Sami lifestyle and health

epidemiological studies from northern Sweden

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Aerpimaahtoe

Tänk om jag kunde följa med dej på din vandring
tätt i dina spår tills jag visste dina vägar:
alla glömda namn du kan
på alla glömda stigar,
älgens väg och rika fiskevatten.

Tänk om jag kunde lägga handen på din hand
och känna pulsen
av det gamla hantverket,
som dina händer vet så mycket om
men sällan kan förklara.

Tänk om jag kunde suga i mej från din mun
det språk, som du har kvar, men som jag saknar:
kittla min gom med diftonger och luftstötar,
lapa i mej de mjuka konsonanterna
från din tungspets.

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Abbreviations

ApoB/ApoA1	apolipoproteinB/apolipoptotein A1 ratio
BMI	body mass index
CI	confidence interval
CVD	cardiovascular disease
FFQ	food frequency questionnaire
FIL	food intake level
HR	hazard ratio
LC	low-carbohydrate
LCHF	low-carbohydrate, high-fat
LCHP	low-carbohydrate, high-protein
MI	myocardial infarction
MONICA	Multinational Monitoring of Trends and Determinants in Cardiovascular Disease
MUFA	monounsaturated fatty acid
OR	odds ratio
PAL	physical activity level
PLS	partial least square
PUFA	polyunsaturated fatty acid
VIP	the Västerbotten Intervention Programme
VHU	Västerbottens hälsoundersökningar
WHO	the World Health Association

List of articles and manuscripts

1) **Nilsson LM**, Dahlgren L, Johansson I, Brustad M, Sjolander P, Van Guelpen B. Diet and lifestyle of the Sami of southern Lapland in the 1930's-1950's and today. Int J Circumpolar Health 2011;70(3):301-18. Epub 2011 May 31.

2) **Nilsson LM**, Winkvist A, Brustad M, Jansson J-H, Johansson I, Lenner P, Lindahl B, Van Guelpen B. Sami diet and mortality in a northern Swedish population. Manuscript submitted 2011.

3) **Nilsson LM**, Winkvist A, Eliasson M, Jansson J-H, Hallmans G, Johansson I, Lindahl B, Lenner P, Van Guelpen B. Low-carbohydrate, high-protein score and mortality in a northern Swedish population-based cohort. Eur J Clin Nutr, accepted 2012.

4) **Nilsson LM**, Johansson I, Lenner P, Lindahl B, Van Guelpen B. Consumption of filtered and boiled coffee and the risk of incident cancer: a prospective cohort study. Cancer Causes Control. 2010 Oct;21(10):1533-44. Epub 2010 May 30

5) **Nilsson LM**, Wennberg M, Lindahl B, Eliasson M, Jansson JH, Van Guelpen B. Consumption of filtered and boiled coffee and the risk of first acute myocardial infarction; a nested case/referent study. Nutr Metab Cardiovasc Dis. 2010 Sep;20(7):527-35. Epub 2009 Aug 19.

Abstract

The aim of this PhD thesis was to expand the current knowledge of "traditional Sami" diet and lifestyle, and to test aspects of the Sami diet and lifestyle, specifically dietary pattern, macronutrient distribution and coffee consumption, in population-based epidemiological studies of mortality and incident cardiovascular disease and cancer in a general population.

In Paper I, semi-structured interviews were conducted with 20 elderly Sami concerning their parent's lifestyle and diet 50-70 years ago. Questionnaire data from 397 Sami and 1842 matched non-Sami were also analyzed, using non-parametric tests and partial least square methodology. In Papers II-IV, mortality data and incident cancer data for participants in the Västerbotten Intervention Program (VIP) cohort were used for calculations of hazard ratios by Cox regression. In Paper II, a Sami diet score (0-8 points) was constructed by adding one point for each intake above the median for red meat, fatty fish, total fat, berries and boiled coffee, and one point for each intake below the median for vegetables, bread and fibre. In Paper III, deciles of energy-adjusted carbohydrate (descending) and protein (ascending) intake were added to create a Low-Carbohydrate, High-Protein (LCHP) score (2-20 points). In Paper IV, filtered and boiled coffee consumption was studied in relation to incident cancer. In Paper V, a nested case-control study of filtered and boiled coffee consumption and acute myocardial infarction, risk estimates were calculated by conditional logistic regression.

Surprisingly, fatty fish may have been more important than reindeer meat for the Sami of southern Lapland in the 1930's to 1950's, and it is still consumed more frequently by reindeer-herding Sami than other Sami and non-Sami. Other dietary characteristics of the Sami 50-70 years ago and present-day reindeer-herding Sami were high intakes of fat, blood, and boiled coffee, and low intakes of bread, fibre and cultivated vegetables (Paper I). Stronger adherence to a "traditional Sami" diet, i.e. a higher Sami diet score, was associated with a weak increase in all-cause mortality, particulary apparent in men (Paper II). A diet relatively low in carbohydrates and high in protein, i.e. a high LCHP score, did not predict all-cause mortality compared with low LCHP score, after accounting for saturated fat intake and established risk factors (Paper III). Neither filtered nor boiled coffee consumption was associated with cancer for all cancer sites combined, or for prostate or colorectal cancer. For breast cancer, consumption of boiled coffee ≥4 versus <1 occasions/day was associated with a reduced risk. An increased risk of premenopausal and a reduced risk of postmenopausal breast cancer were found for both total and filtered coffee. Boiled coffee was positively associated with the risk of respiratory tract cancer, a finding limited to men

(Paper IV). A positive association was found between consumption of filtered coffee and the risk of acute myocardial infarction in men (Paper V).

In conclusion, the findings of Paper I, in particular the relative importance of fatty fish compared to reindeer meat in the "traditional Sami" diet of the 1930's-1950's, suggest that aspects of cultural importance may not always be of most objective importance. The findings of Papers II-V generally did not support health benefits for the factors studied. The relatively good health status of the Sami population is therefore probably not attributable to the studied aspects of the "traditional Sami" lifestyle, but further investigation of cohorts with more detailed information on dietary and lifestyle items relevant for "traditional Sami" culture is warranted.

Keywords: Sami, traditional food, traditional lifestyle, VIP, cohort, mortality, cancer, cardiovascular disease

Abstracts in four Sami languages

There are several different Sami languages and dialects. According to estimates from the Sami Information Centre, run by the Sami Parliament in Sweden, Northern Sami, the most widespread, is spoken by about 17 000 people, followed by Lule Sami and Southern Sami, each of which is spoken by about 700 people (www.eng.samer.se, accessed 2012-01-23). Ume Sami, the indigenous language of the southern Lapland area, is believed to be spoken by only 20 people (www.ethnologue.com, accessed 2012-01-23).

I. Čoahkkáigeassu davvisámegillii

(Northern Sami)

Guorahallama ulbmil lea muitalit sámi biepmu ja eallinvuogi birra ja iskat got árbevirolaš sámi borranvierut, makrobiebmama juogustus ja gáffegolaheapmi váikkuhit jámolašvuođa ja riskka oažžut borasdávdda dehe váibmo-/ suotnadávdda dábálaš davvi-ruoŧŧelaš ássiid luhtte.

Guoktelogi sámi vuorrasa ledje jearahallon daid vánhemiid eallinvuogi ja borramuša birra 50-70 jagi áigi (Oassedutkan 1). Dasa lassin 397 sámi ja 1842 ruoŧŧelačča biebmandata guorahallojuvvo eahpe-paramehtarlaš iskamiid ja partialalaš unnimus kvadráhta metoda (PLS) mielde. Dát golbma čuovvovaš oassedutkama, gait kohortdutkamat, isket jápminsiva dehe borasdávdabuohccivuođa oaseváldiid luhtte Västerbottenis dearvas-vuohtaiskkademiid hárrái (64 603-77 319 iskama) ja riskkaluoitimat leat rehkenaston Cox regrešuvnna mielde. Oassedutkamis 2 árbevirolaš sámi biebman lea speadjalaston čuokkesskála vuostá 0 rájes gitta 8 čuoggá. Dát bealli oaseváldiin geat leat eanemus rukses bierggu, buoiddes guoli, buoiddi, murjiid ja vuoššangáfe borran, lea ožžon 1 čuoggá juohke áidna biebmanelemeanta ovddas, oktiibuot eanemus 5 čuoggá. Vel 3 čuoggá dát bealli oaseváldiin lea ožžon geat lea unnimus šattuid, láibbi ja fiberiid borran, eanemus oktiibuot 3 čuoggá. Oassedutkamis 3 speadjalastá oktavuođa kolhydráhtaid ja proteiinnaid gaskkas biebmamis LCHP (vuolit-kolhydráhta, alit-proteiidna) čuoggáid bokte. Alimus LHCP čuoggát (=20) dát oasseváldit leat ožžon geat leat borran unnimus kolhydráhtaid ja eanemus proteiinnaid ja vuolimus čuoggát (=2) dát oasseváldit leat ožžon geat leat borran eanemus kolhydráhtaid ja unnimus proteiinnaid. Oassedutkamis 4 riska borasdávdabuohccivuođa ektui guorahallojuvvo brygg- ja vuoššangáffejuhkkiid luhtte. Oassedutkan 5 lei goallostuvvon

dárkkástus-dutkan, gos riska fáhkkatlaš healladávdda oažžut gáffejuhkkiid luhtte rehkenasto logistihkalaš eaktuduvvon regrešuvnna bokte.

Sáhttá leahkit nu ahte buoiddes guolli lea rievtti mielde leamašan deataleabbo sámiide go boazobiergu lulli Lapplánddas 1930-1950-logus ja badjeolbmot ain dávjábut borret dan go iežá sámiid ja ruoŧŧelaččat. Iežá sierra erenomášvuohta sámi biebmamis lei alit oassi buoiddis, mális ja vuoššangáfes ja vuolit oassi láibbis, fiberiin ja šaddaduvvon šattuin (Oassedutkan 1). Stuora seammaláganvuođat árbevirolaš sámi biebmamiin, rievtti mielde alit Sami diet score čuoggát, ledje čatnon veahá aliduvvon jámolašvuhtii dievdduid luhtte muhto ii fal nissoniid luhtte (Oassedutkan 2). Biebman mas vuolit oassi kolhydráhtaid ja alit oassi proteiinnat, rievtti mielde alit LHCP čuoggát, ii váikkuhan riskka jápmit, maŋŋel go lea statistihkalaččat jurddašan ahte buoiddi borrat ja mat dát leat dát sajáiduvvon riskafáktorat (Oassedutkan 3). Gáffejuhkan ii lean čatnon eaneduvvon borasdávdariskii, iige eaneduvvon riskii oažžut prostata-gassačoalleborasdávdda. Nissoniin mat juhke vuoššangáfe ≥ 4 geardde/beaivái lei geahpeduvvon riska oažžut čižžeborasdávdda go nissonat mat juhke <1 geardde/beaivái. Ollesgáffe ja brygg-gáffe ledje čatnon eaneduvvon riskii oažžut čižžeborasdávddá nuorat nissoniid luhtte ja geahpeduvvon riskii vuorrasiin luhtte. Dievdduin mat juhke ollu vuoššangáfe lei eaneduvvon riska oažžut borasdávdda (Oassedutkan 4). Dievdduin mat juhke olu brygg-gáfe lei eaneduvvon riska oažžut healladávdda (Oassedutkan 5).

Vuorrasit sámiid muitalusat man olu guoli sin vánhemat leat borran boazobierggu ektui 1930-1950-logus, čujuhit ahte bealit main alit kultuvrralaš mearkkašupmi eai dárbbaš seamma nanu objektivalš mearkkašumi atnit. Oassedutkamiid 2-5 bohtosat čujuhit ahte guorahallon bealit árbevirolaš sámi biebmamis ja eallinvuogis eai váikkut gárrasit dearvvašvuođa ja buohccivuođa dábálaš davviruoŧŧelaš ássiid luhtte.

(translation: Joseph Fjellgren for Daasta NUF)

III. Álkkes tjoahkkájgäsos dárogiellaj

(Lule Sami)

Dán guoradallama ájggom lij sáme biebmov ja viessomvuogev tsuojgodit, ja åtsådit gåk árbbedábak sáme bårråmdábe, stuoräládusebna juohkem ja káffajuhkam nuorttalándak álmmugin, bájnná jábmemav ja bårredávddabalov ja tsåhke-/ varravárredávddabalov.

Guoktalågev sáme gatjádaláduvvin sijá äjgádij viessomvuoge ja biebmo birra 50-70 jage dán åvddåla (Oasseåtsålvis 1). Biebbmodáhtá 397 sámes ja 1842 láttes guoradaláduvvin parametragahtes gähttjalimij ja muhtem miere unnemus kvadráhta vuoge (PLS) viehkijn. Gålmmå tjuovvo oasseåtsådime, gájkka kohorttaåtsådime, vuolggin Västerbottena varresvuohtaåtsådimj oassálasstij jábmemårijs jali bårredávddaskihpudagájs (64 603-77 319). Ballamoarremerustallamav dahkin Cox regressionijn. Oasseåtsådibme 2 spiedjildij avtaárvojt árbbedábak sáme biebmon tjuokkesmåhtajn nållå rájes gávtse tjuoggáj. Dat lahkke oassálasstijs gudi bårrin ienemus ruoppsis biergov, buojdes guolev, buojdev, muorjijt ja máleskáfav, oattjoj avtav tjuoggáv juohkka avta bårråmoases, aktan 5 tjuoggá ienemusát. Ájn 3 tjuoggá oattjoj dat lahkke oassálasstijs mij båråj binnemus ruonudisájt, lájbijt ja fiberijt, aktan ienemusát 3 tjuoggá. Oasseåtsådibme 3 spiedjilt vidjurijt kolhydráhtaj ja proteijnaj gaskan biebmon nåv gåhtjodum LCHP (vuolle-kolhydráhta, alla-proteijna) tjuoggáj viehkijn. Alemus LCHP tjuoggájt (=20) oadtjun oassálasste gudi binnemus kolhydráhtajt ja ienemus proteinajt bårrin ja vuolemus LCHP tjuoggájt (=2) oassálasste gudi ienemus kolhydráhtajt ja binnemus proteijnajt bårrin. Oasseåtsådimen 4 åtsådaláduváj bårredávddaballo brygga- ja máleskáffajuhkkijn. Oasseåtsådibme 5 lij aktijdum guoradim-åtsådibme, gånnå káffajuhkkij tsåhkedávddaballo merustaláduváj aktijdam vihkemåhtsadime baktu.

Vuordedahtek lij buojdes guolle ájnnasabbo gå boatsojbierggo sámijda oarjje Lapplándan 1930-1950-lågojn ja ájn vilá ällosáme guolev ienebut bårri gå ietjá sáme ja látte. Ietjá sierra merka sáme biebmon lij alep oasse buojdes, máles ja máleskáfas ja unnep oasse lájbes, fiberis ja sáddjidum ruonudisájs (Oasseåtsådibme 1). Árbbedábak sáme biebmo muoduk biebbmo, alep Sami diet score tjuoggáj, aktijaneduváj lasse jábmemijn sierraláhkáj ålmmåj hárráj (Oasseåtsådibme 2). Biebbmo vuolep kolhydráhttaåsijn ja alep proteijnnaåsijn, alla LCHP tjuoggáj, ittjij jábmembalov bájne, maŋŋel gå statistijkalattjat gehtjadam buojddebårråmijt ja ieme ballovidjurijt (Oasseåtsådibme 3). Káffajuhkam lij tjanádum juogu de lasse gájkkásasj

bårredávddaballuj, jali lasse prostähta- bahtatjoallebårredávddaj. Kujnajn gudi máleskáfav juhkin ≥ niellji bäjvváj lij binnep njidtjebårredávddaballo gå buohtastahttá kujnaj gudi < akti bäjvváj juhkin. Ålleskáffa ja bryggakáffa tjanáduváj lasse njidtjebårredávddaballuj nuorap kujnaj hárráj ja binnep vuorrasappoj. Ålmmåjn gudi juhkin edna máleskáfav lij lasse bårredávddaballo vuojŋŋamorgánajn (Oasseåtsådibme 4). Ålmmåjn gudi juhkin edna bryggakáfav lij lasse tsåhkedávddaballo (Oasseåtsådibme 5).

Vuorrasap sámij tsuojggoma äjgádij guollebårråmis gå buohtastahttá boatsojbierggobårråmijn 1930-1950-lågo, vuosedi biele alla kultuvrak sisanos e agev dárbaha sämmi nanos objektijvak sisanov adnet. Oasseåtsådimij 2-5 båhtusa vuosedi åtsådum biele árbbedábak sámebiebmos ja viessomvuoges e varresvuodav ja skihpudagáv nuorttalándak álmmuga hárráj heva bájne.

(translation: Karin Tuolja)

IV. Tjöönghkedisteme åarjelsaemiengïelesne

(Southern Sami)

Dan goerehtimmien ulmie lea saemien beapmoem jïh jielemevuekiem buerkiestidh jïh dotkedh guktie aerpievuekien saemien beapmoevuekieh, makrobïepmehtimmiej juekeme jïh prïhtjhjovhkeme jaemedem jïh riskem dijpieh vaajmoe-/ jïh soeneskïemtjelassen muhteste noerhtesvöörjen sïejhmi årroji luvnie.

Lea göökteluhkie saemien voeresh goerehtamme daej eejtegi jielemevuekien jïh beapmoen dïehre 50-70 jaepiej juassah (Stuhtjedotkeme 1). Dïsse lissine lea beapmoedaatam goerehtamme 397 saemijste jïh 1842 laedtijste ov-parametrihken gïehtjedimmiej jïh partiellen unnemes kvadraaten vuekien mietie (PLS). Dah golme båetien stuhtjedotkemh, gaajhkh kohortdotkemh, leah dotkeme man gaavhtan jaameme jallh mïetskeåedtjieskïemtjelassh daej luvnie gïeh meatan Västerbottenen healsoedotkemi muhteste (64 603-77 319 dotkemh) jïh riskeryøknemh dorjeme Cox regresjovnen viehkine. Stuhtjedotkemisnie 2 lea mohtedamme guktie aerpievuekien saemien beapmoe vaestede låhkoeraajterasse 0 raejeste 8 raajan. Daate bielie daejstie gïeh meatan gïeh jeenemes röövpses bearkoem, buajtehks gueliem, buejtiem, muerjieh jïh voessjemeprïhtjegem byöpmedamme, leah aktem låhkoem åådtjeme fiere guhte beapmoeelementen åvteste, jeenemes 5 låhkoeh. Dïsse lissine 3 låhkoeh åådtje daate bielie daejstie gïeh meatan gïeh unnemes

kruanesaath, laejpiem jïh fiberh byöpmedamme, jeenemes 3 låhkoeh. Stuhtjedotkemisnie 3 daelie mohtede kolhydraath jïh proteinh beapmosne LHCP (vuelehks-kolhydraath, jïlle-proteine) låhkoej viehkine. Jillemes LHCP låhkoem åådtjeme (=20) dah gïeh meatan gïeh vaenemes kolhydraath jïh jeenemes proteinh byöpmedamme jïh vueliehkommes LHCP låhkoem (=2) åådtjeme dah gïeh meatan gïeh jeenemes kolhydraath jïh vaenemes proteinh byöpmedamme. Stuhtjedotkemisnie 4 riskem goerehtamme mietskeåedtjieskïemtjelassem åadtjodh brygg- jïh voessjemeprïhtjegejovhkiji luvnie. Stuhjtedotkeme 5 lïj tjetskeme-dotkeme gusnie riskem ryöknoe logistihken regresjovnen baaktoe jis maahta faahketji vaajmoedåeriesmoerh åadtjodh prïhtjhjovhkiji luvnie.

Buajtehks guelie meehti vihkielåbpoe årrodh båatsoesaemide goh bovtsebearkoe åarjel Lapplaantesne 1930-1950-låhkosne jïh daamhtah båatsoesaemieh daam byöpmedieh jeenebe goh jeatjah saemieh jïh laedtieh. Jeatjah sïejhmi sjïere vuekieh saemien beapmosne lea jïlle stuhtje buejteste, maeleste jïh voessjemeprïhtjegistie jïh vuelie stuhtje laejpeste, fiberistie jïh kruanesaatijste (Stuhtjedotkeme 1). Jeenh saemien aerpievuekien beapmoe, jïlle Sami diet score låhkoeh, provhki vuesiehtidh vaenie jeananamme jaemede ålmaj gaskemsh bene ij nyjsenæjjaj gaskemsh (Stuhtjedotkeme 2). Beapmoe man vuelehks stuhtje kolhydraath jïh stoerre stuhtje proteijnh, jeenh LCHP låhkoeh, ij leah dïjpeme riskem jaemedh, dan mænggan goh lea ussjedamme statistihken muhteste man jeene buejtiem byöpmedidh jïh sijjiedahteme riskefaktovrh ussjedamme. (Stuhtjedotkeme 3). Prïhtjhjovhkeme ij leah tjoelmesovveme jeananamme mïetskeåedtjieriskese, jallh jeananamme riskese prostaate-voeresbuejtiemïetskeåedtjiem åadtjodh. Nyjsenæjjah gïeh voessjemeprïhtjegem jovhkeme ≥ 4 aejkien/biejjesne unnemes riskem utnin njammamïetskeåedtjiem åadtjodh nyjsenæjjaj muhteste gïeh jovhkeme <1 aejkien/biejjesne. Ellies prïhtjege jïh bryggeprïhtjege lea tjoelmesovveme jeananamme riskese njammamïestkeåedtjiem åadtjodh noere nyjsenæjjah luvnie jïh unniedamme riskem voeresi luvnie. Ålmah gïeh jeenh voessjemeprïhtjegem juvhkieh jeananamme riskem utnieh mïetskeåedtjiem åadtjodh girsesne (Stuhtjedotkeme 4). Ålmah gïeh jeenh bryggeprïhtjegem jovhkeme jeananamme riskem utnieh vaajmoedåeriesmoerem åadjtodh (Stuhtjedotkeme 5).

Dah saemien voeresi soptsestimmieh man jeeneh gueliem daej eejtegh leah byöpmedamme bovtsebearkoem muhteste 1930-1950-låhkosne, vuesehte ahte daate bielie man vihkeles kultuvren sisvege ij eejnegen seamma objektiven sisvegem utnieh. Illeldahkh stuhtjedotkemijstie 2-5 vuesiehtieh ahte dah bielieh mejtie lea goerehtamme saemien aerpienvuekien beapmoen

jïh jielemevuekien muhteste eah healsoem jïh skïemtjelassem dïjph jeenebe goh sïejme noerhtesvöörjen årrojh.

(translation: Joseph Fjellgren for Daasta NUF)

IV. Unne Uppmie saamien tjuöhkeme

(Ume Sami)

Dahte guoreteme suptseste saamien beäpmoen jah jielemevuökien biire jah giehtjedie guktie aarpievuökien saamien beäpmoeh, oajviebeäpmoeh jah kaavoeh mietete jaameke vahkake jah cancerenne jah vajmoen/ virreveättennea nuorthen allmetjeih luunie.

Guökteluhke saamieih boariesh gihtjedihke lie elltie eihtegeh jielemevuökien jah beäpmoen biire dann baelie 50-70 jaapieh (Oasie 1). Jieneh beäpmoe-dataede dahkedihke lie 397 saamieiheste jah 1842 ruotseiheste dennake viehketihenne ieh parmetriske giehtjedemeh jah partiellen unnemes kvadraten vuökien miete (PLS). Dah gullme oasieh boatien kohort-luhkemeh, allkemme lie jaamemeste jall canceremeste mieteih Västerbottenen varaasgiehtjemeih luunie (64603-77319 ollu) vahkake-tsiehkesjeme dahkedihke Cox-enne regressione. Oasienne 2 vuöjnedihke leh akte laakatjenne aarpievuökien saamien beäpmoeh vuösstede akte tsiehkesjerairoe 0 – 8. Dahte bielie deistie gieh jienemes ruöpses beärrkoede, buöjteks guöliede, buöjtiede borrein jah vuossjeme kaavoede juukein, akte tsiehkie fierte beäpmoih outeste otjoin, jienemes 5 tsiehkieh.Vielie 3 tsiehkieh dahte bielie otjoin gieh unnemes jaamoede jah urhtsede, laipiede jah fiberede borrein, jienemes 3 tsiehkeh. Oasienne 3 vuöjnedihke aktevuotta gasske kolhydrateh jah proteieneh beäpmoenne LCHP-esne (vuöleke kolhydrateh, jylloeke-proteineh) tsiehkie. Jyllemes LCHP tsiehkieh (=20) dainie mietenne unnemes kolhydrateh jah ollomes proteineh borrein jah unnemes LCHP tsiehkieh (2) dainie mietenne ollomes kolhydrateh jah unnemes proteineh borrein. Oasienne 4 giehtjedihke vahkake cancerede brygg- jah vuossjeme kaavoe juukejenne. Oasie 5 tjohkenne lin kontrolle- giehtjedeme vahkake hiehke vaajmoe-narrenne kaavoe-juukejenne tsiehkiesjdihke logistiske regressionenne.

Buöjteke guölieh borretdihke mahtein vieliebe buutsebeärrkoeste saamieihesne oarrjel saamien eätname 1930-1950 jaapienne jah vieliebe borretdihke buutsesaamieiheste guh jeätja saamieh jah ruotse-allmetjeh. Jeätja siejhme sierreme saamien beäpmoesne lin akte jylloeke oasie buöjtie-,

viire-, jah vuossjeme kaavoeste jah akte vuöleke oasie laipie-, fibere-, joamoe jah urhtseste (Oasie 1). Ollu aktelaaka aarpievuökien saamien beäpmoeh, ollu Sami diet score tsiehkieh tjohkan lin vieliebe jaameme ollmaihenne sierrelaaka (oasie 2). Beäpmoihenne unne kolhydrateh jah ollu proteineh, ollu LCHP tsiehkie, ieh vahkake lasste jaamet, dann mingjelen guh statistiske ussjede valltedihke leh borremmiean gallane buöjtieste jah vihties vahkake faktoreiheste (oasie 3). Kaavoejuukeminne lin ieh vielebe aarpievuökien cancer-vahkake tjohkenne, jall vielebe vahkake prostate-kolorektale-cancere. Nyesenejah guh vuossjeme kaavoe juukein ≥4 aikieh/biejvie unnebe vahkake nitje-cancereb lin muhteste nyesenejanneh gieh <1 aikie/biejvie juukein. Gaihkekaavoe jah brygg-kaavoe lie tjoahkan vielebe nitje cancereb nyesenejanne jah unnebe vahkake boariesh nyesenejaihenne. Ollma guh ollu vuossjeme kaavoeb juukein cancereste gonkelmesenne vieliebe vahkake otjoin (oasie 4). Ollma guh ollu brygg-kaavoe vajmoe-narreme vieleb vahkake otjoin (oasie 5).

Dah boariesh saamieh suptsestemeh man jingje guöliede elltie eihtegeh buutsebeärrkoeh borrein 1930-1950-aikie, vuösiete dahte bielie veäksekes kulture miele ieh gaihke aikie darpesjedennake veäksekes objektive miele leh. Oasie 2-5 vuösiete dah giehtjedemes dahte bielie aarpievuökien saamien beäpmoen jah jielemen vuökien ieh varaas jah skieptjeme mietete ieh nuorthen almetejeh ollu.

(translation: Valborg Wiinka and Kenneth Sarstav)

Enkel sammanfattning på svenska

(popular science summary in Swedish)

Syftet med denna avhandling var att beskriva livsstil och kostvanor hos samer. Det var också att undersöka hur en ”traditionell samisk” livsstil påverkar risken att insjukna av eller dö i cancer och hjärt-/kärlsjukdom i en norrländsk normalbefolkning. En majoritetsbefolkning har alltså undersökts ur ett minoritetsperspektiv. Avhandlingen belyser framför allt kostvanor, fördelning av de näringsämnen som innehåller energi (kolhydrat, protein, fett) och konsumtion av kok- och bryggkaffe.

Bakgrunden till undersökningarna var att samerna, till skillnad från de flesta andra urfolk i världen, kan förvänta sig ett lika långt liv som majoritetsbefolkningen. När det gäller hjärtkärlsjukdom finns inga stora etniska skillnader, men samiska män, särskilt renskötande, har lägre risk att drabbas av cancer än icke-samer. Det finns ingen entydig förklaring till samernas relativt goda hälsa, men det kan finnas ett samband med kostvanor och livsstil.

Delstudie I var en intervjustudie med äldre samer och fungerade som bakgrund för de andra delstudierna. Tjugo äldre samer intervjuades om sina föräldrars livsstil och kostvanor för 50-70 år sedan. Dessutom analyserades kostdata från 81 renskötande och 226 icke-renskötande samer och 1842 matchade icke-samer för att se vilka skillnader som fanns mellan grupperna. Intervjuerna visade överraskande att fet fisk kan ha varit viktigare än renkött för samerna i södra Lappland under 1930-1950-talen. Fet fisk äts fortfarande i högre utsträckning av renskötande samer än av andra samer och icke-samer. Saker som har hög kulturell betydelse (i detta fall renkött) behöver alltså inte alltid ha lika stor betydelse ur ett objektivt, vetenskapligt perspektiv. Andra typiska särdrag hos den samiska kosten var en hög andel av fett, blod och kokkaffe och en låg andel av bröd, fibrer och odlade grönsaker. Det dagliga livet hos samerna på 1930-1950-talen präglades också mycket mer av fysisk aktivitet än vad det gör idag. De samiska männen arbetade oftast långt hemifrån, medan kvinnorna hade ansvaret hemmavid för fiske, jordbruk och trädgårdsskötsel (som introducerades under 1930-1950-talen). Kvinnorna tog även hand om hushållsarbetet och barnen.

Delstudierna II-V handlade om olika aspekter av samisk kost i relation till dödlighet och sjuklighet. Till dessa användes huvudsakligen data från Västerbottens hälsoundersökningar, men i delstudie V även från MONICA-projektet, som är en del av ett multinationell forskningsprojekt om hjärt-

/kärlsjukdom. Totalt ingick på så sätt data från mer än 80 000 unika individer från en allmän, till största delen icke-samisk, normalbefolkning.

Delstudie II byggde på en modell liknande den som använts för att undersöka hälsoeffekter av så kallad Medelhavsdiet. En poängskala från 0-8 poäng, en så kallad ”Sami diet score”, skapades för att spegla likheter med ”traditionell samisk” kost. Den hälft av deltagarna som åt mest rött kött, fet fisk, fett, bär respektive kokkaffe, fick 1 poäng var, sammanlagt maximalt 5 poäng. Den hälft av deltagarna som åt minst grönsaker, bröd respektive fibrer fick också 1 poäng var, sammanlagt maximalt 3 poäng.

Stora likheter med en ”traditionell samisk” kost, det vill säga höga ”Sami diet score” poäng, var förknippade med en svagt ökad dödlighet, särskilt hos männen. Det verkar därför osannolikt att den samiska kosten i sig förklarar den relativt goda hälsan hos samer. Denna fråga är dock mycket svår att undersöka, eftersom kostvanorna kan ha skiljt sig mellan olika samegrupper och över tid. Dessutom äter dagens västerbottningar mycket mindre av vissa livsmedel, jämfört med vad samerna gjorde förr i tiden. Det gäller till exempel fet fisk och bär. För sådana livsmedel kan det därför vara extra svårt att påvisa samband med dödlighet. Syftet med kostenkäten i Västerbottens hälsoundersökningar är inte heller att spegla en ”traditionell samisk” kost. Det finns till exempel inga frågor om renkött och vilt, utan sådant kött räknas som en del av övrigt rött kött.

Det här är första gången som någon undersökt betydelsen av ett ”traditionellt samiskt” kostmönster för hälsan på detta sätt. Fler liknande undersökningar i material med mer detaljerade frågor, som bättre fångar en samisk kost, är önskvärda.

Lågkolhydratdieter, som har vissa likheter med den ”traditionella samiska” kosten, är både populära och kontroversiella. Eventuella långtidseffekter för hälsan är till stor del okända. I delstudie III speglades förhållandet mellan kolhydrater och protein i kosten med hjälp av så kallade LCHP (låg-kolhydrat, hög-protein) poäng. Högsta LCHP poäng fick de deltagare som åt minst kolhydrater och mest protein. Höga LCHP poäng påverkade inte risken att dö, eller att dö i cancer eller hjärt-/kärlsjukdom, efter att statistisk hänsyn tagits till intaget av mättat fett och de vanligaste riskfaktorerna.

LCHP score användes i denna studie, istället för exempelvis en LCHF (low carbohydrate, high fat) variant. På så sätt kunde betydelsen av total fettmängd och av mättat fett också vägas in i analyserna. Dessutom innehåller kolhydrater och protein samma mängd energi per gram, vilket gör det lättare att byta ut dem mot varandra i en poängskala. Fett innehåller

nästan dubbelt så mycket energi per gram som proteiner och kolhydrater. Inte bara olika sorters fett, utan även olika sorters protein och kolhydrater, kan spela roll för hälsan. Det är därför mycket svårt att skilja ut effekterna av mängd och kvalitet av kolhydrater, protein och fett i kosten.

I delstudierna IV och V undersöktes risken att bli sjuk i cancer eller få en akut hjärtinfarkt hos västerbottningar som dricker mer respektive mindre kok- och bryggkaffe. De som drack mycket kaffe hade varken ökad generell cancerrisk, eller ökad risk för prostata- eller tjocktarmscancer. Kvinnor som drack kokkaffe ≥ 4 ggr/dag hade minskad risk för bröstcancer jämfört med kvinnor som drack <1 gång/dag. Både totalt kaffeintag och intag av bryggkaffe var kopplade till ökad risk för bröstcancer hos yngre kvinnor och minskad risk hos äldre. Män som drack mycket kokkaffe hade ökad risk för cancer i luftvägarna. Dessa resultat visar att de som dricker olika sorters kaffe kan ha olika stor risk att drabbas av olika sorters cancer. I tidigare studier har inga starka samband hittats mellan kaffedrickande och cancer. Denna studie var den första att undersöka hur cancerriskerna ser ut hos människor som dricker olika sorters kaffe.

När det gäller hjärtinfarkt, hade män som drack mycket bryggkaffe ökad risk, medan inga entydiga resultat kunde visas bland män som drack mycket kokkaffe. Tidigare studier har visat motstridiga resultat när det gäller kaffe och hjärt-/kärlsjukdom, även om kaffekonsumtion är vedertaget förknippat med en del faktorer som kan öka risken att drabbas av hjärtinfarkt, till exempel ökade halter av blodfetter. Betydelsen av kokkaffe har aldrig undersökts tidigare i en studie där uppgifter om kaffedrickande samlats in i förväg.

Delstudierna II-V är alla så kallade observationsstudier. I sådana studier följer deltagarna ingen bestämd forskningsplan, utan lever sina normala liv och jämförs sedan med varandra. I observationsstudier är det mycket svårt att ta hänsyn till alla möjliga störande faktorer som kan finnas i omgivningen. Därför är det i princip omöjligt att bevisa direkta samband mellan orsak och verkan i en observationsstudie. Delstudierna II-V hade emellertid den starkaste design som en observationsstudie kan ha. De byggde på en representativ normalbefolkning (= en befolkningsbaserad kohort), där data samlats in från ett stort antal personer (> 80 000 unika individer) medan de ännu var friska (= en prospektiv kohort). Resultaten av enstaka observationsstudier har störst betydelse som underlag för att planera nya liknande, eller andra typer av mer riktade undersökningar. De är med andra ord hypotesgrundande. Om däremot flera observationsstudier visar på liknande resultat brukar man utgå från att resultaten är sanna, eller åtminstone sannolika.

Preface

I was born 1965 in Lund, a university city in southern Sweden, close to Denmark. Both my parents descended from the rural areas of Västerbotten County, more than 1000 kilometers north of Lund, where we spent most of our longer vacations. In the autumn, picking berries was an important leisure-time family activity. We explored numerous edible wild berries and fruits of southern Sweden for taste and use. We also "imported" reindeer meat and coffee cheese when available from northern relatives.

As a little girl, I was told that my mother was partly "Lappish". I was told that only reindeer-herding Sami were real Sami. Despite this, I was dressed in Sami clothes occasionally on festive events. When my mother defended her PhD thesis in Lund in 1978, she wore a traditional Sami dress, made for her by reindeer-herding relatives, one of whom also encouraged me to try Sami handicraft (duodji) myself. As an adult, at this Sami relative's funeral, I was one of few guests dressed all in black. By then, I was convinced that I did not have the right to wear Sami clothes any longer. At the same time, a sad feeling of unfairly being excluded tormented me.

In 1992, it was legally stated in Sweden that anyone who can show that it is probable that one of his or her grandparents had a Sami language spoken in their homes can be considered to be Sami. Despite a fear of being disapproved, I applied for registration in 2000, and participated in my first election to the Sami Parliament in 2001. Since then my interest in Sami culture has increased by the feeling of being included and personally involved. I have realized how invisible Sami culture is today and how a majority perspective has dominated descriptions of the Swedish culture in general and the northern Swedish culture in specific.

My view is that while genes are diluted when shared, culture can work in an opposite direction, aggregating by sharing, making it irrelevant to classify people into, for example, whole-Sami, half-Sami or quarter-Sami when studying the Sami culture. While a colonial perspective can entail a view of indigenous groups as people who do not develop through history but rather remain as an interesting historical relict, I would never exclude the thought of development in any culture.

In this thesis I have thus tried to apply an opposite perspective compared with the usual. I have studied a majority population from a minority

perspective, letting traditional Sami lifestyle factors define and frame my public health research scope. The result of this, I kindly invite you as a reader to create your own personal opinion about.

Umeå January 19, 2012

Lena Maria Nilsson

1. Background

This is a thesis in public health, with the aim to expand the current knowledge of "traditional Sami" diet and lifestyle 50-70 years ago, and to test aspects of the Sami diet and lifestyle, specifically dietary pattern, macronutrient distribution and coffee consumption, in population-based epidemiological studies of mortality and incident cardiovascular disease and cancer.

1.1 Public health

Public health refers to the health situation of an entire population, for example, the Swedish population, the northern Swedish population, or the Sami population. Most definitions of public health aim at the vision of a good public health, for example: *"the science and art of preventing disease, prolonging life and promoting health through the organised efforts and informed choices of society, organisations, public and private, communities and individuals." (1)* (p. 9)

When diet is the examined determinant (exposure), the field is referred to as nutritional epidemiology, a relatively young discipline within public health (2). In this thesis, nutritional epidemiological methods, described in more detail below, were employed for the study of aspects of Sami diet and lifestyle in relation to mortality and incident cardiovascular disease and cancer in a mainly non-Sami population.

1.2 Sami people

Sami people are the indigenous people of the Sami area (Sapmi) of northern Norway, Sweden, Finland, and the Kola Peninsula of Russia. Reindeer herding, hunting, fishing, as well as small-scale farming are generally considered as traditional Sami sustenances (3) (p. 61-83), with cultural differences depending on different environments. For example mountain Sami have traditionally had a nomadic lifestyle and a more extensive reindeer herding culture compared with forest Sami, who have been characterized as semi-nomadic (4) (p.160). During the 1800's in particular, political directives were implemented to assimilate non-nomadic Sami into, and segregate migratory, reindeer-herding Sami from, the Swedish non-

Sami society (5)(p. 102)(6). This, in combination with legislation primarily benefitting mountain Sami culture (4) (p. 149-72), (5) (p.212-213), enhanced assimilation of Swedish Sami, especially among the forest Sami group.

Since the establishment of the Sami parliament 1993, all Swedish citizens with a Sami background, i.e. citizens with Sami language spoken in their homes and/or in the homes of their parents and/or grandparents, have the right to apply for registration in the electorial registry of the Sami Parliament, though they may be appealed and excluded by people not considering them as "real Sami", as part of the legal registration process [Sametingslag (1992:1433)]. Being confirmed as Sami in Sweden means a special right to support for preservation of culture and language, and also some influence on Sami policy issues [Sametingslag (1992:1433)]. Many traditional rights, such as hunting and fishing in traditional geographical areas, are, however, legally reserved for Sami who are members of a reindeer-herding association (in Swedish, sameby), and thus not available for other Sami, e.g. settled, fishing, or urbanized Sami [Rennäringslag (1971:437)].

The exact numbers of Sami in Sweden or in other parts of Sapmi are unknown, but official estimates are shown in Figure 1. In Sweden, defining the Sami population is a particularly complicated task, since ethnical registration has been forbidden by law since 1945. Despite this, a population of 36 000 Swedish Sami (1998) has been identified for research purposes, by linking so called "index Sami", described in more detail in Methods, defined as either reindeer-herding Sami, people belonging to households with reindeer herding as a significant source of income, or Sami eligible to vote for the Sami Parliament, as well as their relatives and immediate family (7)(p.107-26). In contrast, in 2009, the electoral register for the Swedish Sami Parliament included less than 8000 people (www.sametinget.se, accessed 23 January 2012).

1.3 Sami health

According to a recent review in the Lancet, the common case among the more than 370 million indigenous people of the world is having a larger amount of health related problems than their surrounding majority societies (8). However, in the sparsely populated Sami area of northern Fennoscandia, the indigenous people do not differ much in life expectancy from the majority population (9, 10), and actually show lower risks of dying from cancer, except in Swedish Sami women (11). In Sami men, a

Figure 1. The Sami area of northern Fennoscandia and official estimates of the indigenous Sami population.

significantly lower cancer incidence has also been shown, especially pronounced in reindeer-herding Sami (10, 12, 13). Diabetes, cardiovascular disease, and alcohol abuse, common problems within other indigenous populations (8, 14), are also not clearly associated with Sami ethnicity in Sweden (15-18). In Norway, obesity is more common among Sami women and less common among Sami men compared with the majority population (19).

A limited number of studies have attempted to elucidate the underlying causes for the health disparities, and lack thereof, between Sami and non-Sami. For example, underdiagnosis and socionomic factors have been excluded as likely explanations for differences in cancer and CVD risks, respectively (12, 17). Both genetic factors and lifestyle factors such as diet and physical activity has been suggested as an explanation (10, 18). Regarding health care services and social security systems, Sami and non-Sami inhabitants of Sweden are treated equally.

Looking at problem areas overrepresented among, or specific for, reindeer-herding Sami people today, such as depression, anxiety, headache, musculoskeletal pain, accidents related to outdoor activity, carnivore-induced stress (related to the impact of carnivores, such as wolves, on the reindeer herd), and ageing as Sami, some studies have been carried out in Sweden (10, 20-25).

The United Nations Special Rapporteur has criticized the limited knowledge of the health situation of the Sami in Sweden, and recommended the establishment of a Sami health research unit within the Swedish Ministry of Health (26). To date, no such unit has been established.

1.3.1 Historical perspective on Sami health

In a historical description from the 1600's, Sami people are characterized by longevity, vitality, strength and health: *"Och såsom the icke synnerligen weeta af Swåre siukdomar: altså warda the gamble och komma till een stoor ålder, somblige till 70. 80. 90. ia och 100 åhr och ther öfwer, och äro the och i sin ålder wijge och snälle att giöra sitt wärck arbete, och att Reesa och lööpa i Skogh och i marck; gråna doch ganska sällan."* [1](27)(p. 56*)* However, the reliability of this description may be questioned, since the report might have been aimed to please Swedish authorities, rather than to provide a true picture of the health and life expectancy of the Sami people. Recent research has shown that during the 1800's, Sami people had an increased all-cause mortality compared with non-Sami (28). These differences decreased towards the end of the century (28). When excluding infant and childhood mortality, some Swedish Sami groups had longer life expectancies than the non-Sami during the later parts of the 1800's (28, 29).

In 1929-1931, the nutritional status in the northern Sweden population was generally better in Sami core areas than in the coastal regions (30), though school children from the village of Tärna were described as being thin due to

Table 1. Age distribution and median age of Swedish Sami, 31 December 1945 (N=5278), in comparison with the entire Swedish population and the population of the three northernmost counties of Sweden (31).

Age Years	Sweden %	Northern Sweden[1] %	Sami[2] %
0-15	21.8	27.4	21.1
15-30	22.4	24.5	22.1
30-50	30.5	27.7	26.7
50-65	15.5	12.8	17.4
>65	9.8	7.6	12.7
Median age, years	34	29	35

[1] The counties of Jämtland, Västerbotten and Norrbotten.

[2] Defined by connection to Sami language, either as first language, or as language spoken within the family, N=5278.

[1] And they do not know serious disease, thus they become old and reach a great age, some 70, 80, 90, even 100 years and more, and in old age, they are agile and quick in their work, and travel and run in the forest and terrain; rarely become gray haired. Translation by Lena Nilsson.

miscegenation with Sami (Part 1, Chapt 5, p. 65). Relatively high hemoglobin levels of the inland population were also explained by miscegenation with Sami (Part 1, Chapt 5, p. 9).

In the 1945 census, mortality was not specified for different ethnic groups, but people with connection to Sami language showed a higher median age and a higher proportion of elderly people compared with other inhabitants of northern Sweden (Table 1).

Between the years 1946 and 1955, an approximately 50% lower risk of dying from cancer or CVD was noticed in the northernmost Sami villages of Sweden in comparison with settlers from the same area (32). In contrast, infant- and childhood mortality was higher among these Sami (32). Since then, no generally increased mortality has been noted among Sami people in Sweden (9, 33, 34). In other Nordic countries, similar Sami health patterns have been found (35, 36).

The relatively equal health status of the Sami people in comparison with the majority population, unique among indigenous peoples, and the lower incidence of cancer among Sami, raises the question of potential health impacts associated with a Sami lifestyle.

1.4 Epidemiology

The research field of epidemiology is connected to public health and may similarly be defined in a positive way, as research *"concerned with the distribution and determinants of health and disease in defined populations with the ultimate aim of controlling and preventing disease occurrence"* (37) (p. 0).

Epidemiological investigations often entail observations and comparisons of people with and without a disease of interest. A classic example from Northern Sweden is the association between high childhood mortality from diarreal disease and lack of breast feeding, which was discovered by the general practitioner CJ Wretholm in Haparanda in the 1830's, by observing the infant care habits of the population. After a breast-feeding promotion campaign, infant mortality in Haparanda decreased by 50 % (37) (p. 8).

In years past, epidemiological conclusions were generally drawn like this from observations on a population level, which is referred to as "ecological studies" or "correlation studies". In cohort studies and case-control studies,

individual data are used instead. When these data are collected after disease occurrence, the study is called retrospective. When data are collected before disease occurrence, the study is called prospective. Prospective studies thus require large sample sizes, since it is impossible to know in advance who will be acquire or die of the disease to be studied.

The main advantage of a prospective design is that recall errors are avoided. For example, it is easier to report on current tobacco use, than to recall tobacco consumption 20 years ago. And efter being diagnosed with lung cancer, memories of smoking may be unconsciously reconstructed. Onset of a disease may also affect lifestyle factors such as tobacco use, diet and physical activity, which further increases the value of a prospective design. In this thesis all epidemiological analyses are based on prospective data.

1.5 Nutritional epidemiology.

Nutritional epidemiology is a research field dealing with aspects of diet (food items, nutrients or dietary patterns) assumed to influence the occurrence of human disease (38). In classic studies, focus was generally on deficiency diseases, where associations between diet and disease were easy to demonstrate, such as lack of C vitamin in sailor's diet and scurvy (38).

This was also one of the focuses in the "Norrlandsundersökningen", a large multi-center study performed in northern Sweden 1929-1931, in which also anemia, rickets, and malnutrition were studied in relation to dietary habits and lifestyle in the northern Swedish population (30). Today nutritional epidemiology has shifted attention toward the major chronic diseases of Western civilisation, primarily cardiovascular disease, cancer, and diabetes. These diseases all have in common that they are extremely complex with relatively low frequencies (from a statistical perspective), long latency periods, unclear etiology and multiple causes, making confounding a problematic issue.

Confounding occurs when an appearant association is not necessarily due to the factors examined, but to related factors. For example, associations between total energy intake and measures of body composition, such as mass index (BMI), may be confounded by factors such as physical activity or genetic predisposition. In addition to confounding, risk associations may also be affected by factors in the direct causal pathway between exposure and outcome, referred to as intermediate variables or effect mediators. Effect

modifiers are variables that interact with the exposure variable, affecting the association between exposure and outcome differently at different levels.

1.5.1 Measurements of dietary exposure

A further challenge in nutritional epidemiology is the adequate measurement of dietary exposures (39). One common method is the registration of food intake of individuals over a defined period, through 24-hour recall interviews or individually administered food records, for example. The assumption that the period chosen is representative of the individual's general diet represents the main weakness of this method, since food items that are not consumed on a daily basis will only sporadically be captured. Another weakness is the great economical resources and time required to achieve large, population-based research databases.

Food frequency questionnaires (FFQ) have the advantage of being a relatively inexpensive, standardized means of including large numbers of people (38) (p. 74). In an FFQ, a food list is combined with a frequenzy specification for each food in the list, with the aim of describing the general diet of the individuals over a given time period, often the previous year. Information on portion sizes, seasonal variation, and other types of specification may also be included.

A main limitation of FFQ methods is that unless open-ended questions are included, only food items asked for will be reported, which means that the FFQ will not necessarily reflect the complete energy and nutrient intake of all individuals, especially not of individuals with a very deviant or unstable dietary pattern. Further, a FFQ is culture-specific, which means that even within a population, it can perform differently within different demographic groups and sub-cultures (38) (p. 102). Despite all limitations, FFQ methodology is currently the primary method for measuring dietary intake in epidemiological studies (38) (p. 91), and has been shown to be a valid method for ranking study subjects with respect to dietary intake.

1.5.2 Adequate reporting

Adequate reporting is difficult to achieve in FFQ, 24-hour recall and food records. For example, it has been shown that subjects with higher social desirability and higher eating restraint are especially likely to underreport their dietary intake (40).

A means of assessing dietary intake beyond the limits of adequate reporting is the use of indirect methods, i.e. biochemical indicators as biomarkers of

intake. For example, plasma concentrations of the metabolite alkylresorcinol have recently been shown to be a good biomarker for whole grain wheat and rye intake in free-living populations (41). Indirect methods are also used to validate other dietary assessment methods. By using the so called doubly labelled water method, very precise estimates of energy expenditures may be achieved (42), which can be compared with energy intake from food items reported.

Even if an ideal dietary assessment method did exist, together with a population of only truth-tellers and adequate reporters, changes in diet would inevitably occur over time. One way of assessing temporal changes is repeated measures. Stratification by time units is another.

1.6 Determinants of health

According to the World Health Asociation (WHO), the general determinants of health include *"the social and economic environment, the physical environment and the person's individual characteristics and behaviours*" (43).

The term "social and economic environment" refers to factors such as income, social status, education, culture, and the distribution of welfare. For example, in the United States, the health impact of economic inequality is manifested by poor people showing a fourfold use of hospital days compared with the rich (44). The term physical environment refers to factors such as housing conditions, climate, pollution, vegetation, and availability of fresh water and food. For example, in Canada, the Inuit people have the highest measured levels of almost all persistent organic pollutants compared with other inhabitants in the Arctic region (45). This is due to high consumption of marine mammal fat in which such pollutants are concentrated, and resultant detrimental effects on the public health of the Canadian Inuits have been reported (45).

In Sweden, the socioeconomic and physical environments of the Sami and non-Sami populations are similar (10). In contrast, differences in individual characteristics and behaviors, i.e. both genetics and lifestyle, still exist (10, 46). This thesis focuses solely on lifestyle differences, primarily dietary, between Sami and non-Sami.

1.6.1 Diet as a determinant of health

Lifestyle and diet are related to health and wellbeing in many ways. We all know that starvation may lead to malnutrition, that lack of vitamins may lead to deficiency diseases, and that over-eating is one of the main causes of chronic diseases in Westernized countries today. Despite the methodological limitations of nutritional epidemiology, estimates suggest that approximately every third cancer death is linked to diet (47). It has also been claimed that a majority of CVD in Western countries could be prevented by adequate dietary and lifestyle changes (48).

However, elucidating the dietary factors or patterns that contribute to or help prevent the development of these diseases has proved to be a major challenge. Several inconsistencies exist, especially with respect to the role of specific nutrients in health and disease. For example, cohort and case control studies have suggested a reduced risk of cardiovascular events with intake of vitamin E, whereas randomized controlled trials do not support any unambiguously beneficial effect (49).

A dietary pattern may be defined by a combination of different foods, beverages, and macronutrients. Over the last decade, dietary patterns have received much attention, since they seem to better capture the diet than single nutrients. Dietary patterns may be explored using statistical methods, such as factor analysis, principal component analysis, and cluster analysis, or by diet scores, described in more detail below. Compared to individual nutrients, dietary patterns are considered more relevant for public health recommendations, but less relevant for understanding underlying mechanisms (2).

1.6.2 Dietary patterns as determinants of health

Several dietary patterns have been studied in relation to health. Culturally defined dietary patterns, for example, the traditional diet of the Mediterranean area, i.e. high ratio of monounsaturated to saturated fat, moderate alcohol intake, high legume intake, high intake of grains (including bread and potatoes), high fruit and vegetable intake, low intake of meat and meat products, and moderate intake of milk and other dairy products, has been used as a model for healthy eating and applied on many different populations worldwide (50).

Other culturally defined dietary patterns are “Asian”, with a low total energy intake and a high content of vegetables and spices; “Paleolitic”, so called Stone-Age, including fish, meat, roots, and nuts, and excluding grains,

resulting in a diet high in protein and low in carbohydrates; and "Western", characterized by high intakes of red meat, sugary desserts, high-fat foods, and refined grains (51, 52). In recent years, demands have arisen for the establishment of practical recommendations for healthy eating more tailored to regional food cultures (53), such as "healthy Nordic" diet, an adaption of the Mediterranean diet to the dietary traditions of the Nordic countries, defined by high intakes of fish, cabbages, whole-grain rye, whole-grain oats, apples, pears, and root vegetables (54). Within a given population, culturally food patterns may also be identified by mathemathical models e.g. by cluster and principal component analysis. These patterns are by definition population specific.

There is convincing evidence for a beneficial effect of a Mediterranen dietary pattern on major chronic diseases, and a detrimental effect of a Western dietary pattern (50, 51, 55). Asian, healthy Nordic and Paleolithic diets have been examined to a more limited extent, and their health-promoting potential is therefore a matter of further investigation.

Dietary patterns may also be defined according to public food recommendations, such as the Dietary Approaches to Stop Hypertension (DASH) diet, Healthy Eating Index (HEI), Recommended Food Score (RFS), and Diet Quality Index (DQI) (55). In observational studies, these and similar patterns are not unambiguously associated with increased coronary or cancer-related health (51, 55).

1.6.3 Macronutrient composition as a determinant of health

Another way of studying diet as a determinant of health is the distribution of of energy-containing nutrients, the macronutrients, which are carbohydrate (4 kcal/g), protein (4 kcal/g), and fat (9 kcal/g). Alcohol (7 kcal/g) is also rich in energy, which may contribute to total energy intake depending on individual habits.

Carbohydrates provide energy to the cells in the body and give volume to the intestinal content. Sugar, fiber and starches are all different kinds of carbohydrates with different effects on health. While refined sugar can be considered as pure energy, many micronutrients are attached to less refined carbohydrates, and a high fiber intake, which passes through the gastrointestinal tract largely undigested, has been associated with a reduced risk of heart disease (56) and many types of cancer (51). The glycemic effect of carbohydrates, that is their effect on blood sugar levels, have also been shown to have a health impact (57).

Protein in the diet is essential as a structural component for body construction and reconstruction but can also contribute to energy. Lately much attention has been given to high-protein diets for weight loss. Whereas a lower limit for daily intake to avoid protein deficiency has been defined (>0.8 g/kg weight)(58), no established upper limits for recommended protein intake exist.

Fat in the diet provides energy to the body, and is also essential as a carrier of the fat-soluble vitamins A, D and E. While poly-unsaturated and mono-unsaturated fatty acids (PUFA and MUFA) are essential for the body, consumption of saturated fat, mainly of animal origin, has generally been connected with increased risk of CVD (58). However, this is to some extent a matter of controversy. In a recent meta-analysis of prospective epidemiologic studies no associations between intake of saturated fat and CVD or coronary heart disease were shown (59), while in a meta-analysis of randomized controlled trials, replacement of saturated fat by PUFAs was associated with a 19 % reduced risk of coronary heart disease (60).

The proportions of carbohydrate, protein and fat have in health research been modelled as: low-carbohydrate (LC) diets, low-carbohydrate, high-protein (LCHP) diets, and low-carbohydrate, hig-fat (LCHF) diets. Generally, LC diets have tended to be associated negatively with long-term health outcomes, at least when the main source of protein and fat is animal (61-64). However, since only few observational, and no interventional studies on long-term effects of LC diets, have been presented to date, and since different LC diets have achieved much attention as a method of weight control, there is an apparent need of further exploration of the health impact of carbohydrate restriction.

1.6.4 Coffee as a determinant of health

Coffee may be one of the most studied beverages in the world, and has actually been shown to be the major source of antioxidants in some Western countries (65). Further, coffee is connected to many health claims and has been suggested to be associated with both benefits (e.g. reduced risk of diabetes II, and some cancer types)(66) and risks (e.g. in CVD) (66, 67). Proportions of components of coffee with suggested health impact, i.e. diterpenes, antioxidants and caffeine, are affected by brewing techniques (68).

Filtered coffee is prepared by running sub-boiling water (preferably 92-96^{o}C) through a filter containing finely ground, roasted coffee beans. As a result of filtering, levels of diterpenes are relatively low (68). Diterpenes cause

elevation of cholesterol levels (69, 70), a common risk factor for CVD (71). From a cancer perspective, both diterpenes and polyphenols may have a protective effect (72). Polyphenols are also considered protective for CVD, because of their antioxidant effect (65). Caffeine, the stimulant of coffee, has shown weak negative effects on CVD (73) and equivocal effects on cancer (72).

The procedure of preparing boiled, unfiltered coffee, illustrated in Figure 2, allows for a much higher diterpene content than filtered coffee (68). A mixture of coarsely ground coffee and fresh water is heated to a boil and then removed from the source of heat to settle before serving directly into the cup.

Other components of coffee, i.e. caffeine and polyphenols, are also described as dependent on brewing technique, but not with respect to drip-filtered versus boiled coffee (74).

Studies exploring health effects of coffee prepared by alternative brewing methods are rare (75-80).

1.7 Diet in the Sami population

Given that the Sami culture varies within the Sami area, it is a difficult task to define a uniform "traditional Sami" diet. Changes over time complicate this task further.

The Sami diet prior to the 1800's has been described as being much higher in meat and fish, and much lower in cultivated vegetables and bread than today (27, 81, 82). A macronutrient composition based on historical descriptions and estimated as % of energy has been suggested to include 16-27 % carbohydrates, 50-56 % protein, and 32-46 % fat (81). Historical sources also describe a widespread use of wild herbs, consumption of reindeer milk, blood and organ dishes (27, 82). In historical sources from the 1600's, it is also stressed that Sami men, not women, were responsible for cooking in the homes (27). Some descriptions also point out similarities between the Sami diet before the 1800's and that of stone-age hunter/gatherers (32), today often referred to as a Paleolithic diet.

The main characteristics of a Paleolithic diet is absence of grains, e.g. bread and porridge (52, 83), a food group introduced in the Neolitic era, which occurred in Scandinavia about 4500 years ago. In contrast to a Paleolithic diet, bread and cereals have been available in the Sami area for at least 200

Figure 2. Preparation of boiled coffee in an outdoor situation.

years by trade (4). There is also a genuine Sami word for flour "jafo", with no connection to old Norse language, which has been interpreted as grains being available in the Sami area before the cultural exchange with Nordic people begun, i.e. 200 A.D. (82) (p. 154).

In the 1920's in Russia, Sami people were estimated to eat about 70 kg fish and 120 kg reindeer meat per person and year (84), wich may be compared with the Swedish average consumtion of 30 kg fish and 60 kg meat per person in the year 1990 (85). Compared to other reindeer-herding circumpolar peoples, lake and river fish has been more important in the diet of the Sami (84).

Swedish studies on Sami diet in the early 1930's are more focused on macronutrient composition than concrete food items (81, 86, 87), suggesting a macronutrient distribution, estimated as % of energy, of 20 % carbohydrates, 47 % protein, and 33 % fat. A description of the diet of the general population in northern Sweden in the 1930's includes concerns about lack of vegetables and wild berries in the diet, and widespread "*coffee abuse*"(30). According to a recent report by the Sami Parliament, reindeer milk was an important component of the Sami diet prior to the 1930's, after which it was gradually replaced by goat milk as a consequence of the increasing commercialization of the reindeer meat industry (88).

In 1961, the diet of Finnish Sami was investigated in an analysis of health effects of radionuclide fall-outs in the polar area (89). In that study, a complete absence of vegetables among Finnish Sami was described, and a very low consumption of berries, compared with local non-Sami, the latter eating in average 4.7 kg fruits and berries per month. Fish was mainly eaten in the summer and meat in the winter. During the winter, a reindeer-herding man consumed in average about 20 kg reindeer meat per month. Meat and

fish consumption among reindeer-herding Finnish Sami were more than four times higher than in a reference rural population and a control group of Helsinki inhabitants (89).

The present-time diet of reindeer-herding Sami has been described as being high in meat, especially reindeer meat, fish and fat, and low in vegetables (88, 90, 91). Macronutrient characteristics include lower proportions of carbohydrate and higher proportions of protein and fat intake compared with non-Sami (81, 90), with a suggested macronutrient composition (% of energy) of 42 % carbohydrates, 18 % protein, and 39 % fat (81). A high intake of boiled, unfiltered coffee is another characteristic with strong and deep cultural roots (91, 92). In present-day scientific descriptions of Sami diet in Sweden, which have largely focused on macronutrient composition, coffee preferences and animal food sources have not been specified in detail and consumption of blood and organ dishes, such as liver and kidney, has not been described at all (90). In a recent ethnological thesis however, the strong cultural importance of boiled coffee in Sami traditions has been noted, e.g. an elderly reindeer-herding Sami takes farewell to the landscape before dying, by visiting places of emotional importance together with his grandson, preparing a cup of coffee at each one of them (92)(p. 9).

1.7.1 Sami diet as a determinant of health

To summarize the epidemiological evidence for characteristic Sami dietary elements in health, there is probable evidence for detrimental effects of low intakes of fibre and vegetables in colorectal and stomach cancers respectively, and of high intakes of red and processed meat in colorectal cancer (51). From a cardiovascular perspective, caution with saturated fat, whole grains as the main form of carbohydrates, and abundance of fruits and vegetables has been promoted for reducing risk (48). Fish, especially fatty fish, may reduce the risk of coronary death and total mortality, and may favorably affect other clinical outcomes (93). With respect to more specific traditional foods in relation to health, current knowledge is limited. Reindeer meat is lean and has a higher n-3 fatty acid and antioxidant content than commercial beef (94-96), but the role of reindeer meat in health in unknown, and compared to fatty fish, the levels of n-3 fatty acids in reindeer meat are very low (96). Although a health-promoting effect of berries has also been shown (97), to the best of my knowledge, traditional herbs have not been studied in relation to health endpoints. Reindeer milk, which is richer in fat and protein than cow milk (32), has also not been related to health endpoints.

1.7.2 Other Sami-related lifestyle factors as determinants of health

There is convincing evidence for a protective effect of physical activity in colorectal cancer, and probable evidence for a similar effect in breast and endometrium cancer (51). There is also evidence for beneficial effects of physical activity in CVD, both for general physical activity levels (PAL) (98), and specific activities such as walking (99). The traditional Sami lifestyle, as well as modern reindeer herding, includes a high physical activity level (23, 32). In the present day, there are no major differences between Sami and non-Sami in reported physical activity (19, 23), except an increased proportion af physically strenuous work in Swedish reindeer-herding Sami men (100). However, these findings may partly reflect an underestimation of physical activity by Sami (23). Norwegian Sami women have reported a more sedentary lifestyle than Norwegian non-Sami women (19). Among non-reindeer-herding Sami in Sweden, lower physical activity levels have been observed in women compared to men (100). The latter has also been suggested to explain discrepant CVD and cancer patterns in non-herding Sami women compared with other Sami (10).

From a global perspective nearly 6 million people die every year from tobacco-related illness, including more than 600 000 non-smokers (101), and alcohol is involved in 3.8 % of all global deaths and 4.6 % of all global disability-adjusted life-years (102). Within the Sami area, no differences have been observed in tobacco or alcohol use between Sami and non-Sami (15, 103-105). Exposue to wood smoke from open fires, both in the "kåta" (traditional Sami tent or hut) and outdoors, may also contribute to disease in the Sami (106). Since these topics were not a focus of this thesis, they will not be addressed further.

1.8 Overall perspective

The general idea behind Papers II-V is similar to that of the Mediterranean diet score; to define characteristics for a certain population in a certain time, and apply this on other populations. The Mediterranean diet was first described based on dietary differences observed between southern and northern Europe and the USA in the 1950's in the so called "Seven Countries Study" (107), in which a lower incidence of CVD was found in the southern European area. In 1995, a Mediterranean diet score was constructed based on eight selected dietary components and applied on mortality data from elderly people in three Greek villages (108). Since then, many studies on

Mediterranean score have been carried out in populations within and outside Europe (50).

The frames of this thesis are the small differences in health status between Sami and non-Sami people, and the lower incidence of cancer. In Paper I, the focus on the 1930-50's was chosen because it was the earliest time period of lived experience of a Sami lifestyle available today. In addition, other studies describing this period were available, it was a period of great change for the Sami, and the adult generation of this period provide the basis for the reports comparing mortality and cancer rates. In Papers II-V, characteristic components of a Sami lifestyle were defined by the diet and lifestyle of Sami of southern Lapland in the 1930-1950's, as well as by historical sources addressing earlier time periods. In this region, the mountain Sami culture was (and still is) characterized by seasonal reindeer movements over great distances, even from a Sami perspective (up to 400 km single way), the forest Sami culture was (and still is) on decline, and a large number of Sami had (and still have) Swedish as their first language. During the 1930's the Sami population of southern Lapland was also expanded by migrating northern Sami, relocated by force to the area for policy reasons. The local Sami culture was also affected by the Second World War and by a snowcover-related reindeer-herding crisis in the 1930's.

In this thesis, characteristic elements of this Sami culture were applied on a general northern Swedish population. Thus, I have studied a majority population from a minority perspective.

2. Objectives

The overall aim of this thesis was to investigate associations between different aspects of a "traditional Sami" lifestyle and health in a general northern Swedish population. The specific aims of each paper were:

1. To define and describe Sami diet and lifestyle characteristics in southern Lapland 50-70 years ago and today. (Paper I)
2. To investigate a "traditional Sami" dietary pattern in relation to all-cause, cancer and CVD mortality in the population of Västerbotten in northern Sweden. (Paper II)
3. To investigate a low-carbohydrate, high-protein (LCHP) diet score in relation to all-cause, cancer- and CVD mortality in the population of Västerbotten in northern Sweden. (Paper III)
4. To investigate consumption of boiled and filtered coffe in relation to cancer incidence in the population of Västerbotten in northern Sweden. (Paper IV)
5. To investigate consumption of boiled and filtered coffe in relation to the risk of first acute myocardial infarction in the population of Västerbotten and Norrbotten in northern Sweden. (Paper V)

3. Materials and methods

In this thesis, one paper was providing a descriptive background of a "traditional Sami" diet and lifestyle (Paper I). The other four were epidemiological, prospective, observational studies (Papers II-V).

3.1 Study population

Paper I, conducted to define Sami diet and lifestyle elements to be applied to the Västerbotten population, was based on interviews with 20 elderly Sami from southern Lapland, i.e. the communities Lycksele, Malå, Sorsele, Storuman, and Arvidsjaur, and a subpopulation of present time Sami in Västerbotten, defined by previous research at the Southern Lapland Research Department in Vilhelmina (7).

All epidemiological analyses (Paper II-V) were based on the population of Västerbotten County of northern Sweden. In one study (Paper V), the population of Norrbotten County was also included. With population densities of 5 (Västerbotten) and 3 (Norrbotten) inhabitants per square kilometer, these two counties, the northernmost in Sweden, are among the most sparsely populated areas in Europe.

Approximately 15% of the Swedish Sami population live in Västerbotten and 50% live in Norrbotten (10). Of a total of 19 Sami administrative municipalities[2] (January 2012), in which Sami language and culture are legally entitled to support from the local community, seven are situated in Västerbotten (Dorotea, Lycksele, Malå, Sorsele, Storuman, Umeå, Vilhelmina), and five in Norrbotten (Arjeplog, Arvidsjaur, Gällivare, Jokkmokk, Kiruna).

3.1.1 The Västerbotten Intervention Programme

The Västerbotten Intervention Programme (VIP) is an ongoing cardiovascular preventive health screening. It started in 1985, as a collaboration between researchers and health care practitioners in the municipality of Norsjö, and has thereafter gradually expanded, covering the entire county of Västerbotten since 1991. In VIP, residents of Västerbotten turning 40, 50 and 60 years of age are invited to their local health care center to complete a diet and lifestyle questionnaire, to undergo a medical

[2] In Swedish, förvaltningskommuner

examination including measurements of blood pressure, glucose tolerance, serum cholesterol, triglycerides and anthropometry, and to donate a blood sample for future research. Over the years, some 70 year olds have also been included. Until 1996, residents 30 years of age were regularly invited. From 1996 until year 2008, some health care centers have continued the recruitment of 30 year olds to the VIP as shown in Table 2.

Table 2. Number of participants, by year and age, in the VIP cohort 1991-2008, including repeated measures.

Age group	Time periods						
(±5 years)	1991-1993	1994-1996	1997-1999	2000-2002	2003-2005	2006-2008	Total
30 years	2875	3441	773	160	169	112	7530
40 years	4279	5808	5644	5631	6304	6591	34257
50 years	5027	6174	6794	6616	6673	6741	38025
60 years	3818	4712	5135	5601	6865	7197	33328
70 years	0	47	1	5	1	12	66
Total	15999	20182	18347	18013	20012	20653	113206

To date, there is no detailed description of the 30 years old participants recruited after 1996. However, personal contact in April 2009 with 9 of the 15 health care centers involved suggested that no deliberate selection of these participants has occurred.

The participation rate to VIP, calculated as the proportion of the available population in each age group, has varied between 48 and 67 percent (109). Calculated as proportion of invited subjects, the participation rate would probably be considerably higher, since recruitment to the VIP has varied among health care centers, according to personal communication with a previous worker at the project database. Despite this, little evidence of selection bias has been found (110). Furthermore, cancer incidences demonstrate essentially no differences between the VIP cohort and the population of Västerbotten, indicating a truly population-based cohort (111).

Fasting blood samples from the VIP participants are collected and stored in -80^{o}C freezers at the Medical Biobank, originally organized and run by the Department of Nutritional research, Umeå university, and the principal investigator Göran Hallmans (112, 113), but now administered as a part of the Västerbotten County Council's health care laboratory organisation.

Questionnaire dietary data from the VIP are continuously quality assured and processed in the diet-VIP database, run by the principal investigator Ingegerd Johansson.

3.1.2 The Northern Sweden MONICA study

The Northern Sweden MONICA study (Multinational Monitoring of Trends and Determinants in Cardiovascular Disease) is a part of an international multicenter study run by the World Health Organisation (WHO), with the aim to monitor trends and determinants in cardiovascular diseases. During the years 1986, 1990, 1994, 1999, 2004 and 2009, between 2000 and 2500 randomly selected participants in the counties of Norrbotten and Västerbotten, 25-74 years of age, have been invited to a health screening similar to VIP. In this thesis, data from the MONICA screening 1986, 1994 and 1999 were used (Paper V). During these years, participation rates in MONICA, calculated as proportion of invited subjects, has varied between 71 and 82% (114). The data collection and blood sample collection and handling procedures of the MONICA project are very similar to those of the VIP.

3.1.3 The Swedish Sami Cohort

At the Southern Lapland Research Department in Vilhelmina (1995-2011), founded by the Västerbotten County Council and seven of the municipalities in southern Lapland (Dorotea,Malå, Lycksele, Sorsele, Storuman, Vilhelmina and Åsele), a database of Swedish Sami has been constructed by identifying Sami from the Sami Parliament's electorial registers of the years 1993 and 1997, the Department of Agriculture's registers of reindeer-herding companies of the year 1998, and the population censuses 1960-1990 administered by Statistics Sweden's data on occupation and main source of income. Index Sami were thus defined as people with a considerable economic involvement in reindeer herding and/or eligible to vote for the Sami Parliament. The National Kinship Register was used to identify relatives of these index-Sami, including forfathers, siblings and children, who also were added to the Sami database. The final database included 41 721 Sami, of whom 5699 were index-Sami (7).

In this thesis, the Swedish Sami Cohort was used to identify Sami within the VIP cohort.

3.1.4. Interview respondents

For the interviews, Sami women and men over 60 years of age from southern Lapland were invited by posted letter in 2008. All were suggested either by local reindeer-herding associations, local Sami associations, or the management of forest commons Tärna/Stensele, in which many settled Sami are active.

3.2 Study design and study subjects

Study designs involved in this thesis were one semi-qualitative interview study combined with quantitative comparisons on Sami and non-Sami groups, three prospective cohort studies and one prospective nested case-referent study.

3.2.1 Paper I

Paper I reports a semi-qualitative interview study combined with quantitative comparisons of Sami and non-Sami groups.

Of the 37 women and men who were invited to participate in the interviews, 23 elderly Sami, from the communities of Arvidsjaur, Lycksele, Malå, Sorsele and Storuman, agreed to participate. However, at the time for interview, one man did not answer the phone, one woman was out hiking in the mountains for an unplanned numbers of days, and one woman had to seek acute hospital care.

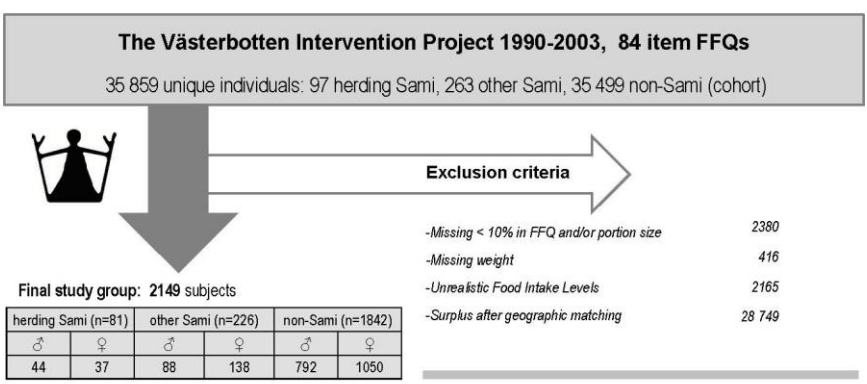

Figure 3. The selection of present-day Sami and geographicly matched non-Sami with 84-item VIP FFQs.

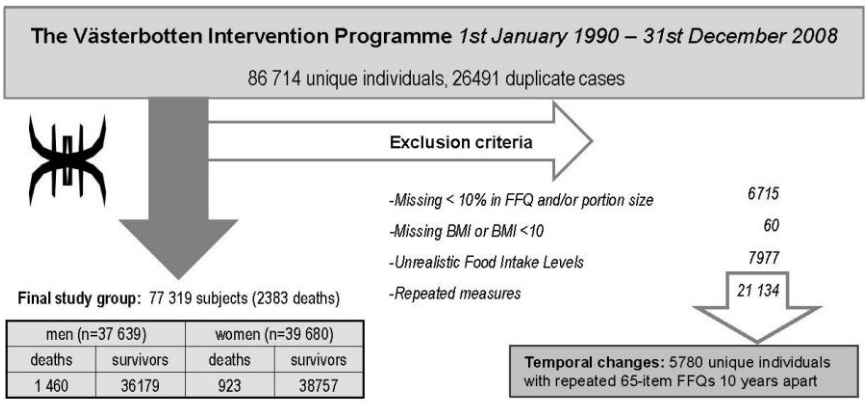

Figure 4. Selection of the study population of the mortality dataset used in Paper II and III.

In some cases, the remaining 20 informants had grown up in different places than their present residences, and so the Vilhelmina area of southern Lapland was represented, and the Nederluleå area of Norrbotten. Ages of the informants ranged from 63 – 89 years.

In June and July 2008, a first round of interviews with 20 elderly Sami (11 men, 9 women) was conducted. When summarising the interviews of 2008, some follow-up questions arose. Thus, a second interview round was performed in spring, 2009. Finally the informants were invited to share the results in autumn 2010, before publishing.

In two cases, siblings, differing by about 10 years in age, were interviewed about the same parent. In both cases, only the interview with the older sibling was used for box plot comparisons.

The selection of the VIP data used for box-plot comparisons and for analyses of present time dietary habits of groups of Sami and geographically matched non-Sami is shown in Figure 3. In this data-set, Sami were defined by linking the VIP FFQ with data from the Swedish Sami cohort.

3.2.2 Papers II, III, and IV

Papers II, III, and IV are cohort studies, in which mortality endpoints (Papers II and III) or cancer incidence data (Paper IV) were identified by linking the VIP database with the Swedish national cause-of-death registry or the regional cancer registry in northern Sweden, respectively. In the mortality studies (Papers II and III) a total of 37 639 men (1460 deaths) and 39 680 women (923 deaths) were selected, as shown in Figure 4. Repeated

sampling occasions (10 years after the first occasion) were kept until the last step of the selection, in order to preserve power. In Figure 4, the selection of subjects for the sub-analyses of temporal changes is also shown.

In the cancer incidence study (Paper IV), a total of 32 425 men (1495 cases) and 32 178 women (1539 cases) were selected. The selection of a study population for Paper IV is shown in Figure 5. Fewer FFQs were available compared to Papers II and III, and repeated measures were excluded in the first step of the selection.

3.2.3 Paper V

Paper V was a prospective nested case-referent study of first acute myocardial infarction in the VIP and MONICA cohorts. Prospective cases of first AMI were identified from the population-based MONICA registry, in which all cases were verified by screening of hospital discharge records, general practitioners´ reports, and death certificates using standardized WHO and MONICA methodology(114).

Inclusion criteria for cases were no previous AMI or stroke, no cancer diagnosis within the five years prior to or one year after AMI, and at least one matching referent. For each case, up to five verified referents that were alive and free from AMI, stroke, and cancer at the time of diagnosis of the index case were randomly selected. The referents were matched to their index cases by sex, age (+/-2 years, generally +/- 1 year), date of health

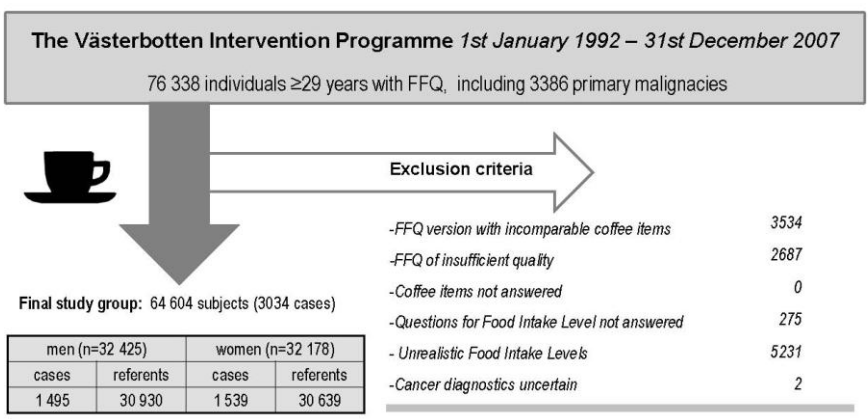

Figure 5. Selection of the study population of the incident cancer dataset used in Paper IV.

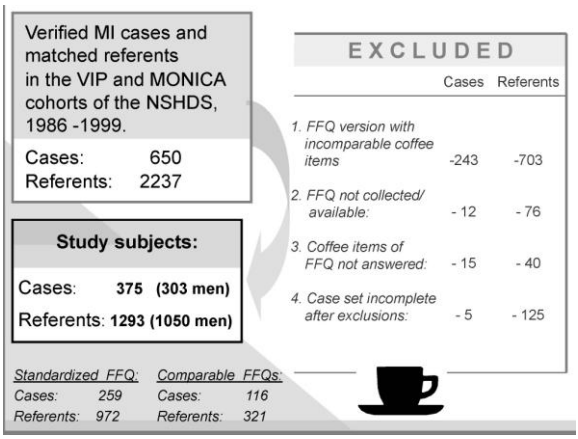

Figure 6. Selection of the study population of the case-referent dataset used in Paper V, reproduced with permission from Nutr Metab Cardiovasc Dis (115).

survey (+/-4 months) and geographical region. Subjects with missing values for any of the coffee items (boiled coffee, filtered coffee) were excluded from the study. The selection of the dataset for this case-referent study is shown in Figure 6.

3.3 Food frequency questionnaire

In the present thesis, four different versions of the FFQs were used; 3 from the VIP and 1 from the MONICA study. From the diet-VIP database the original 84-item VIP FFQ (in use 1992-1996), an older, nearly identical, 84-item FFQ (in use 1990-1992), and the most recent 64-item version (in use since 1996) were used. In the latter, most foods were unchanged from the 84-item versions, some food groups were deleted, and some similar food groups were merged. Similarities and differences among the VIP FFQ versions are summarized in Table 3, with the original 84-item FFQ as a reference. The MONICA FFQ, nearly identical to the original 84-item VIP FFQ, was used in Paper V.

In all 4 versions of the FFQ, intake of food items are estimated on a 9 level fixed scale: never, a few times/year, 1-3 times/month, 1 time/week, 2-3 times/week, 4-6 times/week, 1 time/day, 2-3 times/day, ≥4 times/day. Meal-time portion sizes are estimated with the aid of four colour photographs of a plate containing proportionally increasing amounts of food stuffs representing vegetables and main sources of carbohydrate (for example, rice or pasta) and protein (for example, meat or fish).

Table 3. Differences and similarities between three FFQ types used within the VIP project 1990-2008. Food items (translated to or described in English) are numbered and described according to the original 84-item FFQ used 1992-1996. Items differing within the older 84-item FFQ (old) and the most recent 64-item FFQ (64) are marked with (x) and missing items are marked with (-) in the columns.

Food items included in all FFQs (n=47)	Food items differing in Old[1] and/or 64[2] (n=37)	Old[1]	64[2]
1. 68% butter/32% canola oil, on bread,	12. white soft bread	x	x[4]
2. butter on bread	13. white crisp/flat bread (northern Swedish type)	x	
3. light margarine (40% fat) on bread	15. hard cheese, 28% fat (medium fat)	x[4]	x
4. margarine (80% fat) on bread	16. hard cheese, 10-17 % fat (low fat)		x
5. butter in cooking	17. cream cheese, soft cheese spread	x	-
6. margarine (80%fat) in cooking	18. whey cheese	x	
7. oil in cooking	19. sausage as sandwich topping	x	x[4]
8. salad dressing with oil, vinaigrette	21. liver paté	x	
9. cream, crème fraiche, sour cream	22. porridge, oatmeal	x	x[4]
10. whole grain, high-fibre crisp bread,	23. porridge, graham-, rye- or barley	x	
e.g. husmans bread (rye)	27. whole grain cereals, e.g. musli	x[4]	x
11. whole grain high-fibre soft bread,	28. Corn flakes, low-fibre cereals.		x
14. sweet buns, rusk	30. apples, pears, peaches	x[5]	x[4]
20. meat as sandwich topping	31. orange, mandarin, grapefruit	x	
24. rosemary or juice soup, fruit cream	33. cabbage	x	x[4]
25. soured milk, yoghurt, 3% fat	36. lettuce, Chinese cabbage	x[5]	
26. soured milk, yoghurt, 0,5% fat	37. spinach, kale	x	
29. berries, fresh or deep frozen	38. frozen mixed vegetables	x	-
32. Banana	40. fried potatoes	x	x[4]
34. root vegetables, carrots	41. french fries	x	
35. tomato, cucumber	42. mashed potatoes	x	
39. potato, boiled or baked	43. potato salad	-	-
44. Rice	47. broth + flat bread	x	
45. Pasta	48. pancakes, waffles	x[5]	x[4]
46. baked beans, pea soup	49. potato dumplings	x	
50. Pizza	58. blood dishes	x[6]	
51. ground meat dishes	59. liver, kidney	x	-
52. beef stew	62. seafood (shrimp, mussels/clams)	x	
53. steak, chop, cuts of meat	67. sugar cubes, sugar, honey	x	x[4]
54. bacon, pork belly, ham	68. marmalade, jam	x	
55. sausage dishes	71. milk, ≤ 0,5% fat	x[3]	x[6]
56. Hamburger	73. milk, ≥ 3% fat	x[3]	x
57. Poultry	74. syrups of fruit or berries	x	x[4]
60. lean fish (perch, cod)	75. carbonated soft drinks, coca cola	x	
61. fatty fish (herring, whitefish, salmon),	76. juice	x	
63. salted fish (herring)	77. drip-filtered coffee	x[4]	x
64. smoked fish/smoked meat	78. boiled, unfiltered coffee		x
65. ice-cream			
66. sweets, e.g. chocolate, candy			
69. cakes, cookies, pastry			
70. salted snacks (chips, popcorn, nuts)			
72. milk, 1-1,5% fat	**Food items not included in the original 84-item VIP FFQ (n=3):**		
79. Tea	Egg dishes (Old + 64)		
80. beer, < 2.25 % alcohol	Pie, e.g. gound meat pie, vegetable pie (Old)		
81. beer, 2.8 – 3.5% alcohol	water (64)		
82. beer, ≥ 4,5% alcohol			
83. Wine84. spirits			

[1] the 84-item VIP FFQ, in use before 1992 [2] the 64-item VIP FFQs, in use since 1997 [3] Separate items, [4] Merged with other items, [5] More items included, [6] Fewer items included

Calculation of nutrient intakes from the FFQ items and portion size estimations were based on the national food composition database, as described elsewhere (116). The software MATs (Rudans Lättdata, Västerås, Sweden) was used for calculations of energy and nutrient content. For Paper II food items were recalculated into grams/day by multiplying frequency with portion size and adjusting for validated sex- and age-specific intake levels, defined by a 24-hour dietary recall (117). Calculations of food and nutrient intakes were performed by Professor Ingegerd Johansson, principal investigator for the diet-VIP database.

Validation of the original 84-item FFQ against 24-hour recall and betacarotene and fatty acids has showed a *"good reproducibility and an estimated level of validity similar to that of FFQ measurements in other prospective cohort studies"* (117), and that the FFQ gives a satisfactory estimate of the intake of fish and milk fatty acids, but not of vegetable fatty acids (118). The VIP-FFQ has also been found valid in relation to biomarkers for folate, riboflavin and vitamin B6, but not vitamin B12, in a study in which more recent FFQ versions were partly included (119).

In Papers II, III and V, all intake variables except alcohol and coffee were energy adjusted by the residual method, according to which a regression between the log-transformed intake variable and total energy intake is performed in the population, and the individual deviation from the linear regression (the residual) is used as an estimate of intake in relation to general energy intake. In Paper IV, the energy density method was used, according to which daily intake variables per 1000 kcal are calculated, which thus is not related to the general energy intake in the population. Both these methods are considered equally valid (120), but because of the log function's inability to handle the value zero, the energy density method may be preferable in datasets in which abstainers (null-consumers) are included.

3.4 Interviews

For Paper I, all interviews were performed in the homes of the informants or in other places of their choice. The Swedish language was used, although some traditional herbs and foods were referred to by their Sami names.

In summer 2008, 20 Sami 63-89 years of age were asked how they believed their father or mother would have completed the VIP questionnaire at the age of 40-50 years. The informants were also asked about foods consumed by the parent on special occasions, and about the parent's body proportions

in relation to those of the interviewer (myself, height, 161 cm, body mass index, BMI, 25 kg/m^2).

In spring 2009, 20 food items from the 84-item FFQ and 11 traditional food items not included in the VIP questionnaire were added to the interview as follows: animal fat for cooking, coffee-cheese, wheat porridge, wild herbs, reindeer steak shavings (renskav), meat soup, dried meat, dried fish, brain, buttermilk, and eggs from wild birds. The availability of food items was also specified in months/year. Finally, two open-ended questions on fishing were added: "Who did most of the fishing in your family?" and "What role did gender play in the fishing in your family?"

The informants were asked to read through and, if required, modify the transcribed interview from 2008. The final, written summary of the two interviews was then approved and signed. Each informant was offered a copy of his or her interview summary.

3.5 Content analysis

The transcribed interviews were analyzed qualitatively in a content analysis (121). All responses were sorted according to the 84-item VIP questionnaire or according to new categories that arose during the interviews or data analysis.

Meaning units such as; *"That was not a leisure time activity. That was an 'opportunity for sustenance that could not be passed up'*[3]*. They had to fish, when they were without food, without fish",* were marked, condensed to *"fishing was survival, not a leisure time activity",* and categorized *as "fish important food"*. The results of the qualitative analysis were discussed from temporal, gender, and cultural perspectives with a focus on the manifest content.

Interpretation of the results were also done with awareness of the co-operation between interviewer and informant in the interview situation (121). Thus, to improve trustworthiness, the interpretations of the transcribed interviews were performed together with the second author of Paper I.

[3] levnadsmöjligheterna

The qualitative analysis focused on concept rather than on concrete, in vivo expression, for example, when several synonyms could be used, as was the case for the traditional herb "jomo."

Before publishing the final paper, the informants were invited to share and discuss the results of the content analysis. Eight of the informants participated in this discussion.

Coffee cheese

3.6 Sami diet score

For Paper II, a Sami diet score (0-8 points) representing the "traditional Sami" diet was constructed for use on the VIP FFQ. The score was constructed in a similar way as the Mediterranean diet score (50), by adding one point for each energy-adjusted intake above the median level of red meat, fatty fish, total fat, berries and boiled coffee, and one point for each intake below the median level of vegetables, bread and fibre, all calculated separately for sex and FFQ version. These food items were selected based on the results of Paper I, as well as the scientific and historical literature concerning "traditional Sami" dietary patterns, and in consideration of the items in the FFQ.

Alternative definitions of Sami diet score defined by strictly mathematically criteria were also tested. These models were based on significant differences between present time groups of Sami, i.e. ordinal differences and importance in a PLS projection (Paper I).

3.7 LCHP score

For Paper III, a previously established model for low carbohydrate and high protein intake, an LCHP score, was used (61-63, 122). Deciles of energy-adjusted carbohydrate (descending) and protein (ascending) intake were added to create an LCHP score (2-20 points), whereby higher scores represent a lower proportion of carbohydrate and a higher proportion of protein in the diet. LCHP scores were calculated separately for sex and FFQ version.

3.8 Coffee

The categorization of coffee intake, employed for the risk analyses in Papers IV and V, was as follows: < 1 (reference category), 1–3, and ≥4 occasions/day. In addition to total coffee, separate analyses were performed for boiled coffee and filtered coffee.

In older VIP questionnaires from 1990-1992, n=5776, both times/day and cups/day coffee questions were available. A subanalysis of these cases was done, to give an estimate of the relationship between the times/day scale in relation to the more common cups/day scale.

3.9 Baseline and selection variables

Baseline and selection variables used in the studies were mainly derived from the VIP questionnaire, or the health examinations of VIP. The only exception was number of children, obtained from Statistics Sweden.

3.9.1 Age

In Papers II and III, 10 year age intervals were used as age strata in the multivariate models. In Paper IV, data concerning menopause were not available, but the cohort was age stratified to provide a conservative approximation. Menopausal status was thus defined as age at breast cancer diagnosis <49 years (premenopausal) or >55 years (postmenopausal). The referent cohort participants were stratified according to age at end of follow-up, in order to ensure comparability of baseline data collection.

3.9.2 Apolipoprotein B/Apolipoprotein A1

ApolipoproteinB/apolipoptotein A1 ratio (ApoB/ApoA1), was included as a covariate in Paper V. It was analysed in archival blood samples at the Umeå university hospital laboratory, by immunoturbidimetry with reagents from Dako (Glostrup, Denmark), calibrator (X 0947), Hitachi 911 multianalyzer (Roche Diagnostics GmbH, Mannheim, Germany).

3.9.3 Body mass index

Body mass index was included as a covariate in Papers II-V, and calculated as measured weight (kg)/square height ($m^{2)}$.

3.9.4 Diabetes

The diabetes variable (yes/no) was used for stratification in Papers II and III and tested as a confounder in Papers IV and V. The variable was based on oral glucose tolerance tests (available for essentially all subjects) and/or self-reported diabetes, and was defined as fasting plasma glucose 7.0 mmol/l and/or post-load plasma glucose 11.0 mmol/l (12.2 mmol/l in the VIP cohort, in which capillary plasma was used) and/or diabetes. For definition as non-diabetic, a glucose tolerance test was required.

3.9.5 Education

As a surrogate estimate for socioeconomic factors, lack of postsecondary education was included as a covariate in Papers II-V. Lack of postsecondary education was defined as lack of university, or similar, education (yes/no).

3.9.6 Food intake level

Food intake level (FIL) was used in Papers I-IV for defining limits for exclusion of the most extreme reporters within the FFQs. It was defined as the ratio between reported caloric intake and basal metabolic rate, below the 5th or above the 97.5th percentile based on sex and FFQ-specific distributions. Basal metabolic rate was calculated as a linear function of weight according to the age and sex-specific formulas included in the Nordic Nutritional Recommendations 2004 (122).

3.9.7 Hypertension

The hypertension variable (yes/no) was used for stratification in Papers II and III, and tested for confounding in Paper V. Hypertension was defined as systolic blood pressure≥140 mm Hg and/or diastolic blood pressure ≥90 mm Hg and/or use of antihypertensive medication. For definition as non-hypertensive, a measure of blood pressure was required.

3.9.8 Metabolic low risk, high risk

In Papers II and III, stratifications were done with respect to metabolic health profile as follows:

1. Subjects with low metabolic risk profile, defined as subjects free from hypertension, diabetes, and obesity.
2. Subjects with a high metabolic risk profile, defined as subjects with hypertension and/or diabetes and/or obesity.

3.9.9 Number of children

In Paper IV, number of children was tested as a confounder in women. Data on number of children were obtained by linking VIP with the database of Statistics Sweden.

3.9.10 Saturated fat intake level

In Paper III, saturated fat intake was included as a covariate. Stratification by saturated fat intake level was also performed. Due to low numbers of subjects with saturated fat intakes below the recommendation of 10 % of energy, sex-specific medians were used as the cut-off for low and high intake of saturated fat.

3.9.11 Serum cholesterol

Serum cholesterol, measured at health care centers (VIP) or at a core laboratory of Umeå university (MONICA), was considered as a confounder in Paper V. Serum cholesterol was measured by enzymatic methods using reflotron benchtop analyzers (Boehringer Mannheim GmbH Diagnostica, Germany).

3.9.12 Smoking

Cigarette and/or pipe smoking was included as a covariate in the multivariate analyses of Papers II-V. In Paper IV, a three level categorical variable was used (current smoker, former smoker, never smoker). In the other papers a dichotomized variable, current smoker (yes/no) was used, in which the categories former smoker and never smoker were merged. Other kinds of tobacco use, such as snus were not considered.

3.9.13 Physical activity

In Paper IV, recreational physical activity was included as a covariate in the multivariate model. In Papers II, III and V, sedentary lifestyle was used instead. Recreational physical activity was defined as exercise performed in order to improve physical fitness and feel good; the five response alternatives in the VIP questionnaire were classified as (1) never or rarely, not on a regular basis, (2) 1–2 times per week, (3) 2–3 times per week, and (4) 4 or more times per week. Sedentary lifestyle (yes/no) was defined as never or rarely any recreational physical activity.

3.9.14 Physical activity level

In Paper II, physical activity level (PAL) was used for stratification. To estimate PAL, two questions on work-related and leisure-time physical activity were cross-tabled and used as described elsewhere (123). Missing in either or both of these questions was thus generating missing PAL value, rendering a loss of 5.4 % of the subjects. Subgroups were based on the PAL above or below median (1.6).

3.9.15 Underreporting

In Papers II and III, underreporting was assessed by weighting the estimated energy-reporting. A direct comparison of FIL and PAL was used to define low-energy reporters, an appropriate method in large sample sices (n>100 subjects) (124). Cut-off proportions of low-energy reporters were calculated by the Goldberg cut-off, modified by Black (124) according to the following simplified equations:

$$\textit{Within subject variation} = 8.5$$
$$\textit{Between subject variation} = 15$$
$$\textit{Variation in intake (S)} = \sqrt{(8.5^2 + 15^2)} = 0.172$$
$$\textit{Lower confidence interval of PAL} = PAL * e^{(-1.96*S)} = PAL\_low$$
$$\textit{Underreporters} = \textit{if } FIL < PAL\_low$$

This confidence interval will yield different proportions of low energy reporters in the 84- and 64-items FFQs, as previously demonstrated elsewhere (125), due to the difference in reported energy intake levels. Given that 84-item VIP FFQs are older and 64-item FFQ are more recent, a direct application of the confidence interval cut-off could thus introduce bias in relation to mortality, since death is a time-related event. For this reason, the average proportion for all questionnaires together was used in the entire data set, and applied on the FIL/PAL ratio separately for FFQ version and sex.

3.11 Health outcome endpoints

For Papers II and III, identification of all-cause mortality up to and until 31 December 2008, and cancer and CVD mortality endpoints up to and including 31 December 2007, were identified by linking the VIP database with the Swedish national cause-of-death registry. Swedish 12-digit personal identification numbers were used as the linkage variable. Cancer mortality was defined as underlying cause of death, ICD-9 codes 140-208, or ICD-10

codes C00-C97. Cardiovascular mortality was defined as the main cause of death and/or underlying cause of death, ICD-9 codes 390-438, or ICD-10 codes I00-I69.

For Paper IV, prospective cases of first invasive cancer were identified by linking the VIP database with the regional cancer registry in northern Sweden, which is more up to date than the national cancer registry. Swedish 12-digit personal identification numbers were used as the linkage variable. Cancer sites were defined according to ICD7 as described more in detail in Paper IV.

3.12 Statistical analyses

In this thesis, I have run most statistical analyses essentially on my own, except the PLS analyses, which were run by Ingegerd Johansson. In Paper V (my first study), I had support from the second author Maria Wennberg. In Paper IV (my second study), the selection process, definition of cancer cases and some of the preliminary analyses were done together with a statistician, Robert Johansson, Oncological center, Umeå university. The mortality dataset used for Papers II and III, is also being used in a study outside the frames of this thesis, together with a colleague, which has led to mutual quality assurance.

All statistical analyses were performed using SPSS software (version 15.0, 17.0, 19.0) or, for the PLS analysis, SIMCA P+ (version 12.0, Umetrics AB, Umeå, Sweden). All tests were two-sided and P values < 0.05 were considered statistically significant.

3.12.1 Cox proportional hazard regression

The hazard function describes the probability that a person will die (or have a disease onset) in the next given interval of time, given that he or she has survived (or stayed healthy) until the beginning of the interval (126). The probability is relative, and reference group is thus a free choice within each study. A hazard ratio (HR) of 1.5 means 50% increased risk compared with the reference group. A HR of 0.5 means a 50% decreased risk compared with the reference group. Cox proportional hazard regression (Cox regression) is widely used in epidemiological research, because it permits control for confounding variables, both categorical and continuous. In Papers II-IV, HRs for mortality and incident cancer were calculated by Cox regression.

When number of deaths/cases were >50 in each sex, sex-specific HRs were calculated.

Cox regression assumes that all covariates have proportionate effects on the hazard function over time. If not, data will be automatically manipulated by the computer function to fit this so called "proportional hazard assumption". To avoid manipulation of data, it is thus preferable if the proportional hazarard assumption is confirmed before using Cox regression. This was done in Papers II and III, by Schoenfeld's test. In Paper IV the proportional hazard assumption was not confirmed until after the results were published, by a visual judgement of Kaplan-Meier curves. These curves showed negligible deviations from the proportional hazard assumption in all cancer sites with a significant result. However, in some of the cancer sites with unstable results, the proportional hazard assumption was clearly violated. Since these were all null results, the deviations from the proportional hazards assumption likely did not have had major effects on the general interpretation.

3.12.2 Partial least square analysis

Partial least square (PLS) analysis is a way to analyse a regression with many x-variables and one or more y-variables. It is a regression in space (a projection) constructed to produce the smallest least square distance to all involved covariates. In the PLS analyses (Papers I and V), variables were logarithmically transformed, autoscaled to unit variance, and then modeled on three Sami cathegories (Paper I), and filtered and boiled coffee separately (Paper V). Factors with a "variable of importance in projection" value >1.0 were considered influential.

3.12.3 Conditional logistic regression

Conditional logistic regression is used for case/referent studies. It works in nearly the same way as regular logistic regression, but the cases and referents are divided into matched sets and thus kept together in the analysis. In Paper V, conditional logistic regression was used to calculate odds ratios (OR), which can be interpreted in the same way as HRs for endpoints with low frequencies in the studied population.

3.12.4 Confounder analysis

In Papers II-V covariates were considered to confound associations between exposure and outcome if they affected the HRs for the main exposure variable by more than 10% when included in a bivariate analysis. As almost

none of the tested covariates, except saturated fat in Paper III, appeared as confounders, risk factors for the multivariate models were selected mainly on a theoretical basis. In Paper IV, a PLS analysis was also used for the selection of covariates. In Paper V, a backward stepwise conditional regression was performed to minimize the number theoretically defined covariates in the final multivariate model.

Since cancer is not one, but many different kinds of diseases, with different risk patterns, and since risk patterns for men and women also may differ, a preliminary confounder analysis was done separately for each analysis in Paper IV by step-wise backward logistic Cox regression. A summary of these models are presented in Table 4. These cancer-specific models were, however, ultimately replaced by a general multivariate model in the final study, in order to facilitate comparisons with other studies, and with no material impact on the results.

Table 4: ICD7 codes and multivariate models for specific cancer types, when defined through stepwise backward logistic Cox regression.

Cancer site	ICD7	Multivariate model[1]	Number M/W
All cancer sites		M: Age, body mass index, current smoking, energy, fiber, vegetables, vitamin A W: Age, body mass index, current smoking, energy, cohabitating, education	1495/1538
Prostate	177	Age, body mass index, energy	653/0
Breast	170	Age, fat, vitamin C, energy	0/587
		Age <49 years: + (body mass index, vitamin A, folate) - (fat)	0/109
		Age >55 years: + (fiber, folate, current smoking) - (fat, vitamin C)	0/320
Colorectum	153, 154.0	M: Age, vitamin C, energy fat, carotene W: Age, vitamin C, energy, alcohol	174/147
Respiratory tract	161, 162	M: Age, current smoking, energy, selenium, vegetables W: Age, current smoking, energy, fiber	75/64
Urinary tract	181	Age, sex, smoking, vitamin A	81/37
Non-Hodgkins lymphoma	200, 202	*Age, sedentary lifestyle, sex, vitamin B6, energy*	59/52
Endometrium	172	Age, body mass index, carotene, education, fat, fiber, energy	0/108
Malignant melanoma	190	Age, carotene, education, fat, fiber, sex, vitamin B6, energy	51/57
Leukemia	204-207	Age, body mass index, sex	50/29
Pancreas	157	Age, folate, sex, energy	41/33
Ovary	175.0	Age, sedentary lifestyle, cohabitating, vitamin A, energy	0/71
Stomach	151	Age, sex, energy	42/28
Multiple myeloma	203	Age, carotene, sex, vegetables, energy	38/28
Renal cell	180.0, 180.9	Age, body mass index, folate, selenium, sex, vitamin B6, energy	31/25

M, men; W, women

[1] Defined by step-wise backward logistic Cox regression.

3.12.5 Other statistical tests

Other statistical tests, without further description, were as follows:

- In Papers I- V, the Kruskal Wallis test was used for non-parametric comparisons between groups, though in Paper IV these results were not presented for reasons of space.
- In Paper I, ordinal differences between non-Sami, non-reindeer-herding Sami and reindeer-herding Sami, reflecting hypothetical increasing adherence to "traditional Sami" diet and lifestyle, were tested by the Jonckheere-Terpstra test, which is a non-parametric rank sum test developed from the Kruskal-Wallis test.
- In Papers II and IV, a chi-square test was used to test heterogeneity in the results.
- In Papers III and IV, intra-individual, temporal changes in LCHP, macro-nutrients and coffee consumption were assessed by Wilcoxon's paired samples signed rank test in subjects with repeated surveys 10 years apart.

3.13 Ethical considerations

The study protocol and data handling procedures were approved by the Regional Ethical Review Board of Northern Sweden (Dnr 07-165M), which ensures that no harm will be done to any of the study subjects from a legal perspective. All study subjects provided written informed consent, and the study was conducted in accordance with the Declaration of Helsinki.

In addition, I believe that I have followed the basic ethical principles, that all research involved in human subjects should be conducted in accordance with the International guidelines for ethical review of epidemiological studies. In this study, three basic ethical principles have been of relevance, namely respect for persons, beneficience and non-maleficience. The fourth basic ethical principle, justice, was not, in my opinion, applicable in the studies included in this thesis.

In quantitative analyses, respect for persons was considered by only using previously collected research material, in which all study subjects had provided written informed consent (e.g. VIP, MONICA). In the interview process, it was my intention to give the elderly Sami informants as good a description of the aims and protocol of the study as possible before they agreed to participate, during the data collecting process, and before

publishing the results. Paper I, when published, was translated to Swedish and sent to the informants, together with the English version, in order to assure that all informants had a maximal overview over the use of their stories in qualitative and quantitative analyses.

Beneficence was shown by seriously considering the relevance of the study in relation to potential risks. In Sweden, Sami culture has been ignored and treated in a derogatory way for decades. Children are not taught about Sami history in public schools, and the general level of knowledge about Sami culture is low. To highlight Sami culture in a general context, applied to the whole population, in a sound research design, with research questions of international relevance, and in collaboration with highly professional and competent researchers, is thus, according to my opinion, a way of acting for the beneficience of the Sami. Whereas the results of the thesis are not likely to be of direct benefit to the residents of northern Sweden, they contribute to the field of epidemiology and public health.

Non-maleficience was shown by following the quality-assured routines for data security developed within the Medical Biobank of Umeå[4] . The elderly Sami informants were also able to withdraw confidential information from the transcribed interviews or participation in the study, before these were used for analysis.

When discussing the results from Paper II, a question was raised about the risk of stigmatization of Sami people and culture by the construction and naming of the Sami diet score. Concern was expressed that the score reflected a regional rural, rather than a Sami dietary pattern, and that many Sami might object to the use of the name Sami diet score, given the considerable heterogeneity within the Sami population and the variability over time. In accordance with the international guidelines for ethical review of epidemiological studies, the interpretation of the results was thus thoroughly discussed in consistence with scientific integrity, both within the author group and with an external expert, and with people in my Sami social network.

From a scientific point of view, efforts were made to include food items of evident importance in different groups of Swedish Sami, both from a qualitative, quantitative, and historical perspective. Though the Sami diet score was a novel model, it was based on the established methodology of the Mediterranean diet score. The author group also had the opinion that it would be unethical not to publish the results or to rename the score after the

4 swegene.omv.lu.se/biobanker/practice/SWEGENE_biobanker.html, accessed 3 January 2012

results were known. Further, one of the co-authors made a final review of the manuscript from a Norwegian Sami research perspective, and an external Swedish expert on Sami research reviewed the manuscript and gave his support for the relevance of the study.

In addition, I discussed the study within my Sami social network, in order to identify possible feelings of stigmatization related to the study protocol. With closer Sami friends I also summarized the ethical discussion more explicitly. From my personal view, the positive reactions from Sami people, though not systematically collected, was an important argument to finalize the study.

Transparency has been one of the main principles in this study. Over a 4-year period, aims, methods, and results have been presented both in general public and Sami media, in public seminars, at Sami cultural meetings at nursing homes, and at international scientific meetings.

A weakness of the thesis from a Sami perspective is the lack of ethical review from a specific research ethical review board representing the Sami society. Such a board does not exist, and the establishment of such a board is warranted.

4. Results and discussion

This chapter describes and discusses individual results from Papers I-V, and finally attempt to synthesize all results in a more general discussion.

4.1 Paper I

Interviews with elderly Sami indicated that fatty fish may have been more important than reindeer meat for the Sami of southern Lapland in the 1930's to 1950's. Fatty fish is still consumed more frequently by reindeer-herding Sami than non-reindeer-herding Sami and geographically matched non-Sami.

A substantial seasonal variability was also described in the diet. Meat was mainly consumed during autumn and winter, though dried meat was also eaten in summer and, particulary by men, during work-related migration (herding, hunting, rafting). Wild berries, especially lingonberries, cloudberries and blueberries were widely collected and eaten, and could be available fresh or conserved all year during good seasons. Among the Sami of southern Lapland, women were generally responsible for the home, farm, fishing and gardening, wheras the men had more mobile working situation. The meal pattern described for the men was irregular, often consisting of packed food such as dried meat, animal fat, and cheese eaten in coffee, and berries and herbs picked along the way. The incorporation of cultivated vegetables like carrots, leaf lettuce, and rhubarb into the diet, during the Swedish health-promoting agricultural movement of the 1940's and 1950's, was largely a women's initiative. Traditional wild herbs were concurrently abandonned.

A transition in fishing habits over time was also apparent from the interviews, in which the responsibility shifted from a shared or primarily female dominance in the 1930's and 1940s to a male dominance in the 1950's. In one interview, reflecting the 1950's, the mother did not fish at all.

In the quanititative analyses, higher intakes of fat, blood, and boiled coffee, and lower intakes of bread, fibre and cultivated vegetables, were observed among the historical Sami and present-day reindeer-herding Sami compared with present-day non-reindeer-herding Sami and non-Sami.

Figure 7. The Sami man in the center of the picture was described as big and strong.

Physical activity was also described as a more important part of daily life in the 1930's to 1950's than today. Yet many of the informants found the question on physical activity during work irrelevant and difficult to apply, stressing that they did not believe that their parents would have considered their lifestyle to be strenuous. Of the specific leisure time activities listed in the VIP questionnaire – walking, dancing, biking, shovelling snow, gardening, hunting, fishing and berry picking – all but dancing were not considered to be recreational for the historical Sami in the 1930s to 1950s.

Among present-day reindeer-herding Sami physically strenuous labour still seems to be more common than in non-reindeer-herding Sami and non-Sami.

4.1.1 Results not described in Paper I

Due to limited space, some of the results from the interviews were not described in Paper I. Body proportions described in the interviews were contradictory. For example, one father, described as big and strong, bigger than the interviewer, and able to carry an iron stove on his back for many kilometres in montainous terrain, had a very small and thin appearance in a photograph shown by the informant (Figure 7), and one mother, described as tall and handsome, but very fat, was believed to have had similar body proportions as the interviewer (height 161 cm, BMI 25).

Outside the interview situation (not documented on tape, and not addressed to their parents in specific), some informants also described consumption of moldy meat. It could be used for drying, after removal of the moldy surface,

and was then described as very tasty. It could be eaten in situations of lack of other meat, and was then described as something that not everybody could manage to eat without being sick. Outside a meal situation, it was also described as used as a one-time-only cure against severe fever disease; i.e. mold from a piece of meat mixed in a glass of water.

The macronutrient distribution of the diet described by the informants in the 1930's-1950's (n=20), in median percent (1st-3rd quartile) was: carbohydrate 39 (35-44), protein 16 (13-17), fat 43 (40-49). Including subjects from the 1930's only (n=5), the macronutrient distribution was as follows: carbohydrate 35 (34-40), protein 16 (14-19), and fat 44 (38-49).

4.1.2 Methodological issues specific to Paper I

Content analysis was used for analyzing the interviews since my aim was a relatively close and concrete description, rather than a distant and abstract one. The interviews would probably not be suitable for more in-depth qualitative analysis, since the interview protocol was rather strict, allowing limited associations outside the frames.

The strengths of the interview study (Paper I) were repeated interviews, feed-back meetings with the informants, and a study design allowing comparison with present day FFQ data. The combination of quantitative and qualitative analyse was also a strength, which broadened the perspective of the elderly Sami's stories. Weaknesses were that the interviewing was conducted by a single researcher, and that many of the elderly Sami informant's stories fell outside the scope of the FFQ. This was, on the other hand, also positive, since the dynamics between present-day questions and past experiences enriched the dialogue.

In three cases I recognized the informants as distant relatives. This was not unexpected, given the low number of Sami in Västerbotten. Strong personal ties could affect the interview situation. However, since descriptions of parental diet and lifestyle in the past are not a matter of high confidentiality, and since I did not have any deep contact with these relatives before the interviews, I doubt that family ties affected the reliability of the results.

The contradictory stories about body proportions further indicate that childhood memories of size and shape may be affected by the overall memory of the adult, and also related to average sizes of the childhood, rather than average sizes at present. The methodology used for assessing body size in this study, i.e. comparison with the proportions of the interviewer, was thus not very valuable from a quantitative perspective.

4.1.3 Implications

The importance of fatty fish was stressed in the interviews to a much further extent than I had expected, as previous studies had pointed out reindeer meat as the primary source of protein in Sami culture and fish as a more complementary element. This relatively low recognition of the importance of fatty fish may be an effect of a normative gender power structure, by which Sami culture has been defined from a male meat-producer's perspective, as is the case today (127). However, it might also reflect the greater general recognition of the culture of mountain Sami, who have benefited from Swedish Sami legislation (5) and who historically ate less fish than forest Sami (4) (p. 219). Furthermore, if differences between ethnic groups are stressed when ethnicity is defined(128), then fishing might not be a factor of interest in the 1930's to 1950's, when fishing was central to the survival of all inhabitants of southern Lapland.

An important implication of the importance of fatty fish described, is that for studies investigating characteristic lifestyle elements of specific ethnic groups in relation to health outcomes, the elements of greatest acknowledged cultural importance today (in this case reindeer meat) may not be of the most objective importance traditionally.

Based on the findings of Paper I, the factors assessable by the VIP questionnaire that are most representative of a "traditional Sami" lifestyle in southern Lapland 50-70 years ago include high intakes of fatty fish, fat, blood, boiled coffee and low intakes of bread, fibre and cultivated vegetables.

4.2 Paper II

Increasing Sami diet scores were associated with slightly elevated all-cause mortality in men [Multivariate HR per one-point increase in score 1.04 (95% CI 1.01-1.07), P =0.018], but not in women [Multivariate HR 1.03 (95% CI 0.99-1.07), P =0.130] as shown in Figure 8. This increased risk was approximately equally attributable to CVD and cancer, though somewhat more apparent for CVD mortality in men free from diabetes, hypertension and obesity at baseline [Multivariate HR 1.10 (95% CI 1.01-1.20), P =0.023]. Stratification according to physical activity level did not materially affect the results. None of the individual components of the Sami diet score were clearly associated with mortality

4.2.1 Results not presented in Paper II

In addition to the Sami diet score model presented in Paper II, some more strictly mathematically defined score models were also tested, based on present-day differences between Sami and non-Sami, and importance in a PLS projection on ethnicity. The results of these alternative score models did not deviate materially from the results presented, though, in the strictest defined Sami diet score model, in which only dietary items of importance in a PLS projection were included i.e. intake of red meat, fatty fish, bread and vegetables, the increased mortality was only statistically significant in Model 1, and borderline-significant in the multivariately adjusted Model 2 in men, as shown in Table 6.

Table 6. Hazard ratios for all-cause mortality by the alternative Sami diet score$_{PLS}$[4] in participants of the Västerbotten Intervention Programme cohort 1990-2008.

	Model 1[1,2]		Model 2[1,3]	
Sex (number of deaths)	hazard ratio (95% CI)	P	hazard ratio (95% CI)	P
Men (1460)	1.08 (1.03-1.14)	0.002	1.05 (1.00-1.10)	0.064
Women (923)	1.07 (1.01-1.14)	0.024	1.04 (0.98-1.11)	0.177

[1] Hazard ratios were determined by Cox regression analyses. [2] Age included as strata. [3] Further adjusted for BMI, sedentary lifestyle, education, current smoking, intake of alcohol and total energy [4] based on intake of red meat, fatty fish, bread, vegetables, which are intake variables oriented in the upper left or lower right area and a variable of importance in projection value >1 in a PLS-plot on present-time herding Sami, non-herding Sami and non-Sami in Västerbotten, Northern Sweden.

4.2.2 Methodological issues specific to Paper II

In contrast to the Mediterranean diet score, and Healthy nordic diet, in which all food items included are defined through a putative positive health impact (54, 129), no such intentions were ever attached with the construction of a Sami diet score. The final model was a result of giving priority to items of demonstrated importance for differences between groups of Sami and geographically matched non-Sami in the quantitative or qualitative analyses of Paper I, and research on historical diets. In this context, the heterogenity of the Sami people, combined with considerable changes over time, complicated the selection of characteristic dietary and lifestyle aspects. This was handled to some extent by defining historical and geographical frames for the study.

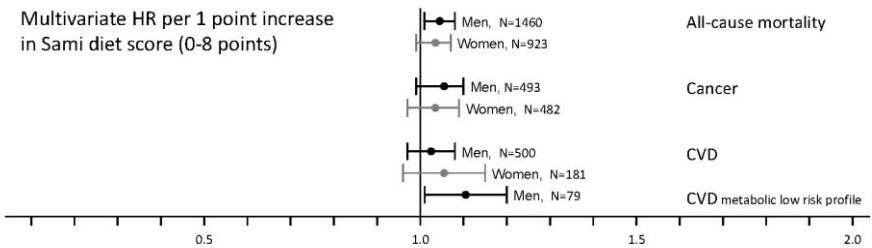

Figure 8. Associations between Sami diet score and all-cause, cancer and CVD mortality in men and women, shown as HRs and confidence interval. The associations are adjusted for BMI, sedentary lifestyle, education, current smoking, intake of alcohol and total energy

The possibility of a different result with a more detailed or specific FFQ cannot be excluded, for example if reindeer and game meat had been specified. In the present study, proportions of game/reindeer meat and meats within the category red meat may have differed considerably among the subjects, which may have diluted the results. Furthermore, it is important to stress that a current inhabitant of northern Sweden with a high Sami diet score may have intake levels of selected food items far below or above "traditional Sami" levels, for example, fatty fish and red meat, respectively, as indicated by Paper I.

Using medians rather than absolute threshold values as a cut-off in dividing a population according to a given variable is a way to preserve power when the distribution is skewed. If all associations between single factors and health were ordinal (or linear), median-based models would also be easier to apply on different populations. However, since effects are often more complex, a score may perform differently in populations with different general dietary habits. Dividing each component of a score into only 2 categories, whether based on relative or absolute cut-offs, provides a crude measure of intake. Using multiple cut-offs, however, reduces power and increases the complexity of the score.

Another methodological consideration is that in the Sami diet score, all dietary items were treated as if they were of equal importance for health, which was not likely the case. For example, based on the interviews, perhaps fatty fish should have had a greater weight than other food items. Other diet scores, including the Mediterranean diet score, have the same limitations as the Sami diet score with respect to variability in intake, the use of a relative versus absolute or multiple cut-offs, and the weighting of food items within the score.

4.2.3 Implications

This was the first study to examine a "traditional Sami" dietary pattern in relation to any health outcome. The weak increased mortality in subjects with higher Sami diet scores is largely in line with the evidence to date for the individual components of the Sami diet score (51), except the lack of increased mortality in men with a higher intake of red meat (48, 51).

The lack of associations between fatty fish and berries with all-cause mortality, may be explained by much higher intakes of both fatty fish and berries believed to have been typical among Sami 50-70 years ago, compared to either Sami or non-Sami in Västerbotten today, as found in Paper I. In a previous report from the same northern Swedish population, no associations between reported fish consumption (lean and fatty fish combined) and risk of acute myocardial infarction were observed (130).

Recently the Mediterranean Diet was acknowledged as *"an Intangible Cultural Heritage of Humanity"* by UNESCO (107). A large number of confirmational studies in many different populations inside and outside Europe provided the background for this UNESCO decision (107). A similar recognition of the Sami diet score is unlikely, since no aim to capture a healthy diet was ever attached with the modelling of it. The aim with the Sami diet score model was rather exploratory on a general level.

The results of Paper II do not support the hypothesis that the slightly lower cancer risk in Sami groups is due to "traditional Sami" dietary habits. However, due to the inherent weakness in the FFQ and the difficulty in defining a Sami diet score, as discussed above, further study of cohorts with more detailed information on dietary and lifestyle items relevant for "traditional Sami" culture is thus warranted.

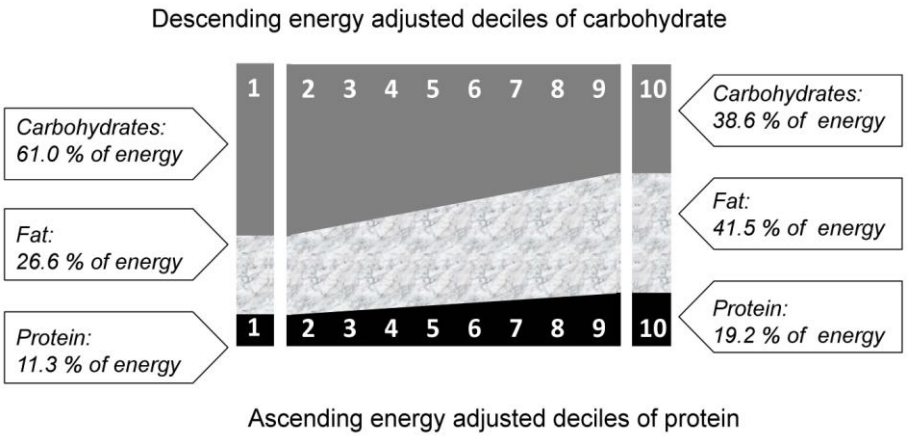

Figure 9. Construction and macronutrient composition (medians) of the LCHP score in the VIP cohort.The left staple shows the macronutrient composition of the lowest LCHP score (1+1=2 points), the right staple shows the composition of the highest LCHP score (10+10=20 points).

4.3 Paper III

The proportions of carbohydrate, protein and fat in the highest and lowest LCHP scores, respectively, are shown in Figure 9. As shown in this figure, the variability in intake of macronutrients was relatively low in the VIP population.

Results from the univariate and multivariate adjusted models are shown in Figure 10 and 11. High LCHP scores (14-20 points) did not predict all-cause mortality compared with low LCHP scores (2-8 points), after accounting for saturated fat intake and established risk factors. For cancer and cardiovascular disease, no associations were found, except areduced cardiovascular disease mortality in men with diabetes, and the opposite in women with diabetes, a finding which is difficult to explain. Results for all-cause, cancer and CVD mortality were generally similar in subgroups based on age and intake of saturated fat.

Carbohydrate intake was inversely associated with all-cause mortality, though only statistically significant in women [Multivariate HR per decile increase 0.95 (95% CI 0.91-0.99), *P*=0.010]. An LCHP score based solely on animal protein resulted in stronger, positive risk associations, but only in univariate analyses, whereas an LCHP score based solely on plant protein

retained the null results, even in multivariate analyses. Similarly, there were stronger, positive risk associations for an LCHP score based on whole grain instead of carbohydrates in Model 1 and opposite tendencies for an LCHP score based on sucrose, but neither of these were statistically significant in multivariate analyses. There were no material differences in results with respect to energy reporting.

The main findings do not support the positive associations with mortality in previous cohort studies, which may in part reflect the apparent lack of adjustment for saturated fat intake in some reports, in the analyses most comparable to this study (61, 63). Saturated fat was the most important confounder in this study. However, other studies have reported a positive association between a carbohydrate-restricted diet and increased mortality after adjusting for saturated fat (62), or with fat intake taken into account by other means (64).

The results for LCHP scores based solely on animal or plant protein were in line with previous studies, (64, 131), and might be explained by the strong association between animal protein and saturated fat, but it could also imply health effects specific to certain types of protein. Similarly, the quality of carbohydrates in an LCHP score is worth attention, as suggested by the discrepant results of LCHP score modelling based solely on whole grain carbohydrates versus sucrose. The result of the sub-analysis of intraindividual temporal changes suggests an increased LCHP score over time.

4.4.1 Methodological issues specific to Paper III

Elucidating potentially different roles of proteins and fat in carbohydrate restricted diets is complicated. In Paper II, a reason for not including fat in the LCHP score or replacing it by a LCHF (low-carbohydrate, high-fat) score was the isocaloric nature of carbohydrates and proteins, making a proportional scoring possible. One gram of fat contains more than twice energy as one gram of protein or carbohydrate. However, the role of fat, and in particular saturated fat, was explored both as a confounder and as an effect modifier.

There is a risk that increased intraindividual LCHP score over time, may have diluted the results. This may be one explanation to the null results.

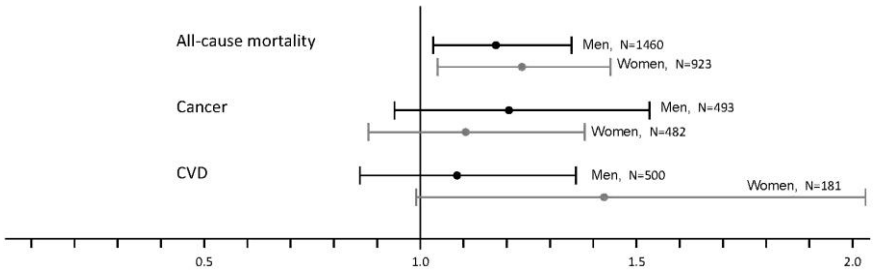

Figure 10. Crude associations between a high LCHP score (14-20 points) compared with a low LCHP (2-8 points) and all-cause, cancer and CVD mortality in men and women, shown as HRs and confidence intervals.

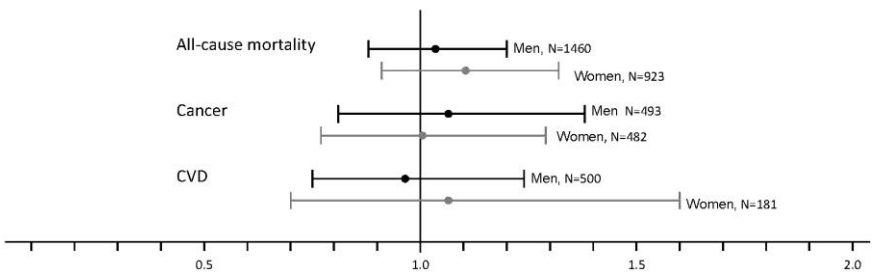

Figure 11. Adjusted associations between a high LCHP score (14-20 points) compared with a low LCHP (2-8 points) and all-cause, cancer and CVD mortality in men and women, shown as HRs and confidence intervals. The associations are adjusted for BMI, sedentary lifestyle, education, current smoking, intake of alcohol and total energy

4.4.2 Implications

No clear, general association between a diet relatively low in carbohydrates and high in protein and increased mortality is supported by this study, when intake of saturated fat is taken into account. In future studies of carbohydrate-restricted diet in health and disease, subgroups based on sex, age, metabolic risk profile, and macronutrient quality should be considered.

4.4 The coffee intake measure in Papers IV and V.

In the VIP population about 35% of the daily coffee consumption is boiled coffee (data not shown), and boiled coffee accounts for 40% of the market share in northern Sweden (www.kaffeinformation.se, accessed 23 January 2012).

The relation between the times/day scale and a cup/day scale for coffee intake is shown in Table 7. These results show that more than one cup of coffee may often be consumed on each occasion, which should be considered when interpreting the results of Papers IV and V.

Table 7. The relation between the times/day scale and a cup/day scale for coffee in VIP questionnaires 1990-1992 (n= 5776).

times/day	number	cups/day	
		median	25-75 percentiles
< 1	494	0.3	0.0-2.0
1-3	3212	3.0	2.5-4.0
≥ 4	2070	5.5	5.0-7.0

4.5 Paper IV

No associations with consumption of any kind of coffee were found for incidence of all cancer sites combined, or for prostate or colorectal cancer. For breast cancer, boiled coffee ≥4 versus <1 occasions/day was associated with a reduced risk (HR=0.52, CI=0.30-0.88, P_{trend}=0.247). An increased risk of premenopausal and a reduced risk of postmenopausal breast cancer were found for both total ($HR_{premenopausal}$=1.69, CI=0.96-2.98, P_{trend}=0.015, $HR_{postmenopausal}$=0.60, CI=0.39-0.93, P_{trend}=0.006) and filtered coffee ($HR_{premenopausal}$=1.76, CI=1.04-3.00, P_{trend}=0.045, $HR_{postmenopausal}$=0.52, CI=0.30-0.88, P_{trend}=0.045). Boiled coffee was positively associated with the risk of respiratory tract cancer (HR=1.81, CI=1.06-3.08, P_{trend}=0.084), a finding limited to men. Main results for less common cancer types included total coffee in renal cell cancer (HR=0.30, CI=0.11-0.79, P_{trend}=0.009) and boiled coffee in pancreas cancer (HR=2.51 CI=1.15-5.50, P_{trend}=0.006). Tests for heterogeneity showed no statistically significant differences between the HRs for trend for boiled versus filtered coffee except in cancer of the respiratory tract (P=0.048) and pancreas (P=0.013), as shown in Figure 12.

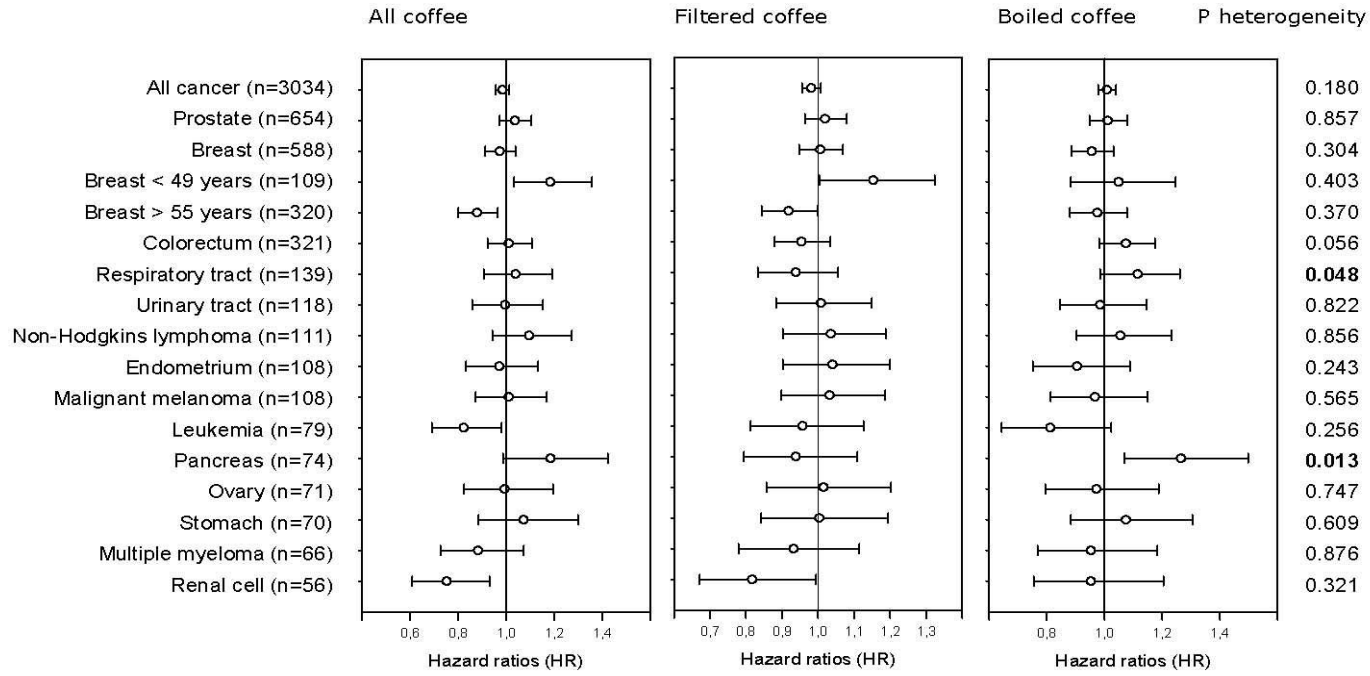

Figure 12. Multivariate hazard ratios for each additional occasion/day of total, filtered, and boiled coffee consumption, determined by Cox regression analyses. Hazards ratios were adjusted for age, sex, body mass index, smoking, education, and recreational physical activity. P values for heterogeneity between hazards ratios for filtered and boiled coffee were determined by chi-square test. Reproduduced with permission from Cancer Causes Control (74) .

4.5.1 Results not presented in Paper IV

A PLS analysis was done on filtered and boiled coffee (Figure 13). Non-influential variables, i.e. values ≤1.0 for both filtered and boiled coffee in both men and women, were: diabetes, number of children, and intake of calcium, dairy products, fish, fruit, red meat, sweets, sugary drinks and vitamin E. Variables remaining were thus, as indicated in Figure 13: sex (male/female, categorical), age at baseline (continuous), BMI (based on measurements taken at the health survey, continuous), cohabitating, (yes/no, categorical), current smoking (yes/no, categorical), education (postsecondary education, yes/no, categorical), sedentary lifestyle (lack of regular physical activity, yes/no, categorical), and daily intake of alcohol, carotene, energy, fat, fiber, folate, selenium, vegetables, and vitamins A, B6, C, and D (continuous).

Different lifestyle factors appear to be associated with different brewing techniques in the population of Västerbotten as shown in PLS analysis, boiled coffee consumers being characterized by low education, low intake of vegetables and high intake of fat, and filtered coffee consumers being characterized by a higher consumption of alcohol, more frequent smoking and a lower grade of cohabiting. This should be taken into consideration both in future studies including different brewing methods, and in interpreting the results of the present study.

4.5.2 Methodological issues specific to Paper IV

Discerning separate risk associations for filtered and boiled coffee is difficult, due to relatively high colinearity. This can be handled by mutual adjustment for the two coffee types. This was done in Paper V but not in Paper IV. In Paper IV risk estimates for total coffee consumption were presented, which to a limited extent may be interpreted in terms of colinearity when compared with risk estimates for the two coffee types.

Coffee consumption had a skewed distribution in the population, which affected the categorization of the coffee items. The reference category must not be too small, which is why < 1 times/day rather than non-consumers was chosen as the cut-off. The absence of a reference group of coffee abstainers limited the potential to identify risks or benefits associated with high coffee consumption in Papers IV and V. Further, data on number of cups/day or concentration of coffee brews were not available for the entire data set, which may have diluted the results.

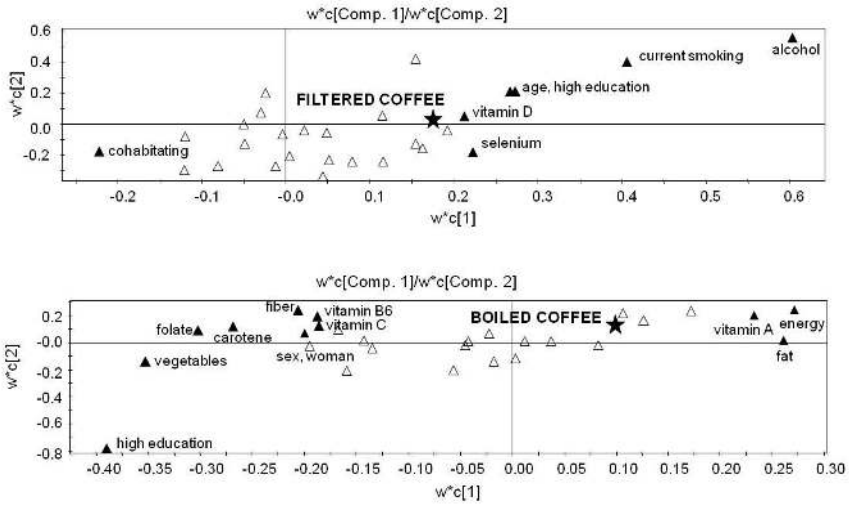

Figure 13. Scatter plot of Partial Least Squares (PLS) weights for lifestyle variables reported to be influential for cancer development (51), modelled on intake of (a) filtered and (b) boiled coffee. Only variables with a variable of importance in projection value >1.0 are labelled. Non-labelled points with no filling indicate non-influential variables(variable of importance in projection value <1.0), and include, (a) sex, BMI, diabetes, sedentary lifestyle, daily intake of calcium, carotene, dairy products, energy, fat, fiber, fish, fruit, folate, red meat, sweets, sugary drinks, vegetables, and vitamins A, B6, C and E, and (b) age at baseline, BMI, cohabitating, current smoking, sedentary lifestyle, daily intake of alcohol, calcium, dairy products, diabetes, fish, fruit, red meat, sweets, sugary drinks, selenium, and vitamins D & E.

4.5.3 Implications

The results of this study demonstrate, for the first time, a potential importance of brewing method in investigations of coffee consumption and cancer risk.

4.6 Paper V

Results from Paper V are shown in Figure 14. In men, an increased risk of first MI was found in univariate analysis for consumption of filtered coffee ≥4 occasions/day versus ≤1 occasion/day (OR: 1.64, 95% CI 1.13-2.38, P_{trend}=0.034). Adjusting for confounders had only minor effects on the magnitude and statistical significance of the risk estimates (multivariate OR:

1.73, 95% CI 1.05-2.84, P_{trend}=0.036). Excluding apoB/apoA-I ratio did not affect the risk estimates materially. Boiled coffee was not associated with the risk of first MI in men. In women, neither filtered nor boiled coffee was clearly related to the risk of first MI. The odds ratios for a high consumption of boiled coffee were above one and statistically significant in univariate but not multivariate analysis in women. Mutual adjustment for the two coffee types did not affect the results in men. In women, the risk estimates were affected by mutual adjustment, but low power rendered the analyses unstable. Univariate and multivariate risk estimates for total coffee consumption, the sum of filtered and boiled coffee consumption, were not statistically significant in trend analysis in either men or women.

4.6.1 Methodological issues specific to Paper V

Methodological issues were largely in common with Paper IV, and will thus not be repeated. The nested case-referent, rather than cohort, design was employed in Paper V because a dataset of strictly verified cases and referents had already been defined for biomarker studies. The number of study subjects available in Paper V was greatly reduced due to the exclusion of FFQs with non-comparable coffee items (-243 cases). In the oldest VIP FFQ, for exemple, boiled and filtered coffee specified only as coffee preference, after an estimate of total coffee consumption.

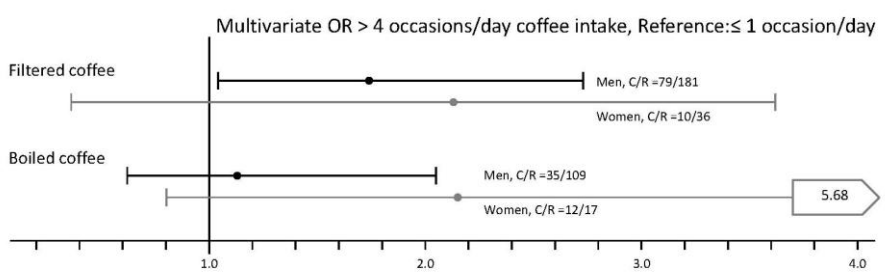

Figure 14. Associations between a high intake of filtered and boiled coffee (≥ 4 times/day) compared with a low intake (≤ 1 time/day) and risk of acute myocardial infarction in men and women, shown as ORs and confidence intervals. The associations are adjusted for current smoking, postsecondary education, apolipoproteinB/apolipoproteinA-I ratio and body mass index in men, and current smoking, postsecondary education, hypertension and sedentary lifestyle in women.

4.6.2 Implications

To our knowledge, this is the first prospective study to address the role of boiled coffee in cardiovascular disease. In a Swedish retrospective case-control study, both filtered and boiled coffee were associated with increased MI risk in men, but not women (79). In Paper V, only filtered coffee increased the risk of first MI in men. Given the well-established cholesterol-raising effect of boiled coffee, this is surprising. One possible explanation is residual confounding by other lifestyle factors not assessed, or not sufficiently assessed, by the questionnaire employed in this study.

4.7 General discussion

In this thesis, for the first time a "traditional Sami" diet and lifestyle was related to health outcomes in a general population. A "traditional Sami" diet was modeled as a diet score containing high intakes of red meat, fatty fish, total fat, berries and boiled coffee, and low intakes of vegetables, bread and fibre. Further, it was modeled as a diet containing relatively low intakes of carbohydrates and high intakes of protein. Finally, one aspect of a "traditional Sami" lifestyle, namely consumption of boiled coffee, was studied in relation to disease incidence endpoints.

The findings of Papers II-V generally did not support health benefits for the factors studied. The equal life expectancies in the Sami and non-Sami populations, and the decreased cancer risk in the Sami population of northern Sweden, can therefore probably not be attributed to these aspects of the "traditional Sami" diet. However, since the inherent weaknesses of the VIP FFQ with respect to capturing the "traditional Sami" diet (as described above in the methodological considerations specific to Paper II), may have precluded detection of risk associations, further study in cohorts with more detailed information on dietary elements common among the Sami is warranted.

In addition to the factors studied in this thesis, the VIP questionnaire may be suitable for investigations of other potential health factors not yet explored from a Sami perspective. For example, although physical activity is an established health factor (51, 98), evidence is scarce with respect to potential additional benefits of physical activity in an outdoor environment, such as hiking, fishing and hunting. Outdoor activities could be examined in relation to disease incidence or mortality endpoints in the VIP database.

This attempt to apply a Sami perspective on the general northern Swedish population also leads to some general methodological considerations.

In the risk analyses (Papers II-V), some intake levels in the general population may not have been high or low enough to capture putative health effects, for example very high intakes of fatty fish and berries in Paper II, higher or lower carbohydrate and protein intakes in Paper III, and non-consumers of coffee in Papers IV and V. Large multicenter studies, or other studies with a wider range of a given variable, may be necessary to detect potential health effects of these "traditional Sami" lifestyle aspects.

A weakness was also the limited numbers of food items included in the FFQ, and the change in FFQ items over time. Some of the food items excluded or merged from the original 84-item FFQ were of importance from a "traditional Sami" perspective, e.g. blood dishes, liver and kidney. However, in relation to macronutrients and intakes of coffee, the limited exclusions and the merging of food items in the 64-item FFQ was likely sufficient to achieve reliable results.

The main strengths of Papers II-V were the prospective design, the large sample size, and the long follow up-time (up to 19 years). Furthermore, the general study design, with health measures, anthropometry and detailed lifestyle data for all subjects, made it possible to consider many possible confounders. This is essential when studying lifestyle-related diseases with multifactorial causes. However, residual confounding due to factors not estimated (such as wood smoke), or not adequately, estimated (such as smoking) was almost certainly present.

In the multivariate statistical models used in this thesis, covariates with a mediating or intermediate effect on the causal pathway between exposure and outcome may have been included, for example saturated fat in the relation between LCHP score and mortality (Paper III), and apolipoprotein levels in the relation between boiled coffee consumption and MI risk (Paper V). In order to account for these intermediate variables, stratification by median saturated fat intake was performed in Paper III, and the multivariate model in Paper V was tested both with and without ApoB/ApoA-1 ratio as a covariate.

Adjustment for multiple testing was not performed in any of the papers. The rational for this was the exploratory nature of the studies. Instead, caution was employed in the interpretation of results. The frequent use of the Bonferroni correction has been questioned in exploratory studies, in which it has been considered to be too conservative (132) .

Finally, it is important to stress that no general dietary recommendations can be based on single studies such as those presented in this thesis. Scientific evidence from prospective studies based on free-living subjects must be repeated, preferably in different populations, before general conclusions can be drawn. Even then, biological cause-effect relationships can seldom be established. In some cases, intervention studies may be possible. But when studying diseases with multifactorial causes and long time intervals between exposure and disease onset, intervention studies are generally not a realistic option.

Hopefully, the results of this thesis, as well as the study design, applying a minority perspective on a majority population, will be useful for hypothesis generating, and for further studies on more specific levels.

5. Conclusions

Paper I: Fatty fish may have been the most important dietary item in the Sami lifestyle of southern Lapland 50-70 years ago. Other factors assessable by the VIP questionnaire that are most representative of a "traditional Sami" lifestyle in southern Lapland 50-70 years ago include high intakes fat, blood, boiled coffee and low intakes of bread, fibre and cultivated vegetables.

Paper II: Higher Sami diet scores were associated with a weak increase in all-cause mortality in men from Västerbotten, approximately equally attributed to CVD and cancer mortality. In women from Västerbotten, there were no stable risk associations for Sami diet score, though all HRs were ≥1.

Paper III: No clear, general association between a LCHP dietary pattern (relatively low in carbohydrates and high in protein) and increased all-cause, CVD or cancer mortality was observed in the population of Västerbotten, when intake of saturated fat was taken into account.

Paper IV: Associations between coffee consumption and cancer risk differed both by brewing method and by cancer site. This suggests a potential importance of brewing method in investigations of coffee consumption and cancer risk.

Paper V: Consumption of filtered coffee, but not boiled coffee, was associated with an increased risk of acute myocardial infarction in men from northern Sweden.

5.1 General conclusions

In conclusion, the findings of Paper I, in particular the relative importance of fatty fish compared to reindeer meat in the "traditional Sami" diet of the 1930's-1950's, suggest that aspects of cultural importance may not always be of most objective importance.

The findings of Papers II-V generally did not support health benefits for the factors studied. The relatively good health status of the Sami population is therefore probably not attributable to the studied aspects of the "traditional Sami" lifestyle, but further investigation of cohorts with more detailed information on dietary and lifestyle items relevant for "traditional Sami" culture is warranted.

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