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Assessment of dietary intake of vitamin C and calcium in the Norwegian population

**Opinion of the Panel on Nutrition, Dietetic Products, Novel Food and Allergy of
the Norwegian Scientific Committee for Food Safety**

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Assessment of dietary intake of vitamin C and calcium in the Norwegian population.

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Assessed and approved

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(Panel members in alphabetical order after chair of the panel)

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Competence of VKM experts

Persons working for VKM, either as appointed members of the Committee or as external experts, do this by virtue of their scientific expertise, not as representatives for their employers or third party interests. The Civil Services Act instructions on legal competence apply for all work prepared by VKM.

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Summary

The Norwegian Scientific Committee for Food Safety (Vitenskapskomiteen for mattrygghet, VKM) has, at the request of the Norwegian Food Safety Authority (Mattilsynet; NFSA), evaluated the intake of vitamin C and calcium in the Norwegian population. VKM has also conducted scenario estimations to illustrate the consequences of amending maximum limits for vitamin C (to 100, 300, 500, 600, 800 or 1000 mg/day) and calcium (to 800, 1200 or 2000 mg/day) in food supplements.

Vitamin C

Vitamin C refers to both ascorbic acid and dehydroascorbic acid. Scurvy is the manifestation of vitamin C deficiency which is preventable by a daily intake of 5-10 mg/day. Fruits, berries and vegetables are important food sources of vitamin C and especially citrus fruit are important contributors. The Norwegian recommendation for dietary intake of vitamin C is 75 mg/day for adults (Helsedirektoratet, 2014).

Vitamin C is absorbed from the intestine by an active process that is dose dependent. The bioavailability is at least 80% for doses up to 100 mg, 70% for doses of 200-500 mg and less than 50% for doses exceeding 1000 mg.

Intestinal discomfort and diarrhea have been reported by persons using large doses (>1000 mg/day) of vitamin C supplementation. In 2000 the Institute of Medicine (IOM) in the USA proposed a tolerable upper intake level (UL) for vitamin C intake from food and supplements of 2000 mg/day for adults. ULs for children and adolescents were extrapolated based on body weight; 400 mg for children 1-3 years, 650 mg/day for children 4-8 years, 1200 mg/day for 9-13 years old adolescents, 1800 mg/day for 14-18 years old (IOM, 2000).

In the assessment of vitamin C, VKM uses the Norwegian recommendations for intakes (Helsedirektoratet, 2014), and the acceptable dose for supplemental vitamin C from EFSA (2004) for adults and the tolerable upper intake levels established by the IOM (2000) for children and adolescents. Daily intakes of vitamin C from diet and supplements are estimated from nationwide dietary surveys performed in selected age groups: Adults 18-70 years, adolescents aged 13 years, and children aged 2, 4, and 9 years.

Not all age-groups in the Norwegian population reach the recommended intake of vitamin C. At the 5th percentile, only 13-year-olds have an intake of vitamin C from food alone above the recommendations. At the 25th percentile, all age groups except adults have a vitamin C intake from food alone at or above the recommendations. At the 40th percentile, adults reach the recommended intake of vitamin C.

The whole population would reach the recommended dietary intake with supplementation of 100 mg vitamin C per day.

All the alternative maximum limits for vitamin C in food supplements listed in the terms of reference from NFSA (100, 300, 500, 600, 800 or 1000 mg/day) will be within the acceptable dose for supplemental vitamin C suggested by EFSA (2004) for adults. None of the alternative maximum limits for vitamin C in food supplements listed in the terms of reference (100, 300, 500, 600, 800 or 1000 mg/day) leads to exceedance of the tolerable upper intake levels established by IOM in adults, 13- year-olds or 9-year-olds, even with intakes from food at the 95th percentile.

However, the tolerable upper intake level proposed by the IOM will be exceeded for 4-year-old children at supplemental doses above 500 mg vitamin C per day, and for 2-year-old children at doses higher than 100 mg/day.

Calcium

Calcium is the most abundant mineral in the body and constitutes approximately 1200 g and 1400 g in adult women and men, respectively. More than 99% of the calcium in the body is bound to hydroxyapatite in bone and tooth enamel. Calcium is crucial for many bodily functions such as cell signalling, coagulation, muscular contraction, and neural transmission as well as skeletal integrity. Milk and dairy products are the main dietary sources of calcium, but foods such as fish, pulses, nuts, seeds (especially millet) and green vegetables may contribute to the total intake. The Norwegian recommendation for dietary intake of calcium is 800 mg/day for adults.

The bioavailability of calcium is dependent on the amount of calcium ingested as well as the individual's vitamin D status and physiological needs, like e.g. growth and pregnancy.

Adverse effects of excessive calcium intake include symptoms of hypercalcaemia such as e.g. anorexia, weight loss, polyuria, heart arrhythmias, fatigue and soft tissue calcification (Jones, 2008 in IOM, 2011), deterioration of kidney function, kidney stone formation, the milk-alkali syndrome and vascular calcification.

In 2012 the European Food Safety Authority (EFSA) established a tolerable upper intake level (UL) for calcium at 2500 mg/day from food and supplements for adults. No UL was set for children and adolescents.

In 2011, IOM established a UL for 1-8 years old children to 2500 mg/day and 3000 mg/day for 9-18 years old children and adolescents (IOM, 2011). VKM however suggests that the UL established for adults by EFSA (2012) is used for the purpose of this VKM opinion also for children and adolescents, as the ULs from IOM for children and adolescents are considered to be high.

In the assessment of calcium, VKM uses the Norwegian recommendations for intakes (Helsedirektoratet, 2014) and the tolerable upper intake levels established by the European Food Safety Authority for adults (includes both foods and supplements) (EFSA, 2012). Daily intakes of calcium from diet and supplements are estimated from nationwide dietary surveys

performed in selected age groups: Adults 18-70 years, adolescents aged 13 years, and children aged 2, 4, and 9 years.

Not all age groups in the Norwegian population reach the recommended intake of calcium. At the 5th percentile, no age groups fulfil the recommended daily intakes of calcium from food alone, and in the 50th percentile the 13-year-olds did not reach the recommended intake for calcium from food alone. At approximately the 65th percentile, the 13-year-olds reach the recommended intake for calcium.

The whole population would reach the recommended dietary intake with supplementation of 800 mg calcium per day.

For calcium, three alternative maximum limits were listed in the terms of reference (800, 1200 and 2000 mg/day). In the scenarios for high intakes of calcium, a dietary calcium intake at the 95th percentile and additionally 800 mg calcium from food supplements, will lead to an intake close to the tolerable upper intake level established by EFSA for the adult population, and supplements with 1200 or 2000 mg calcium per day will lead to exceedance of the tolerable upper intake level in adults.

Children and adolescents with a dietary intake at the 95th percentile and additionally 2000 mg calcium from food supplements, will all exceed the UL suggested for adults by EFSA in 2012. All age groups except 4-year-olds will also exceed the UL with 1200 mg supplemental calcium. With 800 mg supplemental calcium 13-year-old adolescents, 9-year-old, 4 year-old and 2-year-old children will not exceed the suggested UL.

Key words: VKM, risk assessment, Norwegian Scientific Committee for Food Safety, vitamin C, calcium, food supplement, upper level, exposure.

Sammendrag på norsk

På oppdrag fra Mattilsynet har Vitenskapskomiteen for mattrygghet vurdert inntaket av vitamin C og kalsium i den norske befolkningen. VKM har også gjort scenarioberegninger for å illustrere konsekvensene av å endre maksimumsgrensene for vitamin C (til 100, 300, 500, 600, 800 eller 1000 mg/dag) og kalsium (til 800, 1200 eller 2000 mg/dag) i kosttilskudd.

Vitamin C

Vitamin C omfatter askorbinsyre og dehydroaskorbinsyre. Skjørbruk er en manifestasjon av vitamin C-mangel som kan forebygges ved et daglig inntak på 5-10 mg/dag. Frukt, bær og grønnsaker er viktige kilder til vitamin C i kosten, og særlig er sitrusfrukter viktig. Norske helsemyndigheter anbefaler at voksne har et vitamin C inntak på 75 mg/dag (Helsedirektoratet, 2014).

Vitamin C absorberes i tarmen ved hjelp av en aktiv prosess som er doseavhengig. Biotilgjengeligheten er minst 80 % ved doser opp til 100 mg, 70 % for doser på 200-500 mg og mindre enn 50 % for doser som overskrider 1000 mg.

Gastrointestinale plager og diaré har blitt rapportert hos personer som bruker vitamin C tilskudd med høye doser (>1000 mg/dag). Det amerikanske Institute of Medicine (IOM) satte i 2000 et tolerabelt øvre inntaksnivå (UL) for vitamin C fra mat og kosttilskudd på 2000 mg/dag for voksne. UL for barn og unge ble ekstrapolert basert på kroppsvekt; og for barn fra 1 til 3 år satte IOM øvre tolerabelt inntaksnivå til 400 mg/dag, for barn 4 til 8 år, 650 mg/dag, for 9 til 13 år 1200 mg/dag for 9-13 åringer og for 14 til 18 år 1800 mg/dag (IOM, 2000).

I vurderingen av inntaket av vitamin C i den norske befolkningen, legger VKM den norske anbefalingen for inntak (Helsedirektoratet, 2014) og foreslått trygt nivå fra EFSA (2004) for voksne og øvre tolerable inntaksnivåer fra IOM (2000) for barn og ungdom til grunn. Inntak av vitamin C fra mat og kosttilskudd er beregnet på grunnlag av landsomfattende kostholdsundersøkelser i utvalgte aldersgrupper i den norske befolkningen: Voksne 18 til 70 år, ungdommer 13 år, og barn i aldersgruppene 2, 4 og 9 år.

Ikke alle aldersgruppene i den norske befolkningen dekker anbefalt inntak av vitamin C. Ved 5-persentilene er det bare 13-åringene som har et inntak av vitamin C fra mat alene som dekker anbefalingene. Ved 25-persentilene har alle aldersgruppene bortsett fra voksne et vitamin C-inntak fra mat alene tilsvarende eller over det anbefalte inntaket. Ved 40-persentilen har også voksne et inntak av vitamin C som svarer til anbefalingene.

Med et tilskudd på 100 mg vitamin C per dag, vil hele befolkningen komme opp i anbefalt inntak.

Ingen av maksimumsgrensene for vitamin C i kosttilskudd gitt i mandatet (100, 300, 500, 600, 800 eller 1000 mg/dag) medfører overskridelse av den foreslåtte akseptable dosen for vitamin C i tilskudd fra EFSA (2004), og heller ikke overskridelse av tolerable øvre inntaksnivåer foreslått av IOM (2000) for 13-åringer eller 9-åringer, selv ved 95-persentilen for inntak av vitamin C fra mat.

Imidlertid vil det tolerable øvre inntaksnivået foreslått av IOM overskrides for 4-åringer ved kosttilskuddsdoser over 500 mg vitamin C per dag, og for 2-åringer med kosttilskuddsdoser høyere enn 100 mg/dag.

Kalsium

Kalsium er det mineralet som det er mest av i kroppen og utgjør omlag 1200 g og 1400 g hos henholdsvis voksne kvinner og menn. Over 99 % av kalsium i kroppen er bundet i hydroksyapatitt i benvev og tannemalje. Kalsium er viktig for kroppsfunksjoner som cellesignalisering, koagulering, muskelsammentrekninger, og overføring av nervesignaler, samt for skjelettets styrke. Melk og meieriprodukter er de viktigste kostkildene til kalsium, men matvarer som fisk, belgfrukter, nøtter, frø (spesielt hirse) og grønne grønnsaker kan bidra til det totale inntaket. Den norske anbefalingen for inntak av kalsium er 800 mg/dag for voksne (Helsedirektoratet, 2014).

Biotilgjengeligheten av kalsium er avhengig av inntaksnivået samt individets vitamin D-status og fysiologiske behov, som f.eks. vekst og graviditet.

Det er rapportert om negative helseeffekter fra overdrevent inntak av kalsium, herunder symptomer på hyperkalsemi som for eksempel anoreksi, vekttap, polyuri, hjertearytmier, tretthet og nedslag av kalsium i bløtvev (Jones, 2008 i IOM, 2011), reduksjon i nyrefunksjonen, dannelse av nyrestein, melk-alkali syndromet og forkalkninger i årer.

European Food Safety Authority (EFSA) fastsatte i 2012 et tolerabelt øvre inntaksnivå for kalsium på 2500 mg/dag fra mat og kosttilskudd for voksne. Det ble ikke satt et øvre tolerabelt inntaksnivå for barn eller ungdom.

I 2011 fastsatte Institute of Medicine (IOM) et tolerabelt øvre inntaksnivå for kalsium fra kosttilskudd alene på 2500 mg/dag for voksne (19 til 50 år). For 1 til 8 åringer ble tolerabelt øvre inntaksnivå satt til 2500 mg/dag og for 9 til 18 åringer 3000 mg/dag (IOM, 2011). VKM foreslår imidlertid at UL fastsatt av EFSA (2012) for voksne kommer til anvendelse også for barn og ungdom i denne VKM rapporten ettersom UL for disse aldersgruppene fra IOM (2011) anses å være høye.

I vurderingen av kalsium legger VKM til grunn den norske anbefalingen for inntak, og tolerabelt øvre inntaksnivå fra EFSA (2012) for voksne (inkluderer både mat og kosttilskudd). Inntak av kalsium fra mat og kosttilskudd er beregnet på grunnlag av landsomfattende kostholdsundersøkelser i utvalgte aldersgrupper i den norske befolkningen: Voksne 18 til 70 år, ungdommer 13 år, og barn i aldersgruppene 2, 4 og 9 år.

Ikke alle aldersgrupper i den norske befolkningen dekker anbefalt inntak av kalsium. Ved 5-persentilen har ingen av aldersgruppene et inntak av kalsium fra kost alene som når anbefalingene. Ved 50-persentilene er det bare 13-åringene som ikke når det anbefalte inntaket for kalsium fra mat alene. Ved omlag 65-persentilen, har også 13-åringene et inntak av kalsium som svarer til anbefalingene.

Med et tilskudd på 800 mg kalsium per dag, vil hele befolkningen komme opp i anbefalt inntak.

For kalsium ble det angitt tre alternative maksimumsgrenser i mandatet (800, 1200 og 2000 mg/dag). I henhold til scenariene for høyt kalsiuminntak, vil kalsiuminntaket ved 95-persentilen fra kosten alene samt en dose på 800 mg kalsium fra kosttilskudd innebære et inntak nært opptil det tolerable øvre inntaksnivået for voksne fastsatt av EFSA. Doser på 1200 eller 2000 mg kalsium fra kosttilskudd per dag vil føre til at tolerabelt øvre inntaksnivå overskrides.

For barn og ungdom vil kalsiuminntaket ved 95-persentilen fra kosten alene samt en dose på 2000 mg kalsium fra tilskudd føre til at tolerabelt øvre inntaksnivå fra EFSA (2012) for voksne overskrides. Alle aldersgrupper unntatt 4-åringene vil også overskride tolerabelt øvre inntaksnivå med en dose fra kosttilskudd på 1200 mg kalsium. Hverken 2-, 4-, 9-, eller 13-åringer vil overskride UL med en dose fra tilskudd på 800 mg kalsium.

Abbreviations and/or glossary

Abbreviations

EFSA	– European Food Safety Authority
EVM	– Expert group on vitamins and minerals of the Food Standard Agency, UK
LOAEL	– lowest observed adverse effect level
NFSA	– Norwegian Food Safety Authority [<i>Norw.</i> : Mattilsynet]
NNR	– Nordic Nutrition Recommendations
NOAEL	– no observed adverse effect level
IOM	– Institute of Medicine, USA
RI	– recommended intake
UL	– tolerable upper intake level
VKM	– Norwegian Scientific Committee For Food Safety [<i>Norw.</i> : Vitenskapskomiteen for Mattrygghet]

Glossary

P5, 25, 50, 75 or 95-exposure is the estimated exposure at the 5, 25, 50, 75 or 95-percentile.

Percentile is a term for visualising the low, medium and high occurrences of a measurement by splitting the whole distribution into one hundred equal parts. A percentile is a statistical measure indicating the value below which a given percentage of the observations fall. E.g. the 95-percentile is the value (or score) below which 95 percent of the observations are found.

Background as provided by the Norwegian Food Safety Authority

Directive 2002/46/EC on food supplements was implemented in Norwegian law in 2004 in Regulation 20 May 2004 No. 755 on food supplements. Pursuant to Directive 2002/46/EC, common maximum and minimum levels of vitamins and minerals in food supplements shall be set in the EU.

National maximum limits for vitamins and minerals were established in the former vitamin and mineral supplements regulation from 1986 and were continued in the 2004 regulation. These maximum limits apply until common limits are established in the EU.

The European Commission started establishing common limits in 2006, but the work was temporarily put on standstill in 2009. The time frame for the further work is not known.

Maximum limits for levels of vitamins and minerals in food supplements shall be set on the basis of the following criteria, pursuant to article 5 in Directive 2002/46/EC:

- Upper safe levels of vitamins and minerals established by scientific risk assessment based on generally accepted scientific data, taking into account, as appropriate, the varying degrees of sensitivity of different consumer groups
- Intake of vitamins and minerals from other dietary sources

When the maximum levels are set, due account should also be taken of reference intakes of vitamins and minerals for the population.

Pending establishment of common maximums limits in the EU, the Norwegian Food Safety Authority is evaluating the national maximum limits for vitamins and minerals in food supplements.

Assessment of vitamin C and calcium

The Norwegian Food Safety Authority will evaluate the national maximum limits for vitamin C and calcium in the food supplement regulation. The minimum and maximum limits for the content of vitamins and minerals in food supplements are listed in Annex 1 to the food supplement regulation:

Background Table: Minimum and maximum limits for vitamin C and calcium in the food supplement regulation (October 2015).

	Minimum amount per recommended daily dose	Maximum amount per recommended daily dose
Vitamin C (mg)	15	200
Calcium (mg)	15	1500

Permitted vitamin C and calcium substances which may be used in the manufacture of food supplements are listed in Annex 2 in the food supplement regulation.

Terms of reference as provided by the Norwegian Food Safety Authority

The Norwegian Food Safety Authority (NFSA, Mattilsynet) requests the Norwegian Scientific Committee for Food Safety (VKM) to assess the intake of vitamin C and calcium from the diet, including fortified products, in all age groups in the population above 1 year.

VKM is also requested to conduct scenario estimations to illustrate the consequences of amending maximum limits for vitamin C (to 100 – 300 – 500 – 600 – 800 and 1000 mg/day, as an example) and calcium (to 800 – 1200 – 2000 mg/day, as an example) in food supplements.

Assessment

1 Introduction

1.1 Vitamin C

Vitamin C refers to both ascorbic acid and dehydroascorbic acid. Scurvy is the manifestation of vitamin C deficiency which is prevented by a daily intake of 5 -10 mg/day and a plasma concentration of > 11 mmol (Jacob et al., 1987; Leggott et al., 1986).

Vitamin C is absorbed from the intestine by an active process that is dose dependent. The bioavailability is at least 80% for doses up to 100 mg, 70% for doses of 200-500 mg and less than 50% for doses exceeding 1000 mg (Levine et al., 1996).

The body pool of vitamin C increases up to an intake of 100 mg/day (Levine et al., 1996). At a plasma concentration of 50-60 mmol/L the body cells become saturated, but larger doses (up to 2500 mg/day) are capable to increase plasma levels to 80 mmol/L. Plasma concentrations below 23 mmol/L indicate a marginal vitamin C status which corresponded to an intake of 41 mg/day in adults (Jacob et al., 1987). Low vitamin C status results in low antioxidant capacity, fatigue and irritability (Levine et al., 1996). Based on both epidemiologic studies and pharmacokinetic approaches it has been estimated that a plasma concentration of 32 mmol/L represents a satisfactory antioxidant status which is equivalent to an intake of 50-60 mg/day. This intake level has been used to set the recommended intake (RI) of 75 mg/day including a 25% allowance for inter-individual variation (NNR Project Group, 2012).

Fruits, berries and vegetables are important food sources of vitamin C and especially citrus fruits are important contributors.

Intestinal discomfort and diarrhea have been reported by persons using large doses (>1000 mg/day) of vitamin C supplementation (Hoffer, 1971).

A vulnerable group for high vitamin C intakes is patients with pre-existing hyperoxaluria where formation of kidney stones has been documented (Levine et al., 1999). Under certain conditions vitamin C can act as a pro-oxidant contributing to oxidative damage. However, there is no evidence that intakes (>1000 mg/day) of vitamin C are genotoxic (EFSA, 2004).

1.2 Calcium

Calcium is the most abundant mineral in the body and constitutes approximately 1200 g and 1400 g in adult women and men, respectively. More than 99% of the calcium in the body is bound to hydroxyapatite in bone and tooth enamel, and the remaining <1% is present in a

well-regulated easily and exchangeable pool kept within narrow limits at 2.1 to 2.6 mmol/L in plasma. Calcium concentrations are crucial for cell signalling, coagulation, muscular contraction and neural transmission.

Absorption and homeostasis of calcium is regulated by parathyroid hormone (PTH) 1,25-dihydroxyvitamin D (calcitriol) and calcitonin. Absorption takes place in the upper part of the ileum by passive diffusion or by an active energy-requiring process requiring 1,25-dihydroxyvitamin D. The bioavailability of calcium is dependent on amount of calcium, vitamin D status, and physiological needs during growth and pregnancy. The absorption of calcium can be inhibited by dietary factors such as phytic and oxalic acid, but the impact of these substances depends on the total dietary intake of calcium.

Milk and dairy products are the main sources of calcium in the Norwegian diet, but foods like fish, pulses, nuts, seeds (especially millet) and green vegetables may contribute to the total intake.

Hypercalcaemia is defined by serum concentrations > 2.75 mmol/L, and is clinically often indicative of diseases related to absorption, excretion or calcium or renal and bone reabsorption.

Adverse effects of excessive calcium intake have been reported and include symptoms of hypercalcemia such as e.g. anorexia, weight loss, polyuria, heart arrhythmias, fatigue and soft tissue calcification (Jones, 2008 in IOM, 2011), deterioration of kidney function, kidney stone formation, the milk-alkali syndrome and vascular calcification.

2 Recommendations and tolerable upper intake levels

2.1 Vitamin C

2.1.1 Recommendations

The recommended intakes for vitamin C for the different age groups are given in Table 2.1.1-1 (Helsedirektoratet, 2014; NNR Project Group, 2012).

Table 2.1.1-1: Norwegian recommendations for vitamin C intakes, both sexes.

Age, both sexes	Vitamin C, mg/day
1-2 years	25
2-5 years	30
6-9 years	40
10-13 years	50
14- >75 years	75
Pregnant	85
Lactating	100

2.1.2 Tolerable upper intake levels

In 2004, the European Food Safety Authority (EFSA) did not set an UL for vitamin C intake, but suggested 1000 mg/day as an acceptable dose per day in food supplements in addition to food intake (EFSA, 2004).

In 2000 the Institute of Medicine (IOM) in USA proposed a tolerable upper intake level (UL) for vitamin C intake from food and supplements at 2000 mg/day for adults. This UL was based on a lowest observed adverse effect level (LOAEL) of 3000 mg based on flatulent distension, transient colic and diarrhea at doses of 3-4 g/day seen in healthy subjects (Cameron and Campbell, 1974). An uncertainty factor of 1.5 was used to obtain a no observed adverse effect level (NOAEL) and UL. The ULs for children and adolescents were extrapolated based on body weight; 400 mg for children 1-3 years, 650 mg/day for children 4-8 years, 1200 mg/day for 9-13 year-old adolescents, and 1800 mg/day for 14-18 year-olds (IOM, 2000).

The Expert Group on Vitamins and minerals (EVM) in the UK stated in 2003 that a supplemental dose of 1000 mg/day vitamin C supplement would not be expected to have any significant adverse effects and proposed 1000 mg/day as an upper guidance level for supplemental vitamin C (EVM, 2003).

The Nordic Nutrition Recommendations did not propose a UL for vitamin C intake, but stated that high intakes might cause diarrhea and gastrointestinal disturbances and possibly increase the formation of kidney stones (NNR Project Group, 2012).

2.2 Calcium

2.2.1 Recommendations

The recommended intakes for calcium for the different age groups are given in Table 2.2.1-1 (Helsedirektoratet, 2014; NNR Project Group, 2012).

Table 2.2.1-1: Norwegian recommendations for calcium intakes, both sexes.

Age, both sexes	Calcium, mg
1-2 years	600
2-5 years	600
6-9 years	700
10-17 years	900
18-30 years ¹	800
31-60 years	800
61-74 ² years	800
>75 ² years	800
Pregnant	700
Lactating	900

¹The recommended intake for 18-20-year-olds is 900 mg calcium per day.

²Supplementation with 500-1000 mg calcium per day may reduce bone loss in postmenopausal women.

2.2.2 Tolerable upper intake levels

In 2012 EFSA published their opinion on the tolerable upper intake level of calcium (EFSA, 2012). In this opinion EFSA adopted the UL set by the Scientific Committee on Food (SCF) in 2003. A UL for calcium at 2500 mg/day from diet and supplements was established as well tolerated for adults including pregnant and lactating women. This UL was based on a NOAEL with regard to nephrolithiasis, cardiovascular disease and prostate cancer. No UL was set for children and adolescents. This conclusion was repeated in the new EFSA (2015) opinion on "Dietary Reference Values for calcium", and it was commented that no new data had become available to change the UL for adults, and that no new data was available to set ULs for infants, children and adolescents.

In 2011, IOM updated the UL for calcium from 1997. It was stated that a UL for dietary intake from food was impossible to achieve and excess intakes are likely to be associated with use of food supplements (IOM, 2011). For adults the UL was based on a LOAEL. The UL of 2000 mg of supplementary calcium was established for adults >50 years based on risk of formation of kidney stones. The UL of 2500 mg/day was set for adults 19-50 years based on

the consideration that some incidence of kidney stones had been reported at intakes of 3000 mg/day in this age group. For children the ULs were based on various NOAELs, and UL for intake from supplements was set to 2500 mg/day for children 1-8 years old and 3000 mg/day for 9-18 years old children and adolescents.

3 Intakes and scenarios

In the terms of reference, VKM is requested to assess the intake of vitamin C and calcium from the diet, including fortified products, in all age groups in the population above 1 year. VKM is also requested to conduct scenario estimations to illustrate the consequences of amending maximum limits for vitamin C in food supplements (to 100 – 300 – 500 – 600 – 800 and 1000 mg/day, as an example) and calcium (to 800 – 1200 – 2000 mg/day, as an example) in food supplements.

3.1 Short description of the Norwegian dietary surveys

The estimated intakes of vitamin C and calcium presented in this opinion are based on data from the national food consumption surveys for young children (2-year-olds), children and adolescents (4-, 9-, and 13-year-olds) and adults (aged 18 to 70 years). The national food consumption surveys were conducted by the Department of Nutrition, University of Oslo in collaboration with the Directorate of Health and the Norwegian Food Safety Authority. Different methodologies were used in the tree different surveys and thus direct comparisons between the age groups may be misleading.

A description of the food consumption surveys and the different methodologies used is given below.

Adults: "Norkost 3" is based on two 24-hour recalls by telephone at least one month apart. Food amounts were presented in household measures or estimated from photographs (Totland et al., 2012). The study was conducted in 2010/2011, and 1787 adults (925 women and 862 men) aged 18-70 participated.

9- and 13-year-old children/adolescents: "Ungkost 2000" is based on a 4-day food intake registration with a precoded food diary. Food amounts were presented in predefined household units or as portions estimated from photographs (Øverby and Andersen, 2002). The study was conducted in 2000 and 810 9-year-old children and 1005 13-year-old adolescents participated.

4-year-old children: "Ungkost 2000" is based on a 4-day food intake registration with a precoded food diary. Food amounts were presented in predefined household units or as portions estimated from photographs (Pollestad et al., 2002). The study was conducted in 2001, and 391 4-year-olds participated.

2-year-old children: "Småbarnskost 2007" is based on a semi-quantitative food frequency questionnaire. In addition to predefined household units, food amounts were also estimated from photographs. The study was conducted in 2007, and a total of 1674 2-year-olds participated (Kristiansen et al., 2009).

3.2 Dietary intakes of vitamin C in the Norwegian population

Estimated intakes of vitamin C in the various age groups are presented in tables in Appendix 1. The tables in Appendix 1 also include estimates for P25 and P75.

In adults (n=1787)

The mean intake of vitamin C from the diet alone is 108 mg /day (median 91 mg/day) in adults. Intake of vitamin C in the 5th percentile (P5) is 22 mg/day and in the 95th percentile (P95) is 251 mg/day.

In Norkost 3, 446 participants (25%) reported use of supplements containing vitamin C. Their mean total intake of vitamin C including that from food supplements is 238 mg/day (median 167 mg/day), P5 intake is 60 mg/day and P95 intake is 655 mg/day.

Mean intake of vitamin C from supplements alone in adults reporting use of supplements containing vitamin C is 125 mg/day (median 45 mg/day), P5 intake is 13 mg/day and P95 intake is 500 mg/day.

In 13-year-olds (n=1005)

The mean intake of vitamin C from the diet alone is 89 mg/day (median 78 mg/day) in 13-year-olds. The P5 intake is 24 mg/day and the P95 intake is 197 mg/day.

In Ungkost 2000 (13-year-olds), 254 participants (25%) reported use of supplements containing vitamin C. Their mean total intake of vitamin C including that from food supplements is 156 mg/day (median 137 mg/day), P5 intake is 50 mg/day and P95 intake is 318 mg/day.

Mean intake of vitamin C from supplements alone in 13-year-olds reporting use of supplements containing vitamin C is 62 mg/day (median 45 mg/day), P5 intake is 7 mg/day and P95 is 160 mg/day

In 9-year-olds (n=810)

The mean intake of vitamin C from the diet alone is 84 mg/day (median 76 mg/day) in 9-year-olds. The P5 intake is 29 mg/day and the P95 intake is 161 mg/day.

In Ungkost 2000 (9-year-olds), 291 participants (36%) reported use of supplements containing vitamin C. Their mean total intake of vitamin C including that from food supplements is 131 mg/day (median 116 mg/day), P5 intake is 55 mg/day and P95 intake is 254 mg/day.

Mean intake of vitamin C from supplements alone in 9-year-olds reporting use of supplements containing vitamin C is 41 mg/day (median 30 mg/day), P5 intake is 8 mg/day and P95 is 123 mg/day.

In 4-year-olds (n=391)

The mean intake of vitamin C from the diet alone is 66 mg/day (median 61 mg/day) in 4-year-olds. The P5 intake is 26 mg/day and the P95 intake is 125 mg/day.

In Ungkost 2000 (4-year-olds), 197 participants (50%) reported use of supplements containing vitamin C. Their mean total intake of vitamin C including that from food supplements is 104 mg/day (median 96 mg/day), P5 intake is 47 mg/day and P95 intake is 191 mg/day.

Mean intake of vitamin C from supplements alone in 4-year-olds reporting use of supplements containing vitamin C is 36 mg/day (median 30 mg/day), P5 intake is 6 mg/day and P95 is 100 mg/day.

In 2-year-olds (n=1674)

The mean intake of vitamin C from the diet alone is 59 mg/day (median 51 mg/day) in 2-year-olds. The P5 intake is 19 mg/day and the P95 intake is 122 mg/day.

In Småbarnskost 2007, 565 participants (34%) reported use of supplements containing vitamin C. Their mean total intake of vitamin C including that from food supplements is 87 mg/day (median 78 mg/day), P5 intake is 33 mg/day and P95 intake is 178 mg/day.

Mean intake of vitamin C from supplements alone in 2-year-olds reporting use of supplements containing vitamin C is 26 mg/day (median 22 mg/day). P95 intake of vitamin C from supplements is 70 mg/day.

3.3 Scenario estimations for vitamin C

For scenario estimations VKM used the intake groups below the 5th and above the 95th percentile from food alone to calculate vitamin C intake and added the suggested supplementation levels from NFSA (100, 300, 500, 800 or 1000 mg vitamin C per day).

Table 3.3-1: Estimated total vitamin C intakes for various age groups in scenarios with 100, 300, 600, 800, and 1000 mg as supplements added to the 5th percentile of intake from food alone (mg/day).

Age group	5 th percentile from food	Including 100 mg from suppl	Including 300 mg from suppl	Including 500 mg from suppl	Including 800 mg from suppl	Including 1000 mg from suppl
Adults	22	122	322	522	822	1022
13 years	24	129	324	524	824	1024

Age group	5 th percentile from food	Including 100 mg from suppl	Including 300 mg from suppl	Including 500 mg from suppl	Including 800 mg from suppl	Including 1000 mg from suppl
9 years	29	129	329	529	829	1029
4 years	26	126	326	526	826	1026
2 years	19	119	319	519	819	1019

Table 3.3-2: Estimated total vitamin C intakes for various age groups in scenarios with 100, 300, 600, 800, and 1000 mg as supplements added to the 95th percentile of intake from food alone (mg/day).

Age group	95 percentile from food	Including 100 mg from suppl	Including 300 mg from suppl	Including 500 mg from suppl	Including 800 mg from suppl	Including 1000 mg from suppl
Adults	251	351	551	751	1051	1251
13 years	197	297	497	697	997	1197
9 years	161	261	461	661	961	1161
4 years	125	225	425	625	925	1125
2 years	122	222	422	622	922	1122

3.4 Dietary intakes of calcium in the Norwegian population

Estimated intakes of calcium in the various age groups are presented in tables in Appendix 1. The tables in Appendix 1 also include estimates for P25 and P75.

In adults (n=1787)

The mean intake of calcium from the diet alone is 918 mg /day (median 834 mg/day) in adults. The P5 intake is 339 mg/day and the P95 intake is 1745 mg/day.

In Norkost 3, 113 participants (16%) reported use of calcium-containing supplements. Their mean total intake of calcium including that from food supplements is 1167 mg/day (median 1077 mg/day), P5 intake is 502 mg/day and P95 intake is 2210 mg/day.

Mean intake of calcium from supplements alone in adults reporting use of calcium-containing supplements is 248 mg/day (median 150 mg/day), P5 intake is 25 mg/day and P95 intake is 930 mg/day.

In 13-year-olds (n=1005)

The mean intake of calcium from the diet alone is 858 mg /day (median 783 mg/day) in 13-year-olds. The P5 intake is 335 mg/day and the P95 intake is 1674 mg/day.

In Ungkost 2000, five 13-year-olds (0.5%) reported use of calcium-containing supplements. Their mean total intake of calcium including that from food supplements is 844 mg/day (median 670 mg/day). Too few 13-year-olds reported use of calcium-containing supplements to estimate percentiles.

Mean intake of calcium from supplements alone in 13-year-olds reporting use of calcium-containing supplements is 137 mg/day (median 63 mg/day).

In 9-year-olds (n=810)

The mean intake of calcium from the diet alone is 833 mg /day (median 801 mg/day) in 9-year-olds. The P5 intake is 366 mg/day and the P95 intake is 1398 mg/day.

In Ungkost 2000, eight 9-year-olds (1%) reported use of calcium-containing supplements. Their mean total intake of calcium including that from food supplements is 927 mg/day (median 926 mg/day). Too few 9-year-olds reported use of calcium-containing supplements to estimate percentiles.

Mean intake of calcium from supplements alone in 9-year-olds reporting use of calcium-containing supplements is 227 mg/day (median 188 mg/day).

In 4-year-olds (n=391)

The mean intake of calcium from the diet alone is 675 mg /day (median 641 mg/day) in 4-year-olds. The P5 intake is 360 mg/day and the P95 intake is 1047 mg/day.

In Ungkost 2000, five 4-year-olds (1%) reported use of calcium-containing supplements. Their mean total intake of calcium including that from food supplements is 997 mg/day (median 950 mg/day). Too few 4-year-olds reported use of calcium-containing supplements to estimate percentiles.

Mean intake of calcium from supplements alone in 4-year-olds reporting use of calcium-containing supplements is 400 mg/day (median 500 mg/day).

In 2-year-olds (1674)

The mean intake of calcium from the diet alone is 787 mg /day (median 747 mg/day) in 2-year-olds. The P5 intake is 332 mg/day and the P95 intake is 1424 mg/day.

In Småbarnskost 2007, 78 2-year-olds (5%) reported use of calcium-containing supplements. Their mean total intake of calcium including that from food supplements is 981 mg/day (median 916 mg/day). The P5 intake is 393 mg/day and the P95 intake is 1774 mg/day.

Mean intake of calcium from supplements alone in 2-year-olds reporting use of calcium-containing supplements is 128 mg/day (median 125 mg/day).

3.5 Scenario estimations for calcium

For scenario estimations VKM used the intakes of calcium from food alone in the 5th, 50th and 95th percentile, and added the suggested supplementation levels from NFSA (800, 1200 or 2000 mg calcium per day), see Tables 3.5-1 to 3.5-3.

Table 3.5-1: Estimated total calcium intakes for various age groups in scenarios with 800, 1200 and 2000 mg as supplements added to the 5th percentile of intake from food alone (mg/day).

Age group	5th percentile from food	Including 800 mg from suppl	Including 1200 mg from suppl	Including 2000 mg from suppl
Adults	339	1139	1539	2339
13 years	335	1135	1535	2335
9 years	366	1166	1566	2366
4 years	360	1160	1560	2360
2 years	332	1132	1532	2332

Table 3.5-2: Estimated total calcium intakes for various age groups in scenarios with 800, 1200 and 2000 mg as supplements added to the median intake (the 50th percentile) from food alone (mg/day).

Age group	Median intake from food	Including 800 mg from suppl	Including 1200 mg from suppl	Including 2000 mg from suppl
Adults	840	1640	2040	2840
13 years	780	1580	1980	2780
9 years	800	1600	2000	2800
4 years	640	1440	1840	2640
2 years	750	1550	1950	2750

Table 3.5-3: Estimated total calcium intakes for various age groups in scenarios with 800, 1200 and 2000 mg as supplements added to the 95th percentile of intake from food alone (mg/day).

Age group	95th percentile from food	Including 800 mg from suppl	Including 1200 mg from suppl	Including 2000 mg from suppl
Adults	1745	2536	2947	3745
13 years	1674	2474	2874	3674
9 years	1398	2198	2598	3398
4 years	1047	1847	2247	3047
2 years	1424	2224	2824	3424

4 Assessment of the intakes

4.1 Evaluation of low intakes of vitamin C

The recommended intakes for vitamin C for the different age groups are given in Table 2.1.1-1, and intakes from the diet alone are given in Appendix 1, Table 1.

In the 5th percentile, only 13-year-olds have an intake of vitamin C from food alone above the recommendations. In the 25th percentile, all age groups except adults have a vitamin C intake from food alone at or above the recommendations. At the 40th percentile, adults reach the recommended intake for vitamin C.

The whole population would reach the recommended dietary intake with supplementation with 100 mg vitamin C per day.

4.2 Evaluation of high intakes of vitamin C, including scenarios

EFSA (2004) proposed 1000 mg/day as an acceptable dose for supplemental vitamin C, but did not set a UL. VKM refers to this dose as acceptable for adults. All the alternative maximum limits for vitamin C in food supplements listed in the terms of reference from NFSA (100, 300, 500, 600, 800 or 1000 mg/day) will be within the acceptable dose for supplemental vitamin C suggested by EFSA (2004) for adults.

EFSA did not suggest an acceptable dose for children or adolescents but IOM (2000) extrapolated the established UL for adults at 2000 mg vitamin C per day from all sources (food and supplements) corrected for body weight.

According to the estimated scenarios in Table 3.3-2, adults, 13- and 9-year-olds will not exceed the IOM (2000) ULs with use of supplements containing vitamin C at any of the alternative maximum dose levels listed by NFSA with an intake of vitamin C from food at the 95th percentile.

In 4-year-old children food supplements with maximum limits for vitamin C at 100, 300 or 500 mg/day would not lead to exceedance of the UL set by IOM with an intake from food at the 95th percentile. Food supplements with maximum limits for vitamin C at 800 or 1000 mg per day will lead to exceedance of the ULs set by IOM for this age group in those with an intake from food at the 95th percentile.

For the 2-year-old children only the lowest listed maximum limit at 100 mg vitamin C per day from food supplements would not lead to exceedance of the UL set by IOM in the 95th percentile of vitamin C intake from food.

4.3 Evaluation of low intakes of calcium

The recommended intakes for calcium for the different age groups are given in Table 2.2.1-1, and intakes from the diet alone are given in Appendix 1, Table 5.

In the 5th percentile no age groups reach the recommendations for calcium from food alone. In the 50th percentile only the adolescents did not reach the recommended intake for calcium from food alone. At approximately the 65th percentile, the 13-year-olds reach the recommended intake for calcium.

The whole population would reach the recommended dietary intake with supplementation with 800 mg calcium per day.

4.4 Evaluation of high intakes of calcium, including scenarios

In 2012 EFSA re-established a UL for calcium at 2500 mg/day from diet and supplements as well tolerated for adults including pregnant and lactating women (EFSA, 2012). According to the estimated scenarios in Table 3.5-3, adults with a dietary intake at the 95th percentile and additionally 800, 1200 or 2000 mg calcium from food supplements, will reach or exceed the UL suggested by EFSA in 2012.

EFSA did not suggest a UL for children and adolescents, but (IOM, 2011) set a UL for supplementary intake of calcium to 2500 mg/day for children 1-8 years old and 3000 mg/day for 9-18 years old children and adolescents. VKM however suggests that the UL established for adults by EFSA (2012) is used for the purpose of this VKM opinion also for children and adolescents, as the ULs from IOM for children and adolescents are considered to be high.

According to the estimated scenarios, children and adolescents with a dietary intake at the 95th percentile and additionally 2000 mg calcium from food supplements, will all exceed the suggested UL for adults by EFSA in 2012. All age groups except 4-year-olds will exceed the UL with 1200 mg supplemental calcium. With 800 mg supplemental calcium all adolescents and children will have an intake within the UL.

5 Uncertainties

It should be noted that the intakes have been estimated based on various dietary surveys for the different age categories and a comparison of estimates across age groups can be misleading. The estimated intakes in the higher and lower percentiles are always associated with a higher degree of uncertainty than mean or median intakes. Data from "Ungkost 2000" are old, and the use of food supplements may have changed in children and adolescents.

Another issue is that low participation rates limit the representativeness of the background population in Norway – possible selection of health-conscious and higher educated of the participants. Population subgroups not covered, e.g. ethnic minorities.

For the determinations of the ULs for vitamin C and calcium, EFSA and IOM have not reached the same conclusions, indicating uncertainty regarding establishment of these ULs both for adults, and even more for children and adolescents.

6 Answers to the terms of reference

The Norwegian Food Safety Authority (NFSA, Mattilsynet) requests the Norwegian Scientific Committee for Food Safety (VKM) to assess the intake of vitamin C and calcium from the diet, including fortified products, in all age groups in the population above 1 year.

VKM is also requested to conduct scenario estimations to illustrate the consequences of amending maximum limits for vitamin C (to 100 – 300 – 500 – 600 – 800 and 1000 mg/day, as an example) and calcium (to 800 – 1200 – 2000 mg/day, as an example) in food supplements.

Vitamin C

In the assessment of vitamin C, VKM uses the Norwegian recommendations for intakes (Helsedirektoratet, 2014) and EFSA (2004) acceptable dose from food supplements for adults and the tolerable upper intake levels established by the Institute of Medicine (includes both foods and supplements) (IOM, 2000) for children and adolescents.

Not all population groups reach the recommended intake of vitamin C. In the 5th percentile, only 13-year-olds have an intake of vitamin C from food alone above the recommendations. In the 25th percentile, all age groups except adults have a vitamin C intake from food alone at or above the recommendations. At the 40th percentile, adults reach the recommended intake for vitamin C.

The whole population would reach the recommended dietary intake with supplementation with 100 mg vitamin C per day.

All the alternative maximum limits for vitamin C in food supplements listed in the terms of reference from NFSA (100, 300, 500, 600, 800 or 1000 mg/day) will be within the acceptable dose for supplemental vitamin C suggested by EFSA (2004) for adults. In the scenarios for high intakes of vitamin C, none of the alternative maximum limits for vitamin C in food supplements listed in the terms of reference (100, 300, 500, 600, 800 or 1000 mg/day) lead to exceedance of the tolerable upper intake levels established by IOM in 13-year-olds or 9-year-olds even with intakes from food at the 95th percentile.

However, the tolerable upper intake level from IOM will be exceeded for the 4-year-old children with supplemental doses higher than 500 mg vitamin C per day, and for 2-year-old children with doses higher than 100 mg/day.

Calcium

In the assessment of calcium, VKM uses the Norwegian recommendations for intakes (Helsedirektoratet, 2014) and the tolerable upper intake levels established by the European Food Safety Authority for adults (includes both foods and supplements) (EFSA, 2012).

Not all population groups reach the recommended intake of calcium. In the 5th percentile, no age groups reach recommended intakes of calcium from food alone. In the 50th percentile only the adolescents did not reach the recommended intake for calcium from food alone. At approximately the 65th percentile, the 13-year-olds reach the recommended intake for calcium.

The whole population would reach the recommended dietary intake with supplementation with 800 mg calcium per day.

For calcium, three alternative maximum limits were listed in the terms of reference (800, 1200 and 2000 mg/day). Based on the scenario estimations, a dietary calcium intake at the 95th percentile and additionally 800 mg calcium from food supplements will lead to an intake close to the tolerable upper intake level established by EFSA for the adult population, while supplements with 1200 or 2000 mg calcium per day will lead to exceedance of the tolerable upper intake level.

Children and adolescents with a dietary intake at the 95th percentile and additionally 2000 mg calcium from food supplements, will all exceed the UL suggested for adults by EFSA in 2012. All age groups except 4-year-olds will exceed the UL with 1200 mg supplemental calcium. With 800 mg supplemental calcium 13-year-old adolescents, 9-year-old, 4 year-old and 2-year-old children will not exceed the suggested UL.

7 Data gaps

Dietary intake is changing over time and data from 2000 (Ungkost) is to be regarded as outdated. Newer dietary surveys are therefore requested for this type of reports. In addition more age groups should be included in dietary surveys in addition to subgroups like different ethnical groups.

In the chapter 5 we refer to the uncertainties setting ULs both for vitamin C and calcium. This refers to few clinical studies evaluating high intakes and different clinical endpoints.

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Appendix I

Summary tables of the intake of vitamin C for all age groups

Estimated intakes of vitamin C in the various age groups are presented in the tables below. The tables summarise intakes from the diet alone, vitamin C containing supplements alone (users only) and total intakes from both diet and supplements (Tables 1-4). In adults, intakes are also estimated separately for women and men.

Table 1: Estimated vitamin C intakes from diet alone in various age groups (mg/day).

	Adults (n=1787)	13 years (n=1005)	9 years (n=810)	4 years (n=391)	2 years (n=1674)
Vitamin C from diet alone, mean	108	89	84	66	59
Vitamin C from diet alone, median	91	78	76	61	51
Vitamin C from diet alone, P5	22	24	29	26	19
Vitamin C from diet alone, P25	53	50	52	45	36
Vitamin C from diet alone, P75	145	114	105	82	74
Vitamin C from diet alone, P95	251	197	161	125	122

Table 2: Estimated intakes from vitamin C supplements alone (users only) and total intakes from diet and supplements in various age groups (mg/day).

	Adults (n=446)	13 years (n=254)	9 years (n=291)	4 years (n=197)	2 years (n=565)
Total vitamin C from food and supplements, mean	238	156	131	104	87
Total vitamin C from food and supplements, median	167	137	116	96	78
Total vitamin C from food and supplements, P5	60	50	55	47	33
Total vitamin C from food and supplements, P25	110	97	88	69	56
Total vitamin C from food and supplements, P75	263	191	164	127	105
Total vitamin C from food and supplements, P95	655	318	254	191	178

	Adults (n=446)	13 years (n=254)	9 years (n=291)	4 years (n=197)	2 years (n=565)
Vitamin C from supplements alone, mean	125	62	41	36	26
Vitamin C from supplements alone, median	45	45	30	30	22
Vitamin C from supplements alone, P5	13	7	8	6	4
Vitamin C from supplements, P25	30	19	19	15	13
Vitamin C from supplements, P75	100	75	50	45	32
Vitamin C from supplements, P95	500	160	123	100	70

Table 3 Estimated intakes of vitamin C in girls and women from the diet alone, vitamin C containing supplements alone (users only) and total intakes from both diet and supplements (users only) (mg/day).

	Adults (n=925)	13 years (n=515)	9 years (n=408)
Vitamin C from diet alone, mean	111	85	81
Vitamin C from diet alone, median	97	76	75
Vitamin C from diet alone, P5	25	25	28
Vitamin C from diet alone, P25	57	49	51
Vitamin C from diet alone, P75	147	108	100
Vitamin C from diet alone, P95	244	186	156
Total vitamin C from food and supplements, mean	146	103	95
Total vitamin C from food and supplements, median	113	85	85
Total vitamin C from food and supplements, P5	28	26	31
Total vitamin C from food and supplements, P25	68	55	57
Total vitamin C from food and supplements, P75	173	134	116
Total vitamin C from food and supplements, P95	333	220	201

Table 4 Estimated intakes of vitamin C in boys and men from the diet alone, vitamin C containing supplements alone (users only) and total intakes from both diet and supplements (users only) (mg/day).

	Adults (n=862)	13 years (n=490)	9 years (n=402)
Vitamin C from diet alone, mean	105	93	87
Vitamin C from diet alone, median	84	79	79
Vitamin C from diet alone, P5	21	23	29
Vitamin C from diet alone, P25	49	51	54
Vitamin C from diet alone, P75	141	119	108

	Adults (n=862)	13 years (n=490)	9 years (n=402)
Vitamin C from diet alone, P95	258	206	169
Total vitamin C from food and supplements, mean	132	106	102
Total vitamin C from food and supplements, median	96	90	93
Total vitamin C from food and supplements, P5	22	25	36
Total vitamin C from food and supplements, P25	55	56	64
Total vitamin C from food and supplements, P75	162	136	125
Total vitamin C from food and supplements, P95	316	245	205

Summary tables of calcium intake for all age groups

Estimated intakes of calcium in the various age groups are presented in the tables below. The tables summarise intakes from the diet alone, calcium containing supplements alone (users only) and total intakes from both diet and supplements (Tables 5-9). In adults, intakes are also estimated separately for women and men.

Table 5: Estimated calcium intakes from diet alone in various age groups (mg/day).

	Adults (n=1787)	13 years (n=1005)	9 years (n=810)	4 years (n=391)	2 years (n=1674)
Calcium from diet alone, mean	918	858	833	675	787
Calcium from diet alone, median	834	783	801	641	747
Calcium from diet alone, P5	339	335	366	360	332
Calcium from diet alone, P25	601	558	624	530	551
Calcium from diet alone, P75	1146	1047	999	797	961
Calcium from diet alone, P95	1745	1674	1398	1047	1424

Table 6 Estimated intakes from calcium in supplements alone (users only) and total intakes from diet and supplements in various age groups (mg/day).

	Adults n=113	13 years n=5	9 years n=8	4 years n=5	2 years n=78
Total calcium from food and supplements, mean	1167	844	927	997	981
Total calcium from food and supplements, median	1077	670	926	950	916
Total calcium from food and supplements, P5	502	-	-	-	393
Total calcium from food and supplements, P25	775	-	-	-	654
Total calcium from food and supplements, P75	1426	-	-	-	1219
Total calcium from food and supplements, P95	2210	-	-	-	1774
Calcium from supplements alone, mean	248	137	227	400	128
Calcium from supplements alone, median	150	63	188	500	125
Calcium from supplements alone, P5	25	-	-	-	36
Calcium from supplements, P25	83	-	-	-	63

	Adults n=113	13 years n=5	9 years n=8	4 years n=5	2 years n=78
Calcium from supplements, P75	359	-	-	-	124
Calcium from supplements, P95	930	-	-	-	256

Table 7 Estimated intakes of calcium in girls and women from the diet alone, calcium containing supplements alone (users only) and total intakes from both diet and supplements (users only) (mg/day).

	Adults (n=925)	13 years (n=515)	9 years (n=408)
Calcium from diet alone, mean	809	785	752
Calcium from diet alone, median	764	732	746
Calcium from diet alone, P5	317	295	313
Calcium from diet alone, P25	547	535	568
Calcium from diet alone, P75	1027	962	921
Calcium from diet alone, P95	1501	1412	1260
Total calcium from food and supplements, mean	834	785	756
Total calcium from food and supplements, median	779	732	747
Total calcium from food and supplements, P5	320	295	313
Total calcium from food and supplements, P25	555	538	568
Total calcium from food and supplements, P75	1051	962	930
Total calcium from food and supplements, P95	1525	1412	1275

Table 8 Estimated intakes of calcium in boys and men from the diet alone, calcium containing supplements alone (users only) and total intakes from both diet and supplements (users only) (mg/day).

	Adults (n=862)	13 years (n=490)	9 years (n=402)
Calcium from diet alone, mean	1035	935	916
Calcium from diet alone, median	939	835	867
Calcium from diet alone, P5	390	349	451
Calcium from diet alone, P25	696	597	693
Calcium from diet alone, P75	1295	1161	1076
Calcium from diet alone, P95	2032	1869	1576
Total calcium from food and supplements, mean	1041	936	917
Total calcium from food and supplements, median	941	835	878
Total calcium from food and supplements, P5	393	349	451
Total calcium from food and supplements, P25	706	598	693
Total calcium from food and supplements, P75	1300	1161	1076
Total calcium from food and supplements, P95	2040	1869	1576

Table 9 Estimated intakes of total calcium in men and women from both diet and supplements (users only) (mg/day).

	Men (n=30)	Women (n=83)
Total calcium from food and supplements, mean	1305	1116
Total calcium from food and supplements, median	1151	1061
Total calcium from food and supplements, P5	-	500
Total calcium from food and supplements, P25	-	774
Total calcium from food and supplements, P75	-	1339
Total calcium from food and supplements, P95	-	2073