judge study quality, and perhaps should not be used as a single proxy measure for this. There is no simple answer to what is an appropriate rate and no single rate is automatically indicative of greater or lesser accuracy and utility (Morton, Bandara et

al. 2012). Still, it remains possible that respondents with identical demographic and sociodemographic characteristics to non-respondents have systematically different eating behaviour (Patterson, Haines et al. 1994). The reasons for not attending the studies here either once or dropping-out do not contain obvious systematic bias. It is reasonable to suggest that non-participation is random.

In general, responding increases with educational level (Tolonen, Helakorpi et al. 2006), age (Jackson, Chambless et al. 1996; Eaker, Bergstrom et al. 1998) and socio-economic status (Jackson, Chambless et al. 1996). When analysing outcome measures, there may be underlying explanatory factors such as family situation, education and income (Laaksonen, Talala et al. 2008) which reflect in results. In conscripts, all of these are exposed to change as this study population is in a transition period between youth and independent adult life.

6.2.4 Measures

Regarding dietary data collection, FFQ was the most feasible method in this study setting also due to available resources. It was suitable in the distinct military environment as well as for the study population of young men. Food indexes were chosen to describe the quality of diet of young men. Adaptation of the pre-existing food indexes for was not realisable because of the study populations' homogeneous sex, age and situation-of-life structure. Formation of the used indexes also covered knowledge of conscripts diet including food served in the military environment (Bingham, Ovaskainen et al. 2009).

As for dietary indexes, composite measures of diet have been preferred to measures of single nutrients or foods in the area of dietary assessment(Kim, Haines et al. 2003). Use of a single dietary component, for example percent of energy of fat, to indicate the whole quality of diet can lead to substantial misclassification. So, unlike a scale, individual parts of dietary indexes are manifestations of constituent parts which are summed up to quantify diet quality as a phenomenon. Regarding scaling of items of dietary indexes, substantial information can be lost if measures are dichotomised (Patterson, Haines et al. 1994). Often dietary indexes have been used in connection with other dietary assessment methods such as food diaries with scoring of indexes being based on calculated nutrient intakes (Leppälä, Lagström et al. 2010).

When reviewed earlier, indexes of overall diet quality were related to disease risk more strongly than single nutrients and foods (Kant 1996). Later, this last finding was questioned although the association between dietary indexes and disease risk remained modestly (Waijers, Feskens et al. 2007). These associations were found also in the results of this dissertation. Finally, the ultimate purpose of the indexes was to capture the main elements of young men's diet. Also, important factors in formation of indexes used here (items included in the indexes, continuous scoring, defining purposes of the indexes) were taken into account (Waijers, Feskens et al. 2007).

Health risk factor measurements used in this dissertation were planned and conducted according to standard protocols (Jallinoja, Sahi et al. 2008) used in several large-scale studies (Aromaa and Koskinen 2002; Peltonen, Harald et al. 2008) assessing the health status at the national population level. Also, the measuring protocol was tailored to suit the military setting with its specific characteristics. The controlled environment helped to reduce distractions than could be related to conducting measurements.

6.3 Implications for further research and practice

Regarding eating, clear changes were found during military service as an indication of military service being a powerful intervention in itself. However, it is not only a positive one when for example consumption of sweet food increased. This may be difficult to influence because the military affects also food attitudes as craving for sweet foods and using food as a reward and a source of pleasure increases (Jallinoja, Tuorila et al. 2011). The studied intervention was successful in addressing sweet food choices but developing and executing other methods would be of interest.

Young men's low consumption of fruit and vegetables is of concern. Their consumption did not increase during military service and nor was the intervention successful in increasing their consumption. This is an important issue and challenging to impact (Hoppu, Lehtisalo et al. 2010). Successful strategies, including environmental interventions, have been identified in the military (Lassen, Thorsen et al. 2004; Thorsen, Lassen et al. 2010), worksite (Sorensen, Linnan et al. 2004; Engbers, van Poppel et al. 2005) and school settings (French and Wechsler 2004; Knai, Pomerleau et al. 2006).

Schools are a critical setting where also health status can be positively impacted (Flynn, McNeil et al. 2006). As school-based nutrition education should consider the needs and interests of students and the school (Pérez-Rodrigo and Aranceta 2003), the same applies for intervening in the military setting. Successful school-based nutrition education programmes have covered: behavioural focus, theory-driven strategies, adequate time and intensity, multicomponent strategies, developmental appropriateness, self-assessment elements, self-efficacy, modifying school environment with regard to access to healthy food, and evaluation (Pérez-Rodrigo and Aranceta 2003). These approaches could also be applied in the military setting as well as studying their effect.

School students have been studied widely and these findings should be taken into account when acting in the military. Also, lessons could be learned from these positive results to develop and improve creatively new approaches and methods applicable to young men and in the specific setting. For example, goal setting may be an effective strategy for improving nutrient intake in adolescents (Shilts, Horowitz et al. 2004).

Dietary interventions can be more effective for girls (Hoppu, Lehtisalo et al. 2010) so actions need to be targeted directly for boys and gender specificity of actions needs to be improved. Furthermore, peers are very important for adolescents and have major influence in developing food habits. Keeping this in mind, improving implementation and ensuring maintenance of achievements is of importance (Pérez-Rodrigo and Aranceta 2001).

In the course of military service, the studied men were followed for six months which is a limited period of time concerning eating habits and health risk factors. Questions arise on the permanence and sustainability of the changes observed during this time. Further research is required to analyse the development of eating habits, health risk factors and associations between them both during further military service and also in later adulthood. As conscripts are in transition to independent adulthood, they make their own decisions on their future comprising education and occupation among others which become important health determinants. Additionally, health behaviour choices, including eating habits, smoking and physical activity, form into patterns in adulthood. With time, young men become adult men whose health is of importance and has also public health relevance. Thus, finding effective ways to influence the developing ways of life remains a key issue.

7 Conclusions

To conclude, in Finland there has been limited dietary data of young men to which this dissertation has added general knowledge. Results show both healthy and unhealthy findings of young men's diet. Firstly and positively, young men's everyday diet contains frequent consumption of core foods such as skimmed milk and rye bread. Also, consumption levels of several extra foods are relatively low. Still, a less positive finding is the infrequent consumption of fruit and vegetables. With clustering on the threshold of independent adult life, men's healthy behaviours have accumulated and unfortunately unhealthy behaviours have too.

Secondly, the results indicate that military service acts as a clear intervention compared to civilian life. The controlled environment, institutionalized life, scheduled actions and ordered regular daily programme differ significantly from other circumstances. This applies also to eating as a unifying effect on diet appears. In military conditions, proportions of energy-yielding nutrients are favourable and micronutrient intakes adequate. Food consumption is diverse as an indication of a varied and nutritionally planned diet. During military service, consumption of fibre containing foods increases, but mainly regarding cereals, and unfortunately not of fruit and vegetables. At the same time, less-nutritious food choices prevail in free-time eating. Energy- and sugar-rich foods are favoured and their consumption becomes more frequent in the course of service. This implies freedom of choice, relaxation and pleasure outside the strictly controlled military life. Thus, the role of quality of diet manifested as individual food choices should not be ignored.

Overall levels of health risk factors of conscripts are relatively low which can be explained by the relatively young age of the study population. In the course of military service, both positive and negative changes take place in health risk factors. Anthropometric as well as body composition indicators develop favourably in the environment with a high physical load. Some clinical indicators develop less favourably as a possible reflection of consumption of sugary foods during free-time.

The real-world intervention trial was conducted in this setting to improve the supply of healthy foods at the two main military eating environments, garrison canteen and soldier's home cafeteria. The intervention proved to be successful in impacting conscripts' eating habits and increasing healthy food choices. Positive effects were on increasing cereal containing foods and lower consumptions of several fat and especially sugar containing foods. The intervention effects on conscripts' risk factor levels should be explored in further research.

Young men's consumption of especially vegetables is low and is not reported to increase in the military. This could not either be impacted with the intervention, at least manifesting by self-reported dietary outcome measures. It remains possible that young men did not observe the consumption of these as garnish or combined into

foods and dishes, as possibly “hidden”. It can be concluded that increasing young men’s conscious fruit and vegetable consumption remains challenging also in the military setting.

The context, framework and results of this dissertation can have far-reaching implications. The studied young men are stepping into adulthood and orienting towards their own ways of life and health profiles. As socioeconomic status forms and changes throughout adulthood, it also causes health differences later in the life of young men. So, intervening on young men’s eating habits with a positive effect can have significant public health implications. A longer follow-up would give valuable information on sustainability of possible dietary changes occurring during military service and on development of health later in adulthood.

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9 References

Aatola, H., T. Koivistoinen, et al. (2010). "Lifetime fruit and vegetable consumption and arterial pulse wave velocity in adulthood: the Cardiovascular Risk in Young Finns Study." Circulation **122**(24): 2521-8.

Abraham, C. and S. Michie (2008). "A taxonomy of behavior change techniques used in interventions." Health Psychol **27**(3): 379-387.

Absetz, P., R. Valve, et al. (2007). "Type 2 diabetes prevention in the "real world": one-year results of the GOAL Implementation Trial." Diabetes Care **30**(10): 2465-70.

Alonso, A., C. de la Fuente, et al. (2004). "Fruit and vegetable consumption is inversely associated with blood pressure in a Mediterranean population with a high vegetable-fat intake: the Seguimiento Universidad de Navarra (SUN) Study." Br J Nutr **92**(2): 311-9.

Ammerman, A. S., C. H. Lindquist, et al. (2002). "The efficacy of behavioral interventions to modify dietary fat and fruit and vegetable intake: a review of the evidence." Prev Med **35**(1): 25-41.

Anderson, L. M., T. A. Quinn, et al. (2009). "The effectiveness of worksite nutrition and physical activity interventions for controlling employee overweight and obesity: a systematic review." American journal of preventive medicine **37**(4): 340-357.

Anttolainen, M., J. Javanainen, et al. (1998). Finravinto 1997 - tutkimus. The 1997 dietary survey of Finnish adults. Helsinki, National Public Health Institute.

Aromaa, A. and S. Koskinen (2002). Terveys ja toimintakyky Suomessa. Terveys 2000 -tutkimuksen perustulokset. Helsinki, Kansanterveyslaitos. National Public Health Institute**:** 148.

Avenell, A., J. Broom, et al. (2004). "Systematic review of the long-term effects and economic consequences of treatments for obesity and implications for health improvement." Health Technol Assess **8**(21): iii-iv.

Baliunas, D. O., B. J. Taylor, et al. (2009). "Alcohol as a risk factor for type 2 diabetes: A systematic review and meta-analysis." Diabetes Care **32**(11): 2123-2132.

Banfi, G., A. Colombini, et al. (2012). "Metabolic markers in sports medicine." Adv Clin Chem **56**: 1-54.

Barnard, K., J. M. Sinclair, et al. (2012). "Alcohol-associated risks for young adults with Type 1 diabetes: a narrative review." Diabet Med **29**(4): 434-440.

Bartholomew, L. K., G. S. Parcel, et al. (2011). Planning Health Promotion Programs. An Intervention Mapping Approach. San Francisco, Jossey-Bass.

Bazzano, L. A., M. K. Serdula, et al. (2003). "Dietary intake of fruits and vegetables and risk of cardiovascular disease." Curr Atheroscler Rep **5**(6): 492-9.

Beer-Borst, S., S. Hercberg, et al. (2000). "Dietary patterns in six european populations: results from EURALIM, a collaborative European data harmonization and information campaign." Eur J Clin Nutr **54**(3): 253-62.

Bellisle, F., A. M. Dalix, et al. (2003). "Contribution of snacks and meals in the diet of French adults: a diet-diary study." Physiol Behav **79**(2): 183-9.

Bentley, B. (2006). "A review of methods to measure dietary sodium intake." J Cardiovasc Nurs **21**(1): 63-67.

Bingham, C. M., M. L. Ovaskainen, et al. (2009). "Nutrient intake and food use of Finnish conscripts in garrison, on leave, and in encampment conditions." Mil Med **174**(7): 678-84.

Bolton-Smith, C. and M. Woodward (1994). "Coronary heart disease: prevalence and dietary sugars in Scotland." J Epidemiol Community Health **48**(2): 119-22.

Bowles, S. V., J. Picano, et al. (2006). "The LIFE program: a wellness approach to weight loss." Mil Med **171**(11): 1089-94.

Breidablik, H. J., E. Meland, et al. (2009). "Self-rated health during adolescence: stability and predictors of change (Young-HUNT study, Norway)." Eur J Public Health **19**(1): 73-8.

Bremer, A. A., P. Auinger, et al. (2009). "Relationship between insulin resistance-associated metabolic parameters and anthropometric measurements with sugar-sweetened beverage intake and physical activity levels in US adolescents: findings from the 1999-2004 National Health and Nutrition Examination Survey." Arch Pediatr Adolesc Med **163**(4): 328-335.

Brinton, E. A. (2010). "Effects of ethanol intake on lipoproteins and atherosclerosis." Curr Opin Lipidol **21**(4): 346-351.

Brown, C. M., A. G. Dulloo, et al. (2008). "Sugary drinks in the pathogenesis of obesity and cardiovascular diseases." Int J Obes (Lond) **32 Suppl 6**: S28-34.

Brunner, E. J., M. Thorogood, et al. (2005). "Dietary advice for reducing cardiovascular risk." Cochrane Database Syst Rev(4): CD002128.

Bull, N. L. (1988). "Studies of the dietary habits, food consumption and nutrient intakes of adolescents and young adults." World Rev Nutr Diet **57**: 24-74.

Burstein, R., A. W. Coward, et al. (1996). "Energy expenditure variations in soldiers performing military activities under cold and hot climate conditions." Mil Med **161**(12): 750-4.

Campbell, I. T. (1982). "Nutrition in adverse environments, 2. Energy balance under polar conditions." Hum Nutr Appl Nutr **36**(3): 165-78.

Cederberg, H., I. Mikkola, et al. (2011). "Exercise during military training improves cardiovascular risk factors in young men." Atherosclerosis **216**(2): 489-95.

Champagne, C. M., A. E. Hunt, et al. (2001). "Incorporating new recipes into the Armed Forces Recipe File: determination of acceptability." Mil Med **166**(2): 184-90.

Chimen, M., A. Kennedy, et al. (2012). "What are the health benefits of physical activity in type 1 diabetes mellitus? A literature review." Diabetologia **55**(3): 542-551.

Choudhury, S. R., H. Ueshima, et al. (1994). "Alcohol intake and serum lipids in a Japanese population." Int J Epidemiol **23**(5): 940-947.

Committee for Proprietary Medicinal Products (2004). "Committee for Proprietary Medicinal Products (CPMP): points to consider on adjustment for baseline covariates." Stat Med **23**(5): 701-9.

Croteau, K. A. and C. J. Young (2000). "Effectiveness of a Navy remedial exercise intervention." Mil Med **165**(10): 786-90.

Davis, M. K. (1996). "A comprehensive weight-loss program for soldiers." Mil Med **161**(2): 84-8.

Dennis, K. E., K. W. Pane, et al. (1999). "The impact of a shipboard weight control program." Obes Res **7**(1): 60-7.

Department of Defense (2009). DoD survey of health related behaviors among active duty military personnel, Military Health System.

Donkin, A. J., A. E. Johnson, et al. (1998). "Gender and living alone as determinants of fruit and vegetable consumption among the elderly living at home in urban Nottingham." Appetite **30**(1): 39-51.

Drewnowski, A. (2009). "Defining nutrient density: development and validation of the nutrient rich foods index." J Am Coll Nutr **28**(4): 421S-426S.

Drewnowski, A. (2010). "The Nutrient Rich Foods Index helps to identify healthy, affordable foods." Am J Clin Nutr **91**(4): 1095S-1101S.

Eaker, S., R. Bergstrom, et al. (1998). "Response rate to mailed epidemiologic questionnaires: a population-based randomized trial of variations in design and mailing routines." Am J Epidemiol **147**(1): 74-82.

Earles, J. E., B. Kerr, et al. (2007). "Clinical effectiveness of the LE(3)AN Program: A military healthy lifestyle program." J Clin Psychol Med Settings **14**(1): 51-57.

El, A. W., C. Stock, et al. (2011). "Health promoting behaviours and lifestyle characteristics of students at seven universities in the UK." Cent Eur J Public Health **19**(4): 197-204.

Elinder, L. S., E. Sundblom, et al. (2011). "Low physical activity is a predictor of thinness and low self-rated health: gender differences in a Swedish cohort." J Adolesc Health **48**(5): 481-6.

Engbers, L. H., M. N. van Poppel, et al. (2006). "The effects of a controlled worksite environmental intervention on determinants of dietary behavior and self-reported fruit, vegetable and fat intake." BMC Public Health **6**: 253.

Engbers, L. H., M. N. van Poppel, et al. (2005). "Worksite health promotion programs with environmental changes: a systematic review." Am J Prev Med **29**(1): 61-70.

Feskanich, D., H. R. Rockett, et al. (2004). "Modifying the Healthy Eating Index to assess diet quality in children and adolescents." J Am Diet Assoc **104**(9): 1375-1383.

Finnish Defence Forces. (2010). "Palvelukseen astuvien miesten kehonpaino ja -pituus vuosina 1993-2009 (In Finnish). In English: Weight and height of conscripts entering service in 1993-2009." Retrieved 9.9., 2010, from http://www.puolustusvoimat.fi/wcm/4e27990041190b9eb6a1ffe364705c96/palvelukseen_astuvien_nuorten_miesten_fyysinen_kunto_tilastot_1975_2009.pdf?MOD=AJPERES&CONVERT_TO=url

&CACHEID=4e27990041190b9eb6a1ffe364705c96.

Flynn, M. A., D. A. McNeil, et al. (2006). "Reducing obesity and related chronic disease risk in children and youth: a synthesis of evidence with 'best practice' recommendations." Obes Rev **7**: 7-66.

Foti, K. and D. Eaton (2010). "Associations of selected health risk behaviors with self-rated health status among U.S. high school students." Public Health Rep **125**(5): 771-81.

Fraser, G. E., A. Welch, et al. (2000). "The effect of age, sex, and education on food consumption of a middle-aged English cohort-EPIC in East Anglia." Prev Med **30**(1): 26-34.

French, S. A. and H. Wechsler (2004). "School-based research and initiatives: fruit and vegetable environment, policy, and pricing workshop." Prev Med **39**: S101-7.

Fulgoni, V. L., 3rd, D. R. Keast, et al. (2009). "Development and validation of the nutrient-rich foods index: a tool to measure nutritional quality of foods." J Nutr **139**(8): 1549-1554.

Gaesser, G. A. (2007). "Carbohydrate quantity and quality in relation to body mass index." J Am Diet Assoc **107**(10): 1768-1780.

Galea, S. and M. Tracy (2007). "Participation rates in epidemiologic studies." Ann Epidemiol **17**(9): 643-653.

Gambera, P. J., B. O. Schneeman, et al. (1995). "Use of the Food Guide Pyramid and US Dietary Guidelines to improve dietary intake and reduce cardiovascular risk in active-duty Air Force members." J Am Diet Assoc **95**(11): 1268-73.

Gan, W. Y., N. M. Mohd, et al. (2011). "Differences in eating behaviours, dietary intake and body weight status between male and female Malaysian University students." Malays J Nutr **17**(2): 213-28.

Giskes, K., M. Avendano, et al. (2010). "A systematic review of studies on socioeconomic inequalities in dietary intakes associated with weight gain and overweight/obesity conducted among European adults." Obes Rev **11**(6): 413-29.

Glanz, K. and D. B. Bishop (2010). "The role of behavioral science theory in development and implementation of public health interventions." Annu Rev Public Health **31**: 399-418.

Glanz, K., F. M. Lewis, et al. (1997). Health Behavior and Health Education. Theory, Research and Practice. San Francisco, Jossey-Bass.

Glueck, C. J., G. Heiss, et al. (1981). "Alcohol intake, cigarette smoking and plasma lipids and lipoproteins in 12--19-year-old children. The Collaborative Lipid Research Clinics Prevalence Study." Circulation **64**(3 Pt 2): III-48.

Gonzalez, C. A. and E. Riboli (2006). "Diet and cancer prevention: where we are, where we are going." Nutr Cancer **56**(2): 225-231.

Gonzalez, C. A. and E. Riboli (2010). "Diet and cancer prevention: Contributions from the European Prospective Investigation into Cancer and Nutrition (EPIC) study." Eur J Cancer **46**(14): 2555-2562.

Greaves, C. J., K. E. Sheppard, et al. (2011). "Systematic review of reviews of intervention components associated with increased effectiveness in dietary and physical activity interventions." BMC Public Health **11**: 119.

Groth, M. V., S. Fagt, et al. (2001). "Social determinants of dietary habits in Denmark." Eur J Clin Nutr **55**(11): 959-66.

Guenther, P. M., J. Reedy, et al. (2008). "Evaluation of the Healthy Eating Index-2005." J Am Diet Assoc **108**(11): 1854-1864.

Guezennec, C. Y., P. Satabin, et al. (1994). "Physical performance and metabolic changes induced by combined prolonged exercise and different energy intakes in humans." Eur J Appl Physiol Occup Physiol **68**(6): 525-30.

Gupta, S. and G. Rajagopal (2007). "The significance of plasma high density lipoprotein cholesterol (hdlc)." Nepal Med Coll J **9**(3): 212-214.

Haines, P. S., A. M. Siega-Riz, et al. (1999). "The Diet Quality Index revised: a measurement instrument for populations." J Am Diet Assoc **99**(6): 697-704.

Hardeman, W., S. Griffin, et al. (2000). "Interventions to prevent weight gain: a systematic review of psychological models and behaviour change methods." Int J Obes Relat Metab Disord **24**(2): 131-143.

Harnack, L., K. Nicodemus, et al. (2002). "An evaluation of the Dietary Guidelines for Americans in relation to cancer occurrence." Am J Clin Nutr **76**(4): 889-896.

Hart, S. and C. Morrison (1992). "Effect of age, family status, and physical activity on selected dietary components of TAC pilots." Mil Med **157**(8): 397-401.

Hata, Y. and K. Nakajima (2000). "Lifestyle and serum lipids and lipoproteins." J Atheroscler Thromb **7**(4): 177-197.

Helakorpi, S., T. Pajunen, et al. (2011). Suomalaisen aikuisväestön terveyskäyttäytyminen ja terveys, kevät 2010. Health Behaviour and Health among the Finnish Adult Population, Spring 2010. Helsinki, National Institute for Health and Welfare (THL).

Hirvonen, T., S. Männistö, et al. (1997). "Increasing prevalence of underreporting does not necessarily distort dietary surveys." Eur J Clin Nutr **51**(5): 297-301.

Hoikkala, T., M. Salasuo, et al. (2009). Tunnetut sotilaat (in Finnish, with English summary). Jyväskylä, Nuorisotutkimusverkosto.

Holbrook, A., J. Krosnick, et al. (2007). The causes and consequences of response rates in surveys by the news media and government contractor survey research firms. Advances in Telephone Survey Methodology. J. M. Lepkowski, N. C. Tucker, J. M. Bricket al. New York, Wiley.

Hoppu, U., J. Lehtisalo, et al. (2010). "The diet of adolescents can be improved by school intervention." Public Health Nutr **13**(6A): 973-9.

Hoppu, U., J. Lehtisalo, et al. (2010). "Dietary habits and nutrient intake of Finnish adolescents." Public Health Nutr **13**(6A): 965-72.

Howarth, N. C., T. T. Huang, et al. (2007). "Eating patterns and dietary composition in relation to BMI in

younger and older adults." Int J Obes (Lond) **31**(4): 675-84.

Howarth, N. C., T. T. Huang, et al. (2005). "Dietary fiber and fat are associated with excess weight in young and middle-aged US adults." J Am Diet Assoc **105**(9): 1365-1372.

Hu, G., T. A. Lakka, et al. (2007). "Epidemiological studies of exercise in diabetes prevention." Appl Physiol Nutr Metab **32**(3): 583-595.

Hu, G., J. Rico-Sanz, et al. (2006). "Exercise, genetics and prevention of type 2 diabetes." Essays Biochem **42**: 177-192.

Huang, T. T., K. J. Harris, et al. (2003). "Assessing overweight, obesity, diet, and physical activity in college students." J Am Coll Health **52**(2): 83-6.

Hung, H. C., K. J. Joshipura, et al. (2004). "Fruit and vegetable intake and risk of major chronic disease." J Natl Cancer Inst **96**(21): 1577-84.

Hunter, C. M., A. L. Peterson, et al. (2008). "Weight management using the internet a randomized controlled trial." Am J Prev Med **34**(2): 119-26.

Hwang, C. L., Y. T. Wu, et al. (2011). "Effect of aerobic interval training on exercise capacity and metabolic risk factors in people with cardiometabolic disorders: a meta-analysis." J Cardiopulm Rehabil Prev **31**(6): 378-385.

Imamura, H., K. Tanaka, et al. (1996). "Relationship of cigarette smoking to blood pressure and serum lipids and lipoproteins in men." Clin Exp Pharmacol Physiol **23**(5): 397-402.

Jackson, R., L. E. Chambless, et al. (1996). "Differences between respondents and nonrespondents in a multicenter community-based study vary by gender ethnicity. The Atherosclerosis Risk in Communities (ARIC) Study Investigators." J Clin Epidemiol **49**(12): 1441-46.

Jallinoja, P., T. Sahi, et al. (2008). Varusmiesten ravitsemus, terveyden riskitekijät ja terveystaju (in Finnish with English summary). In English: Conscripts' nutrition, health risk factors and health sense. Helsinki, National Public Health Institute.

Jallinoja, P., H. Tuorila, et al. (2011). "Conscripts' attitudes towards health and eating. Changes during the military service and associations with eating." Appetite **57**(3): 718-21.

James, L. C., R. A. Folen, et al. (2001). "Behavioral telehealth applications in the treatment of obese soldiers: A feasibility project and a report on preliminary findings." Mil Psychol **13**(3): 177-186.

James, L. C., R. A. Folen, et al. (1997). "A new frontier for clinical health psychologists: Our leadership role in the development and management of an inpatient weight management program." Prof Psychol Res Pr **28**(2): 146-152.

James, L. C., R. A. Folen, et al. (1997). "The Tripler Army Medical Center LEAN Program: a healthy lifestyle model for the treatment of obesity." Mil Med **162**(5): 328-32.

James, L. C., R. A. Folen, et al. (1999). "The Tripler LE3AN Program: a two-year follow-up report." Mil Med **164**(6): 389-95.

Janzon, L., K. Berntorp, et al. (1983). "Glucose tolerance and smoking:

a population study of oral and intravenous glucose tolerance tests in middle-aged men." Diabetologia **25**(2): 86-8.

Johansson, A. K., A. Johansson, et al. (1996). "Dental erosion, soft-drink intake, and oral health in young Saudi men, and the development of a system for assessing erosive anterior tooth wear." Acta Odontol Scand **54**(6): 369-78.

Johnson, R. J., M. S. Segal, et al. (2007). "Potential role of sugar (fructose) in the epidemic of hypertension, obesity and the metabolic syndrome, diabetes, kidney disease, and cardiovascular disease." Am J Clin Nutr **86**(4): 899-906.

Johnson, R. K., L. J. Appel, et al. (2009). "Dietary sugars intake and cardiovascular health: a scientific statement from the American Heart Association." Circulation **120**(11): 1011-20.

Jones, M., N. Dailami, et al. (2012). "Food sustainability education as a route to healthier eating: evaluation of a multi-component school programme in English primary schools." Health Educ Res.

Kant, A. K. (1996). "Indexes of overall diet quality: a review." J Am Diet Assoc **96**(8): 785-791.

Kant, A. K. (2004). "Dietary patterns and health outcomes." J Am Diet Assoc **104**(4): 615-35.

Karjalainen, S., E. Söderling, et al. (2011). "Effect of infancy-onset dietary intervention on salivary cholesterol of children: a randomized controlled trial." J Dent Res **90**(7): 868-73.

Karvonen, M. J., E. Orma, et al. (1970). "Coronary heart disease in seven countries. VI. Five-year experience in Finland." Circulation **41**(4 Suppl): I52-62.

Katz, J., M. Gordon, et al. (1991). "Sugar consumption in Israeli Defense Forces personnel." Clin Prev Dent **13**(2): 32-4.

Kautiainen, S., A. M. Koivisto, et al. (2009). "Sociodemographic factors and a secular trend of adolescent overweight in Finland." Int J Pediatr Obes **4**(4): 360-70.

Kautiainen, S., L. Koivusilta, et al. (2005). "Use of information and communication technology and prevalence of overweight and obesity among adolescents." Int J Obes (Lond) **29**(8): 925-33.

Kautiainen, S., A. Rimpelä, et al. (2002). "Secular trends in overweight and obesity among Finnish adolescents in 1977-1999." Int J Obes Relat Metab Disord **26**(4): 544-52.

Kelley, G. A. and K. S. Kelley (2007). "Aerobic exercise and lipids and lipoproteins in children and adolescents: a meta-analysis of randomized controlled trials." Atherosclerosis **191**(2): 447-453.

Kelley, G. A. and K. S. Kelley (2009). "Impact of progressive resistance training on lipids and lipoproteins in adults: a meta-analysis of randomized controlled trials." Prev Med **48**(1): 9-19.

Kelley, G. A., K. S. Kelley, et al. (2006). "Aerobic exercise and lipids and lipoproteins in patients with cardiovascular disease: a meta-analysis of randomized controlled trials." J Cardiopulm Rehabil **26**(3): 131-9;.

Kelley, G. A., K. S. Kelley, et al. (2011). "Efficacy of aerobic exercise and a prudent diet for improving selected lipids and lipoproteins in adults: a meta-analysis of randomized controlled trials." BMC Medicine **9**: 74.

Kelley, G. A., K. S. Kelley, et al. (2012). "Comparison of aerobic exercise, diet or both on lipids and lipoproteins in adults: a meta-analysis of randomized controlled trials." Clin Nutr **31**(2): 156-167.

Kelley, G. A., K. S. Kelley, et al. (2004). "Aerobic exercise and lipids and lipoproteins in women: a meta-analysis of randomized controlled trials." J Womens Health **13**(10): 1148-1164.

Kelley, G. A., K. S. Kelley, et al. (2005). "Aerobic exercise, lipids and lipoproteins in overweight and obese adults: a meta-analysis of randomized controlled trials." Int J Obes (Lond) **29**(8): 881-893.

Kennedy, E. T., J. Ohls, et al. (1995). "The Healthy Eating Index: design and applications." J Am Diet Assoc **95**(10): 1103-1108.

Kestilä, L., O. Rahkonen, et al. (2009). "Do childhood social circumstances affect overweight and obesity in early adulthood?" Scand J Public Health **37**(2): 206-19.

Keys, A. (1970). "Coronary heart disease in seven countries. I. The study program and objectives." Circulation **41**(4 Suppl): I1-8.

Keys, A. (1970). "Coronary heart disease in seven countries. II. Methods." Circulation **41**(4 Suppl): I9-13.

Keys, A. (1970). "Coronary heart disease in seven countries. XVII. The diet." Circulation **41**(4 Suppl): I162-83.

Keys, A., J. T. Anderson, et al. (1957). "Prediction of serum-cholesterol responses of man to changes in fats in the diet." Lancet **273**(7003): 959-66.

Kim, S., P. S. Haines, et al. (2003). "The Diet Quality Index-International (DQI-I) provides an effective tool for cross-national comparison of diet quality as illustrated by China and the United States." J Nutr **133**(11): 3476-3484.

Knai, C., J. Pomerleau, et al. (2006). "Getting children to eat more fruit and vegetables: a systematic review." Prev Med **42**(2): 85-95.

Koppes, L. L., J. W. Twisk, et al. (2005). "Cross-sectional and longitudinal relationships between alcohol consumption and lipids, blood pressure and body weight indices." J Stud Alcohol **66**(6): 713-721.

Kranz, S., T. Hartman, et al. (2006). "A diet quality index for American preschoolers based on current dietary intake recommendations and an indicator of energy balance." J Am Diet Assoc **106**(10): 1594-1604.

Kyrölainen, H., J. Karinkanta, et al. (2008). "Hormonal responses during a prolonged military field exercise with variable exercise intensity." Eur J Appl Physiol **102**(5): 539-46.

Laaksonen, D. E., J. Lindström, et al. (2005). "Physical activity in the prevention of type 2 diabetes: the Finnish diabetes prevention study." Diabetes: A Journal of the American Diabetes Association **54**(1): 158-165.

Laaksonen, D. E., L. Niskanen, et al. (2004). "Epidemiology and treatment of the metabolic syndrome." Ann Med **36**(5): 332-346.

Laaksonen, M., K. Talala, et al. (2008). "Health behaviours as explanations for educational level differences in cardiovascular and all-cause mortality: a follow-up of 60 000 men and women over 23

years." Eur J Public Health **18**(1): 38-43.

Lahti-Koski, M., K. Harald, et al. (2012). "Changes in body mass index and measures of abdominal obesity in Finnish adults between 1992 and 2007, the National FINRISK Study." Clin Obes **2**(1-2): 57-63.

Lahti-Koski, M., E. Seppänen-Nuijten, et al. (2010). "Twenty-year changes in the prevalence of obesity among Finnish adults." Obes Rev **11**(3): 171-6.

Lakka, T. A. and D. E. Laaksonen (2007). "Physical activity in prevention and treatment of the metabolic syndrome." Appl Physiol Nutr Metab **32**(1): 76-88.

Lallukka, T., T. Chandola, et al. (2010). "Work-family conflicts and health behaviors among British, Finnish, and Japanese employees." Int J Behav Med **17**(2): 134-42.

Lallukka, T., M. Laaksonen, et al. (2007). "Multiple socio-economic circumstances and healthy food habits." Eur J Clin Nutr **61**(6): 701-10.

Lallukka, T., J. Pitkäniemi, et al. (2010). "The association of income with fresh fruit and vegetable consumption at different levels of education." Eur J Clin Nutr **64**(3): 324-7.

Lallukka, T., S. Sarlio-Lähteenkorva, et al. (2004). "Working conditions and health behaviours among employed women and men: the Helsinki Health Study." Prev Med **38**(1): 48-56.

Lassen, A., A. V. Thorsen, et al. (2004). "Successful strategies to increase the consumption of fruits and vegetables: results from the Danish '6 a day' Work-site Canteen Model Study." Public Health Nutr **7**(2): 263-270.

Lavrador, M. S., P. T. Abbes, et al. (2011). "Cardiovascular risks in adolescents with different degrees of obesity." Arq Bras Cardiol **96**(3): 205-11.

Lee, L., S. Kumar, et al. (1994). "The impact of five-month basic military training on the body weight and body fat of 197 moderately to severely obese Singaporean males aged 17 to 19 years." Int J Obes Relat Metab Disord **18**(2): 105-9.

Lee, S. K., D. P. Keenan, et al. (2007). "Identification of weight-control behaviors practiced by diverse groups of college students." Nutr Res Pract **1**(3): 218-23.

Lemmens, V. E., A. Oenema, et al. (2008). "A systematic review of the evidence regarding efficacy of obesity prevention interventions among adults." Obes Rev **9**(5): 446-455.

Leppälä, J., H. Lagström, et al. (2010). "Construction and evaluation of a self-contained index for assessment of diet quality." Scand J Public Health **38**(8): 794-802.

Levine, R. (1986). "Monosaccharides in health and disease." Annual review of nutrition **6**: 211-224.

Lieberman, H. R., M. D. Kellogg, et al. (2008). "Female marine recruit training: mood, body composition, and biochemical changes." Med Sci Sports Exerc **40**(11 Suppl): S671-6.

Lindström, J., A. Louheranta, et al. (2003). "The Finnish Diabetes Prevention Study (DPS): Lifestyle intervention and 3-year results on diet and physical activity." Diabetes Care **26**(12): 3230-6.

Lindström, J., M. Peltonen, et al. (2006). "High-fibre, low-fat diet predicts long-term weight loss and decreased type 2 diabetes risk: the Finnish Diabetes Prevention Study." Diabetologia **49**(5): 912-20.

Lombard, C. B., A. A. Deeks, et al. (2009). "A systematic review of interventions aimed at the prevention of weight gain in adults." Public Health Nutr **12**(11): 2236-2246.

Lowik, M. R., K. F. Hulshof, et al. (1999). "Food-based dietary guidelines: some assumptions tested for The Netherlands." Br J Nutr **81**: S143-9.

Magnussen, C. G., H. Niinikoski, et al. (2011). "When and how to start prevention of atherosclerosis? Lessons from the Cardiovascular Risk in the Young Finns Study and the Special Turku Coronary Risk Factor Intervention Project." Pediatr Nephrol **27**(9): 1441-52.

Malone, S. K. (2005). "Improving the quality of students' dietary intake in the school setting." J Sch Nurs **21**(2): 70-76.

Martinez-Gonzalez, M. A., C. de la Fuente-Arrillaga, et al. (2011). "Low consumption of fruit and vegetables and risk of chronic disease: a review of the epidemiological evidence and temporal trends among Spanish graduates." Public Health Nutr **14**(12A): 2309-15.

Mattila, V. M., K. Tallroth, et al. (2009). "DEXA body composition changes among 140 conscripts." Int J Sports Med **30**(5): 348-53.

Mattila, V. M., K. Tallroth, et al. (2007). "Physical fitness and performance. Body composition by DEXA and its association with physical fitness in 140 conscripts." Med Sci Sports Exerc **39**(12): 2242-2247.

McBride, P. (2008). "Triglycerides and risk for coronary artery disease." Curr Atheroscler Rep **10**(5): 386-390.

McLaughlin, R. and G. Wittert (2009). "The obesity epidemic: implications for recruitment and retention of defence force personnel." Obes Rev **10**(6): 693-9.

Mead, A., G. Atkinson, et al. (2006). "Dietetic guidelines on food and nutrition in the secondary prevention of cardiovascular disease - evidence from systematic reviews of randomized controlled trials (second update, January 2006)." J Hum Nutr Diet **19**(6): 401-19.

Mealing, N. M., E. Banks, et al. (2010). "Investigation of relative risk estimates from studies of the same population with contrasting response rates and designs." BMC Med Res Methodol **10**: 26.

Meiselman, H. L. and H. G. Schutz (2003). "History of food acceptance research in the US Army." Appetite **40**(3): 199-216.

Mikkilä, V., M. Lahti-Koski, et al. (2003). "Associates of obesity and weight dissatisfaction among Finnish adolescents." Public Health Nutr **6**(1): 49-56.

Mikkilä, V., L. Räsänen, et al. (2009). "Long-term dietary patterns and carotid artery intima media thickness: the Cardiovascular Risk in Young Finns Study." Br J Nutr **102**(10): 1507-12.

Mikkilä, V., L. Räsänen, et al. (2007). "Major dietary patterns and cardiovascular risk factors from childhood to adulthood. The Car-

diovascular Risk in Young Finns Study." Br J Nutr **98**(1): 218-25.

Mikkilä, V., L. Räsänen, et al. (2004). "Longitudinal changes in diet from childhood into adulthood with respect to risk of cardiovascular diseases: The Cardiovascular Risk in Young Finns Study." Eur J Clin Nutr **58**(7): 1038-45.

Mikkilä, V., L. Räsänen, et al. (2005). "Consistent dietary patterns identified from childhood to adulthood: the cardiovascular risk in Young Finns Study." Br J Nutr **93**(6): 923-31.

Mikkola, I., J. J. Jokelainen, et al. (2009). "Physical activity and body composition changes during military service." Med Sci Sports Exerc **41**(9): 1735-42.

Mikkola, I., S. Keinänen-Kiukaanniemi, et al. (2007). "Metabolic syndrome in connection with BMI in young Finnish male adults." Diabetes Res Clin Pract **76**(3): 404-9.

Mikolajczyk, R. T., P. Brzoska, et al. (2008). "Factors associated with self-rated health status in university students: a cross-sectional study in three European countries." BMC Public Health **8**: 215.

Milligan, R. A., V. Burke, et al. (1998). "Influence of gender and socioeconomic status on dietary patterns and nutrient intakes in 18-year-old Australians." Aust N Z J Public Health **22**(4): 485-93.

Ministry of Social Affairs and Health (2010). Joukkoruokailun kehittäminen Suomessa. Joukkoruokailun seuranta- ja kehittämistyöryhmän toimenpidesuositus. (Developing mass catering services. Guidelines by the working group to monitor and develop mass catering services.). Helsinki, Ministry of Social Affairs and Health.

Mirmiran, P., M. Mirbolooki, et al. (2002). "Familial clustering of obesity and the role of nutrition: Tehran Lipid and Glucose Study." Int J Obes Relat Metab Disord **26**(12): 1617-22.

Mokdad, A. H., E. S. Ford, et al. (2003). "Prevalence of obesity, diabetes, and obesity-related health risk factors, 2001." JAMA **289**(1): 76-9.

Montain, S. J. and A. J. Young (2003). "Diet and physical performance." Appetite **40**(3): 255-67.

Moreno-Gomez, C., D. Romaguera-Bosch, et al. (2012). "Clustering of lifestyle factors in Spanish university students: the relationship between smoking, alcohol consumption, physical activity and diet quality." Public Health Nutr: 1-9.

Moreno, L. A., G. Rodriguez, et al. (2010). "Trends of dietary habits in adolescents." Crit Rev Food Sci Nutr **50**(2): 106-12.

Morton, L. M. (2008). "Encouraging participation in medical research: what strategies work?" J Clin Epidemiol **61**(10): 969-970.

Morton, S. M., D. K. Bandara, et al. (2012). "In the 21(st) Century, what is an acceptable response rate?" Aust N Z J Public Health **36**(2): 106-108.

Mousavinasab, F., T. Tähtinen, et al. (2005). "Lack of increase of serum adiponectin concentrations with a moderate weight loss during six months on a high-caloric diet in military service among a young male Finnish population." Endocrine **26**(1): 65-9.

Multimäki, P., K. Parkkola, et al. (2005). "Military fitness class of Finnish

18-year-old men--prediction of military fitness class at call-up with the YASR and sociodemographic factors." Soc Psychiatry Psychiatr Epidemiol **40**(1): 57-63.

Myklebust, S., I. Espelid, et al. (2003). "Dental health behavior, gastroesophageal disorders and dietary habits among Norwegian recruits in 1990 and 1999." Acta Odontol Scand **61**(2): 100-4.

Mäki, P., T. Hakulinen-Viitanen, et al., Eds. (2010). Lasten terveys. LATE-tutkimuksen perustulokset lasten kasvusta, kehityksestä, terveydestä, terveystottumuksista ja kasvuympäristöstä. [Child Health – Results of the LATE-study on growth, development, health, health behavior and growth environment]. Helsinki, National Institute for Health and Welfare.

Männistö, S., T. Laatikainen, et al. (2010). "Monitoring diet and diet-related chronic disease risk factors in Finland." Public Health Nutr **13**(6A): 907-14.

Männistö, S., M.-L. Ovaskainen, et al. (2003). The national FINDIET 2002 study. Publications of the National Public Health Institute B3 (in Finnish, with English tables, figures and summaries), National Public Health Institute.

National Institute for Health and Welfare. (2011, 28.9.2011). "School Health Promotion Study." Retrieved 27.2., 2012, from http://info.stakes.fi/kouluterveyskysely/EN/index.htm.

National Institute for Health and Welfare. (2012, December 5 2011). "Fineli. Finnish Food Composition Database." 14. Retrieved May 1., 2012, from http://www.fineli.fi/index.php?lang=en.

National Nutrition Council (1998). Finnish nutrition recommendations. Committee report 1998.

National Nutrition Council (2005). Finnish nutrition recommendations (in Finnish). Committee report 2005., National Nutrition Council,.

National Nutrition Council. (2012). "National Nutrition Council - Guardian of public nutrition." Retrieved 20.3., 2012.

Nicklas, T. A. (1995). "Dietary studies of children and young adults (1973-1988): the Bogalusa Heart Study." Am J Med Sci **310 Suppl 1**: S101-8.

Nielsen, S. J., A. M. Siega-Riz, et al. (2002). "Trends in food locations and sources among adolescents and young adults." Prev Med **35**(2): 107-13.

Niinikoski, H., K. Pahkala, et al. (2012). "Effect of repeated dietary counseling on serum lipoproteins from infancy to adulthood." Pediatrics **129**(3): e704-13.

Nissinen, K., V. Mikkilä, et al. (2009). "Sweets and sugar-sweetened soft drink intake in childhood in relation to adult BMI and overweight. The Cardiovascular Risk in Young Finns Study." Public Health Nutr **12**(11): 2018-26.

Noar, S. M., C. N. Benac, et al. (2007). "Does tailoring matter? Meta-analytic review of tailored print health behavior change interventions." Psychol Bull **133**(4): 673-693.

Noar, S. M. and R. S. Zimmerman (2005). "Health Behavior Theory and cumulative knowledge regarding health behaviors: are we moving

in the right direction?" Health Educ Res **20**(3): 275-290.
Norman, G. J., M. F. Zabinski, et al. (2007). "A review of eHealth interventions for physical activity and dietary behavior change." Am J Prev Med **33**(4): 336-345.
O'Doherty Jensen, K. and L. Holm (1999). "Preferences, quantities and concerns: socio-cultural perspectives on the gendered consumption of foods." Eur J Clin Nutr **53**(5): 351-9.
Osler, M., B. L. Heitmann, et al. (2001). "Dietary patterns and mortality in Danish men and women: a prospective observational study." Br J Nutr **85**(2): 219-225.
Ovaskainen, M. L., M. Paturi, et al. (2010). "Educational differences in the diet of Finnish adults and the associations between education and the determinants and facilitators of dietary fat quality." Public Health Nutr **13**(6A): 925-31.
Ovaskainen, M. L., H. Reinivuo, et al. (2006). "Snacks as an element of energy intake and food consumption." Eur J Clin Nutr **60**(4): 494-501.
Ovaskainen, M. L., H. Tapanainen, et al. (2010). "Changes in the contribution of snacks to the daily energy intake of Finnish adults." Appetite **54**(3): 623-6.
Painter, J. E., C. P. Borba, et al. (2008). "The use of theory in health behavior research from 2000 to 2005: a systematic review." Ann Behav Med **35**(3): 358-362.
Patterson, R. E., P. S. Haines, et al. (1994). "Diet quality index: capturing a multidimensional behavior." J Am Diet Assoc **94**(1): 57-64.
Patton, J. F., W. L. Daniels, et al. (1980). "Aerobic power and body fat of men and women during army basic training." Aviat Space Environ Med **51**(5): 492-6.
Paturi, M., H. Tapanainen, et al. (2008). "The National FINDIET 2007 Survey." Publications of the National Public Health Institute (in Finnish, with English tables, figures and summaries).
Pearson, N., S. J. Biddle, et al. (2009). "Family correlates of breakfast consumption among children and adolescents. A systematic review." Appetite **52**(1): 1-7.
Pearson, N., S. J. Biddle, et al. (2009). "Family correlates of fruit and vegetable consumption in children and adolescents: a systematic review." Public Health Nutr **12**(2): 267-83.
Peltonen, M., K. Harald, et al. (2008). National FINRISKI 2007 health study. (In Finnish, with English summary). Helsinki, National Public Health Institute.
Pérez-Rodrigo, C. and J. Aranceta (2001). "School-based nutrition education: lessons learned and new perspectives." Public Health Nutr **4**(1A): 131-139.
Pérez-Rodrigo, C. and J. Aranceta (2003). "Nutrition education in schools: experiences and challenges." Eur J Clin Nutr **57**: S82-5.
Pietinen, P., M. Lahti-Koski, et al. (2001). "Nutrition and cardiovascular disease in Finland since the early 1970s: a success story." J Nutr Health Aging **5**(3): 150-4.
Pietinen, P., A. Nissinen, et al. (1988). "Dietary changes in the North Karelia Project (1972-1982)." Prev Med **17**(2): 183-93.
Pietinen, P., M. Paturi, et al. (2010). "FINDIET 2007 Survey: energy

and nutrient intakes." Public Health Nutr **13**(6A): 920-4.

Pietinen, P., E. Vartiainen, et al. (1996). "Changes in diet in Finland from 1972 to 1992: impact on coronary heart disease risk." Prev Med **25**(3): 243-50.

Pietraszek, A., S. Gregersen, et al. (2010). "Alcohol and type 2 diabetes. A review." Nutr Metab Cardiovasc Dis **20**(5): 366-375.

Pomerleau, J., K. Lock, et al. (2005). "Interventions designed to increase adult fruit and vegetable intake can be effective: a systematic review of the literature." J Nutr **135**(10): 2486-2495.

Poobalan, A. S., L. S. Aucott, et al. (2010). "Weight loss interventions in young people (18 to 25 year olds): a systematic review." Obes Rev **11**(8): 580-92.

Poston, W. S., C. K. Haddock, et al. (2005). "Comparison of weight status among two cohorts of US Air Force recruits." Prev Med **40**(5): 602-9.

Prattälä, R. (2012). "Social determinants of health behaviours and social change." Eur J Public Health.

Prattälä, R., S. Hakala, et al. (2009). "Association between educational level and vegetable use in nine European countries." Public Health Nutr **12**(11): 2174-82.

Prattälä, R., V. Helasoja, et al. (2001). "The consumption of rye bread and white bread as dimensions of health lifestyles in Finland." Public Health Nutr **4**(3): 813-9.

Prattälä, R., A. Karisto, et al. (1994). "Consistency and variation in unhealthy behaviour among Finnish men, 1982-1990." Soc Sci Med **39**(1): 115-22.

Prattälä, R., L. Paalanen, et al. (2007). "Gender differences in the consumption of meat, fruit and vegetables are similar in Finland and the Baltic countries." Eur J Public Health **17**(5): 520-5.

Prattälä, R. S., M. V. Groth, et al. (2003). "Use of butter and cheese in 10 European countries: a case of contrasting educational differences." Eur J Public Health **13**(2): 124-32.

Prättälä, R., M. A. Berg, et al. (1992). "Diminishing or increasing contrasts? Social class variation in Finnish food consumption patterns, 1979-1990." Eur J Clin Nutr **46**(4): 279-87.

Psaltopoulou, T., I. Ilias, et al. (2010). "The role of diet and lifestyle in primary, secondary, and tertiary diabetes prevention: a review of meta-analyses." Rev Diabet Stud **7**(1): 26-35.

Public Information Division of the Defence Staff (2008). Facts about the Finnish Defence Forces. Helsinki, The Finnish Defence Forces.

Puska, P. (2000). "Nutrition and mortality: the Finnish experience." Acta Cardiol **55**(4): 213-20.

Puska, P., K. Koskela, et al. (1976). "The North Karelia Project: a programme for community control of cardiovascular diseases." Scand J Soc Med **4**(2): 57-60.

Puska, P., J. Tuomilehto, et al. (1979). "Changes in coronary risk factors during comprehensive five-year community programme to control cardiovascular diseases (North Karelia project)." Br Med J **2**(6199): 1173-8.

Puska, P., E. Vartiainen, et al., Eds. (2009). The North Karelia Project: From North Karelia to National Action. Helsinki, Helsinki University Printing House.

Raj, M. and R. K. Kumar (2010). "Obesity in children & adolescents." Indian J Med Res **132**(5): 598-607.

Raulio, S., M. L. Ovaskainen, et al. (2009). "Food use and nutrient intake at worksite canteen or in packed lunches at work among Finnish employees." J Foodservice **20**: 330-41.

Raulio, S., E. Roos, et al. (2012). "Sociodemographic and work-related variation in employees' lunch eating patterns." International Journal of Workplace Health Management **In press**.

Raulio, S., E. Roos, et al. (2010). "School and workplace meals promote healthy food habits." Public Health Nutr **13**(6A): 987-92.

Raulio, S., E. Roos, et al. (2005). "Twenty year trends of workplace lunches in Finland." Food Serv Technol **5**(4): 57-66.

Ray, S., R. Udumyan, et al. (2012). "Evaluation of a novel nutrition education intervention for medical students from across England." BMJ Open **2**: e000417.

Rimm, E. B., A. Ascherio, et al. (1996). "Vegetable, fruit, and cereal fiber intake and risk of coronary heart disease among men." JAMA **275**(6): 447-51.

Roine, P., M. Pekkarinen, et al. (1958). "Diet and cardiovascular disease in Finland." Lancet **2**(7039): 173-5.

Rolland-Cachera, M. F., F. Bellisle, et al. (2000). "Nutritional status and food intake in adolescents living in Western Europe." Eur J Clin Nutr **54 Suppl 1**: S41-6.

Rolls, B. J., I. C. Fedoroff, et al. (1991). "Gender differences in eating behavior and body weight regulation." Health Psychol **10**(2): 133-42.

Roos, E., E. Lahelma, et al. (1998). "Gender, socioeconomic status and family status as determinants of food behaviour." Soc Sci Med **46**(12): 1519-29.

Roos, E., M.-L. Ovaskainen, et al. (1995). "Validation and comparison of three saturated fat indices." Scandinavian Journal of Nutrition **39**: 55-59.

Roos, E., R. Prättälä, et al. (1996). "Modern and healthy?: socioeconomic differences in the quality of diet." Eur J Clin Nutr **50**(11): 753-60.

Roos, E., S. Sarlio-Lähteenkorva, et al. (2004). "Having lunch at a staff canteen is associated with recommended food habits." Public Health Nutr **7**(1): 53-61.

Roos, E., S. Sarlio-Lähteenkorva, et al. (2007). "Associations of work-family conflicts with food habits and physical activity." Public Health Nutr **10**(3): 222-9.

Roos, E., K. Talala, et al. (2008). "Trends of socioeconomic differences in daily vegetable consumption, 1979-2002." Eur J Clin Nutr **62**(7): 823-33.

Roos, G., R. Prättälä, et al. (2001). "Men, masculinity and food: interviews with Finnish carpenters and engineers." Appetite **37**(1): 47-56.

Rye, J. A., N. O'Hara Tompkins, et al. (2008). "Promoting youth physical activity and healthy weight through schools." W V Med J **104**(2): 12-5.

Räsänen, L., M. Ahola, et al. (1985). "Atherosclerosis precursors in Finnish children and adolescents. VIII. Food consumption and nutrient intakes." Acta Paediatr Scand Suppl **318**: 135-53.

Räsänen, L., S. Laitinen, et al. (1991). "Composition of the diet of

young Finns in 1986." Ann Med **23**(1): 73-80.
Salmenpohja, J.-M. (2009). Education distribution of conscripts.
Sandberg, H., L. Roman, et al. (1973). "The effect of smoking on serum somatotropin, immunoreactive insulin and blood glucose levels of young adult males." J Pharmacol Exp Ther **184**(3): 787-91.
Sanderson, P. W., S. A. Clemes, et al. (2011). "The correlates and treatment of obesity in military populations: a systematic review." Obes Facts **4**(3): 229-37.
Santtila, M., K. Häkkinen, et al. (2008). "Changes in cardiovascular performance during an 8-week military basic training period combined with added endurance or strength training." Mil Med **173**(12): 1173-9.
Santtila, M., H. Kyröläinen, et al. (2009). "Changes in maximal and explosive strength, electromyography, and muscle thickness of lower and upper extremities induced by combined strength and endurance training in soldiers." J Strength Cond Res **23**(4): 1300-8.
Santtila, M., H. Kyröläinen, et al. (2006). "Physical fitness profiles in young Finnish men during the years 1975-2004." Med Sci Sports Exerc **38**(11): 1990-4.
Sanz, C., J. F. Gautier, et al. (2010). "Physical exercise for the prevention and treatment of type 2 diabetes." Diabetes Metab **36**(5): 346-351.
Sargeant, L. A., K. T. Khaw, et al. (2001). "Cigarette smoking and glycaemia: the EPIC-Norfolk Study. European Prospective Investigation into Cancer." Int J Epidemiol **30**(3): 547-54.
Seike, N., M. Noda, et al. (2008). "Alcohol consumption and risk of type 2 diabetes mellitus in Japanese: a systematic review." Asia Pac J Clin Nutr **17**(4): 545-551.
Shilts, M. K., M. Horowitz, et al. (2004). "Goal setting as a strategy for dietary and physical activity behavior change: a review of the literature." Am J Health Promot **19**(2): 81-93.
Simell, O., H. Niinikoski, et al. (2009). "Cohort Profile: the STRIP Study (Special Turku Coronary Risk Factor Intervention Project), an Infancy-onset Dietary and Lifestyle Intervention Trial." Int J Epidemiol **38**(3): 650-5.
Similä, M. (2012). Glycemic Index in Epidemiologic Study of Type 2 Diabetes. Tampere, National Institute for Health and Welfare.
Singh, A., P. A. Deuster, et al. (1988). "Nutritional status of land-based U.S. Navy divers." Undersea Biomed Res **15**(2): 135-45.
Siri-Tarino, P. W., Q. Sun, et al. (2010). "Saturated fat, carbohydrate, and cardiovascular disease." Am J Clin Nutr **91**(3): 502-509.
Sonestedt, E., N. C. Overby, et al. (2012). "Does high sugar consumption exacerbate cardiometabolic risk factors and increase the risk of type 2 diabetes and cardiovascular disease?" Food Nutr Res **56**.
Sorensen, G., L. Linnan, et al. (2004). "Worksite-based research and initiatives to increase fruit and vegetable consumption." Prev Med **39**: S94-100.
Spahn, J. M., R. S. Reeves, et al. (2010). "State of the evidence regarding behavior change theories and strategies in nutrition counseling to facilitate health and food be-

havior change." J Am Diet Assoc **110**(6): 879-891.

Sproul, A. D., D. D. Canter, et al. (2003). "Does point-of-purchase nutrition labeling influence meal selections? A test in an Army cafeteria." Mil Med **168**(7): 556-60.

Subar, A. F., F. E. Thompson, et al. (2001). "Comparative validation of the Block, Willett, and National Cancer Institute food frequency questionnaires : the Eating at America's Table Study." Am J Epidemiol **154**(12): 1089-99.

Sundin, J., N. T. Fear, et al. (2011). "Obesity in the UK Armed Forces: risk factors." Mil Med **176**(5): 507-12.

Sutton, E., P. Emmett, et al. (2008). "Measuring dietary sodium intake in infancy: a review of available methods." Paediatr Perinat Epidemiol **22**(3): 261-268.

Tanskanen, M., A. L. Uusitalo, et al. (2008). "Aerobic fitness, energy balance, and body mass index are associated with training load assessed by activity energy expenditure." Scand J Med Sci Sports.

Thomas, G. N., C. Q. Jiang, et al. (2010). "A systematic review of lifestyle modification and glucose intolerance in the prevention of type 2 diabetes." Curr Diabetes Rev **6**(6): 378-387.

Thomson, C. A. and J. Ravia (2011). "A systematic review of behavioral interventions to promote intake of fruit and vegetables." J Am Diet Assoc **111**(10): 1523-1535.

Thorsen, A. V., A. D. Lassen, et al. (2010). "Long-term sustainability of a worksite canteen intervention of serving more fruit and vegetables." Public Health Nutr **13**(10): 1647-52.

Tike Information Centre (2010). Ravintotase - Balance Sheet for Food Commodities, Ministry of Agriculture and Forestry.

Tolonen, H., S. Helakorpi, et al. (2006). "25-year trends and socio-demographic differences in response rates: Finnish adult health behaviour survey." Eur J Epidemiol **21**(6): 409-15.

Tonstad, S. (2009). "Cigarette smoking, smoking cessation, and diabetes." Diabetes Res Clin Pract **85**(1): 4-13.

Trent, L. K. and L. T. Stevens (1993). "Survey of the Navy's three-tiered obesity treatment program." Mil Med **158**(9): 614-8.

Trent, L. K. and L. T. Stevens (1995). "Evaluation of the Navy's obesity treatment program." Mil Med **160**(7): 326-30.

Trichopoulou, A., A. Kouris-Blazos, et al. (1995). "Diet and overall survival in elderly people." BMJ **311**(7018): 1457-1460.

Tuomilehto, J., J. Lindström, et al. (2001). "Prevention of type 2 diabetes mellitus by changes in lifestyle among subjects with impaired glucose tolerance." N Engl J Med **344**(18): 1343-50.

Tähtinen, T., M. Vanhala, et al. (2000). "Changes in insulin resistence-associated cardiovascular risk factors of Finnish men during military service." Ann Med Milit Fenn **75**(3): 163-169.

Tähtinen, T., M. Vanhala, et al. (2001). "Changes in insulin resistance-associated cardiovascular risk factors of Finnish men during military service are due to changes in eating habits." Ann Med Milit Fenn **76**(3): 239-246.

Uglem, S., W. Frolich, et al. (2007). "Correlates of vegetable consumption

among young men in the Norwegian National Guard." Appetite **48**(1): 46-53.

Uglem, S., W. Frolich, et al. (2008). "Preferences and perceptions of personal vegetable consumption: a study among young men in the Norwegian National Guard." Int J Food Sci Nutr **59**(4): 279-90.

Waijers, P. M., E. J. Feskens, et al. (2007). "A critical review of predefined diet quality scores." Br J Nutr **97**(2): 219-231.

Valsta, L. M., H. Tapanainen, et al. (2010). "Explaining the 25-year decline of serum cholesterol by dietary changes and use of lipid-lowering medication in Finland." Public Health Nutr **13**(6A): 932-8.

Wardle, J., A. M. Haase, et al. (2004). "Gender differences in food choice: the contribution of health beliefs and dieting." Ann Behav Med **27**(2): 107-16.

Vartiainen, E., P. Puska, et al. (1986). "Effects of dietary fat modifications on serum lipids and blood pressure in children." Acta Paediatr Scand **75**(3): 396-401.

Weber, J. L., P. M. Reid, et al. (2001). "Validity of self-reported energy intake in lean and obese young women, using two nutrient databases, compared with total energy expenditure assessed by doubly labeled water." Eur J Clin Nutr **55**(11): 940-950.

Vella-Zarb, R. A. and F. J. Elgar (2009). "The 'freshman 5': a meta-analysis of weight gain in the freshman year of college." J Am Coll Health **58**(2): 161-6.

Westenhoefer, J. (2005). "Age and gender dependent profile of food choice." Forum Nutr(57): 44-51.

Whitehead, T. P., D. Robinson, et al. (1996). "The effects of cigarette smoking and alcohol consumption on blood lipids: a dose-related study on men." Ann Clin Biochem **33 (Pt 2)**: 99-106.

WHO/FAO (2003). Diet, nutrition and the prevention of chronic disease. Report of a joint WHO/FAO Expert Consultation. Geneva, World Health Organization.

Viikari, J. S., H. Niinikoski, et al. (2004). "Risk factors for coronary heart disease in children and young adults." Acta Paediatr Suppl **93**(446): 34-42.

Willett, W. C. (1998). Nutritional epidemiology. New York, Oxford University Press.

Williamson, D. A., P. D. Martin, et al. (2002). "Changes in food intake and body weight associated with basic combat training." Mil Med **167**(3): 248-53.

Vincent, D., S. Lauque, et al. (1998). "Changes in dietary intakes with age." J Nutr Health Aging **2**(1): 45-8.

Wisloff, T. F., O. Vassend, et al. (1995). "Dental anxiety, utilisation of dental services, and DMFS status in Norwegian military recruits." Community Dent Health **12**(2): 100-3.

Visser, P. S., J. A. Krosnick, et al. (1996). "Mail surveys for election forecasting? An evaluation of the Colombia Dispatch Poll." Public Opin Q **60**: 181-227.

Wolever, T. M. (2000). "Dietary carbohydrates and insulin action in humans." Br J Nutr **83**: S97-102.

Wu, D. M., L. Pai, et al. (2001). "Joint effects of alcohol consumption and cigarette smoking on atherogenic lipid and lipoprotein profiles: results from a study of Chi-

nese male population in Taiwan." Eur J Epidemiol **17**(7): 629-635.

Xu, Z., H. Su, et al. (2011). "Self-rated health of Chinese adolescents: distribution and its associated factors." Scand J Caring Sci **25**(4): 780-6.

Yamane, G. K. (2007). "Obesity in civilian adults: potential impact on eligibility for U.S. military enlistment." Mil Med **172**(11): 1160-5.

Zive, M. M., T. A. Nicklas, et al. (1996). "Marginal vitamin and mineral intakes of young adults: the Bogalusa Heart Study." J Adolesc Health **19**(1): 39-47.

Zizza, C., A. M. Siega-Riz, et al. (2001). "Significant increase in young adults' snacking between 1977-1978 and 1994-1996 represents a cause for concern!" Prev Med **32**(4): 303-10.