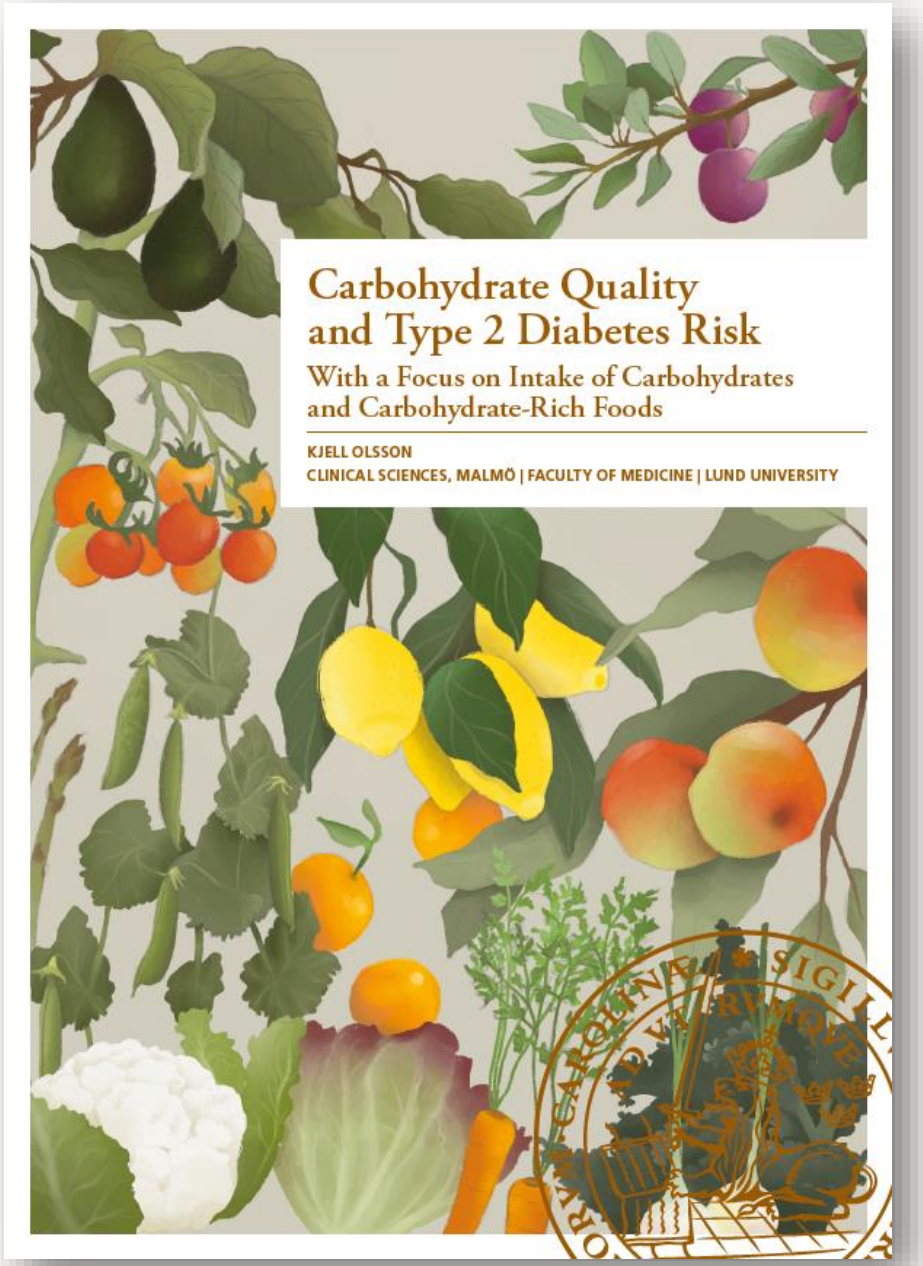


Inkluderade artiklar

I. Olsson K, Ramne S, González-Padilla E, Ericson U, Sonestedt E. Associations of carbohydrates and carbohydrate-rich foods with incidence of type 2 diabetes. **Br J Nutr**. 2021 Oct 14;126(7):1065-1075.

II. Olsson K, González-Padilla E, Janzi S, Stubbendorff A, Borné Y, Ramne S, Ericson U, and Sonestedt E. Clusters of carbohydrate-rich foods and associations with type 2 diabetes incidence: a prospective cohort study. **Nutr J**. 2023 Dec 18;22(1):71.

III. Ramstedt M, Janzi S, **Olsson K**, González-Padilla E, Ramne S, Borné Y, Ericson U, Sonestedt E. Comparisons of Different Carbohydrate Quality Indices for Risk of Type 2 Diabetes in the Malmö Diet and Cancer Study. **Nutrients**. 2023 Sep 5;15(18):3870.

IV. Zhang S, Stubbendorff A, **Olsson K**, Ericson U, Niu K, Qi L, Borné Y, Sonestedt E. Adherence to the EAT-Lancet diet, genetic susceptibility, and risk of type 2 diabetes in Swedish adults. **Metabolism**. 2023 Apr;141:155401.

V. Olsson K, Janzi S, Stubbendorff A, Borné Y, Ericson U, and Sonestedt E. Associations between intake of sub-types of fruits and vegetables with incident type 2 diabetes in a cohort in southern Sweden. **Manuscript**.

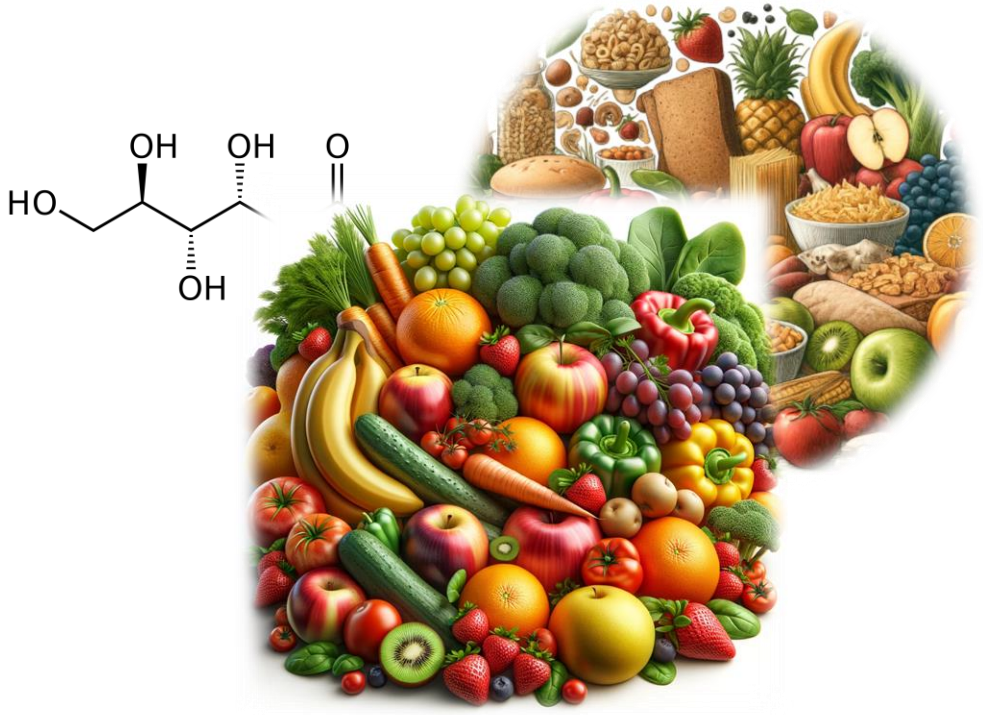
Bakgrund

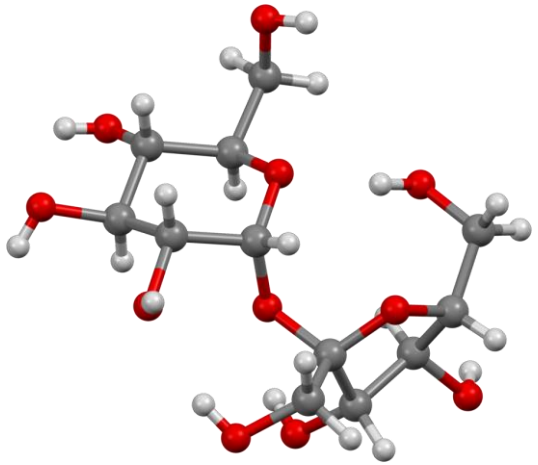
>500 miljoner vuxna lever med diabetes idag

Beräknas stiga till **800 miljoner** till år 2045

Intag av **kolhydrater & kolhydratrika livsmedel** har kopplats till **ökad risk för typ 2 diabetes**

Kolhydraternas kvalitet tycks vara viktigare än mängd eller andel kolhydrater I kosten





Studie II

Studie III

Studie IV

Studie I

Studie V

Studie I

Övergripande syfte

Att studera sambandet mellan **kolhydratkvalitet** och **risken att utveckla typ 2-diabetes**

Kostundersökning i 3 delar

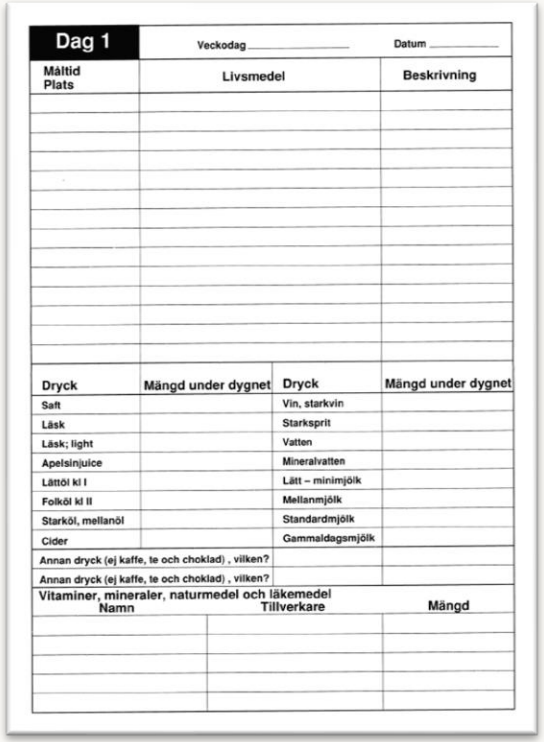
Exempel

Pålägg

Hur många smörgåsar (även knäckebröd) äter Du med pålägg per dag? 5 skivor per dag
Fördela dessa på de olika pålägginen nedan.

	Äter sällan eller aldrig	Antal brödskivor med pålägg per dag	per vecka	Antal skivor av pålägget per brödskiva	Se bild	Mängd per brödskiva Ringa in
Gräddost; hyvlade skivor typ Åseda, Västervik	✓	2		1	12	A B C D
Hårdost; hyvlade skivor	✓				12	A B C D
Mager hårdost; hyvlade skivor		5		2	13	A B C D
Påläggskorv typ salami	✓					
Påläggskorv typ medvurst	✓	2		1	13	A B C D
Skinka, saltkött, hamburgerkött	✓					
Leverkorv						
Leverpastej, leverkorv; bredbar	✓	1			14	A B C D
Mager leverpastej; bredbar	✓					
Mjukost typ Kavli, NNP	✓					
Mager mjukost typ Kavli, NNP						
Marmelad, honung		1				

5

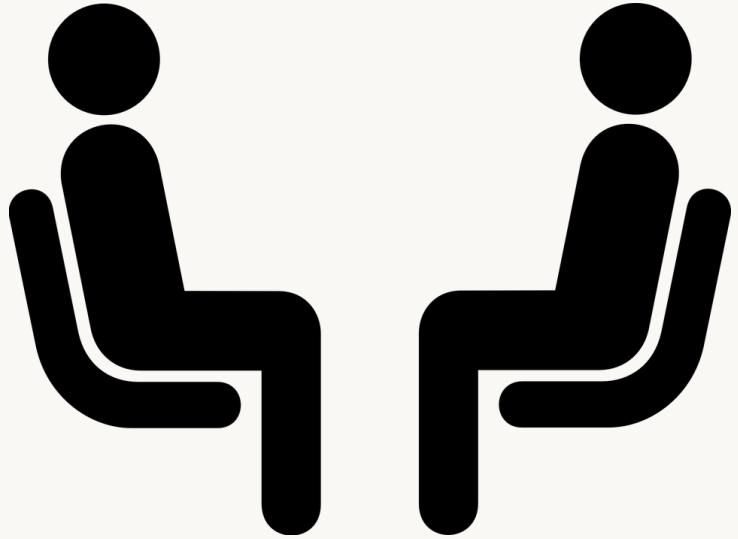


Dag 1 Veckodag _____ Datum _____

Måltid Plats	Livsmedel	Beskrivning

Dryck	Mängd under dygnet	Dryck	Mängd under dygnet
Saft		Vin, starkvin	
Läsk		Starksprit	
Läsk; light		Vatten	
Apelsinjuice		Mineralvatten	
Lättöl kl I		Lätt – minimjölk	
Folköl kl II		Mellanmjölk	
Starköl, mellanöl		Standardmjölk	
Cider		Gammaldagsmjölk	
Annan dryck (ej kaffe, te och choklad) , vilken?			
Annan dryck (ej kaffe, te och choklad) , vilken?			

Vitaminer, mineraler, naturmedel och läkemedel Namn	Tillverkare	Mängd



Frekvensformulär

Matdagbok

Kostintervju

Diabetesfall – register och screening

Swedish National Diabetes Register

HbA1c Register, Clinical Chemistry, SUS, Malmö

Diabetes 2000 – Scania Diabetes Registry

ANDIS – All New Diabetics in Scania

National Board of Health and Welfare:

National Inpatient Registry

Hospital-based Outpatient Care

Cause-of-Death Register

Swedish Prescribed Drug Register

Cohort rescreening:

MDC baseline - cardiovascular cohort (1992-1994)

MDC 5-year rescreening (1997-2001)

Malmö Preventive Project rescreening (2002-2006)

MDC cardiovascular rescreening (2007-2012)

STUDIE I

ASSOCIATIONS OF CARBOHYDRATES AND CARBOHYDRATE-RICH FOODS WITH INCIDENCE OF TYPE 2 DIABETES

Olsson K, Ramne S, González-Padilla E, Ericson U, Sonestedt E

British Journal of Nutrition (2021), 126, 1065–1075 doi:10.1017/S0007114520005140
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Associations of carbohydrates and carbohydrate-rich foods with incidence of type 2 diabetes

Kjell Olsson[1]*, Stina Ramne[1], Esther González-Padilla[1], Ulrika Ericson[2] and Emily Sonestedt[1]

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[2]*Diabetes and Cardiovascular Disease-Genetic Epidemiology, Department of Clinical Sciences Malmö, Lund University, SE-21428 Malmö, Sweden*

(Submitted 12 August 2020 – Final revision received 10 December 2020 – Accepted 13 December 2020 – First published online 23 December 2020)

Abstract

Dietary carbohydrates have long been expected to be associated with risk of type 2 diabetes; however, the associations for many carbohydrates and carbohydrate-rich foods remain inconclusive. This study analysed associations between intakes of six types of carbohydrates and thirteen carbohydrate-rich foods with incident type 2 diabetes in 26 622 participants (61 % women) in the Malmö Diet and Cancer Study in southern Sweden. Dietary intake was assessed at baseline (1991–1996) by using a modified diet history method. During mean follow-up of 18 years, 4046 cases were identified. Adjusting for potential confounders (including lifestyle, BMI and dietary factors), comparing highest *v.* lowest quintile of intake, monosaccharides (hazard ratio (HR) 0·88; 95 % CI 0·79, 0·98; P_{trend} = 0·02) and fruits (HR 0·91; 95 % CI 0·82, 1·01; P_{trend} = 0·03) were inversely associated with incident type 2 diabetes, while disaccharides (HR 1·17; 95 % CI 1·04, 1·30; P_{trend} = 0·002) and sweets (HR 1·09; 95 % CI 1·00, 1·19; P_{trend} = 0·02) were positively associated. After stratification by sex, marmalade/honey/jam (HR 0·82; 95 % CI 0·72, 0·94; P_{trend} < 0·001) and vegetables (HR 0·85; 95 % CI 0·73, 0·98; P_{trend} = 0·06) were inversely associated with incident type 2 diabetes in men and chocolate (HR 1·26; 95 % CI 1·09, 1·46; P_{trend} < 0·001) was positively associated in women. In conclusion, we identified inverse associations for intake of monosaccharides and fruits with type 2 diabetes risk, and positive associations for disaccharides and sweets. Additional sex-specific associations were also identified. Future studies are needed to explore these associations further.

Key words: **Carbohydrates: Carbohydrate-rich foods: Epidemiology: Malmö Diet and Cancer Study: Type 2 diabetes**

In 2019, an estimated 463 million adults were living with diabetes worldwide and the prevalence is expected to increase to 700 million by 2045[1]. Roughly, nine out of ten diabetes cases worldwide are of type 2. The estimated global health expenditure due to diabetes is currently about 760 billion US dollars annually.

Diet is one of the main modifiable risk factors for type 2 diabetes, due to its effect on post-prandial glucose levels, insulin resistance and obesity[2]. Dietary carbohydrates have long been predicted to be associated with risk of type 2 diabetes; however, the metabolic effect differs between different carbohydrates and carbohydrate-rich foods. For example, a higher intake of sugar-sweetened beverages has been associated with greater risk of type 2 diabetes, while a higher intake of whole grains has been found to be protective[3–5]. Apart from these findings, however, most associations between carbohydrates and carbohydrate-rich foods with incident type 2 diabetes remain largely inconclusive[6,7]. For example, few studies have examined different sugars in relation to type 2 diabetes risk, and they have shown conflicting results[6,8]. Similarly, evidence of a protective effect from vegetable and fruit intake is still inadequate[9].

Studies on dietary carbohydrates are often focused on individual nutrients, for example, fibres and sugars, as well as foods and food groups with a high carbohydrate content[9]. Adapting a broad approach, studying the effects of multiple carbohydrates and carbohydrate-rich foods on health outcomes, can provide a better understanding of healthy dietary patterns. Findings from large-scale studies with long follow-up are needed to provide further evidence of the associations with type 2 diabetes risk[6,8,10]. The aim of this study was to analyse the associations between intake of different types

Abbreviation: HR, hazard ratio.

***Corresponding author:** Kjell Olsson, email kjell.olsson@med.lu.se

Syfte

Analysera samband mellan intag av olika typer av kolhydrater och kolhydratrika livsmedel och incidens av typ 2-diabetes.

Study I

MACRONUTRIENTS

Carbohydrates
Monosaccharides
Disaccharides
Sucrose
Added sugar
Fibre

FOODS

Whole grains
Refined grains
Potato
Fruit
Vegetables
Juice
Sugar-sweetened beverages
Table sugar
Sweets
Chocolate
Ice cream
Pastries
Marmalade/Honey/Jam

4 046 cases in 18 years of follow-up

OUTCOME

Incidence of type 2 diabetes

Method

Survival analysis
Cox proportional hazard regression
Hazard ratios Q5 vs. Q1 (95% CI)

P for trend
Interaction with sex

Basic model
sex
age
diet method version
season
total energy intake

Extended model excl. BMI
sex
age
diet method version
season
total energy intake
leisure-time physical activity
alcohol
smoking habits
level of education

Extended model incl. BMI
sex
age
diet method version
season
total energy intake
leisure-time physical activity
alcohol
smoking habits
level of education
BMI

Extended model incl. diet & BMI
sex
age
diet method version
season
total energy intake
leisure-time physical activity
alcohol
smoking habits
level of education
BMI
coffee
meat
whole grains
sugar-sweetened beverages

Results

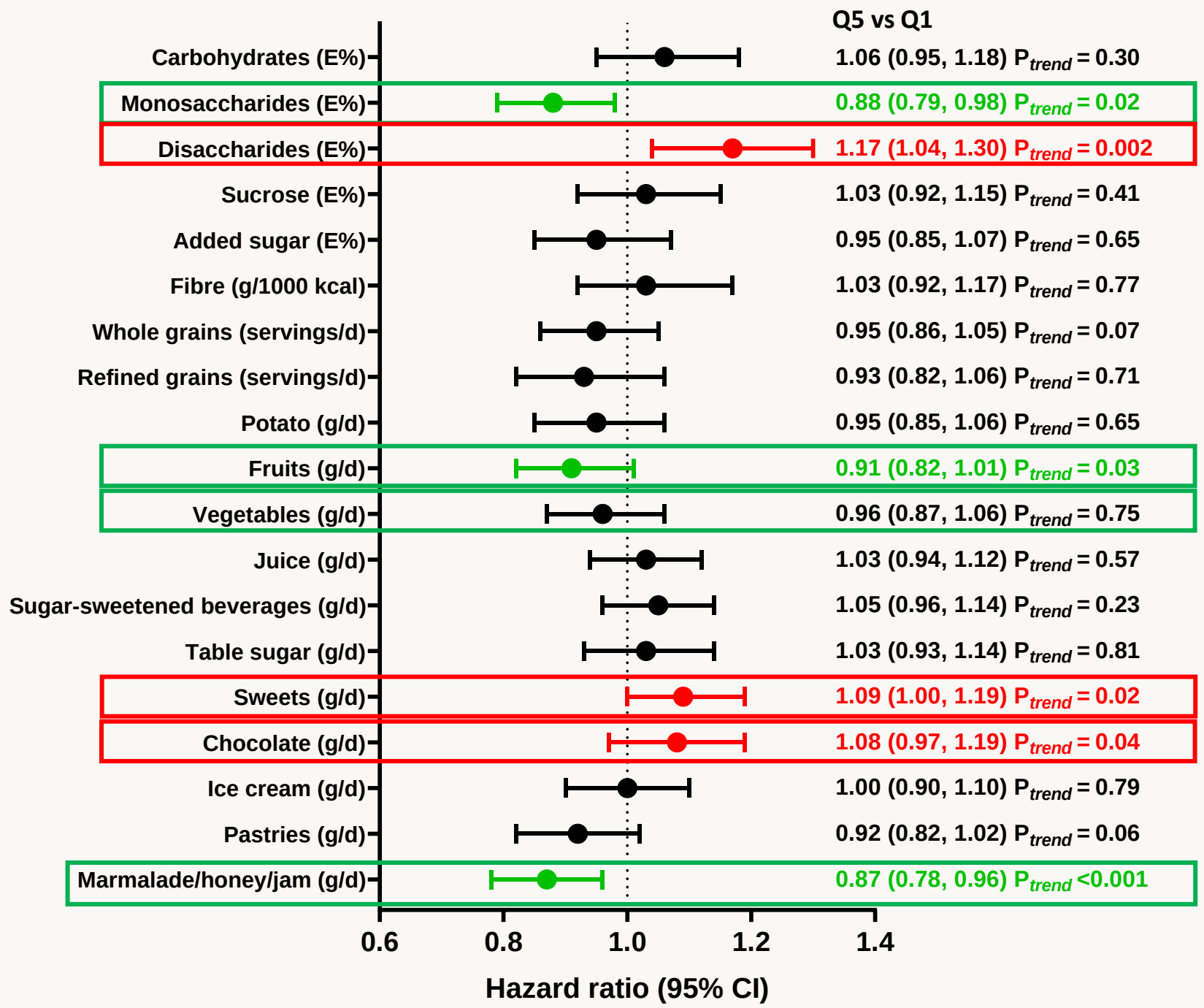
♂

Vegetables
HR 0.85 (0.73, 0.98) P_{trend} = 0.06

Marmalade/honey/jam
HR 0.82 (0.72, 0.94) P_{trend} < 0.001

♀

Chocolate
HR 1.26 (1.09, 1.46) P_{trend} < 0.001



Slutsats

Monosackarider och **frukt** var kopplat till **lägre risk** för typ 2-diabetes.

Disackarider och **sötsaker** var kopplat till en **ökad** risk.

Grönsaker och **marmelad/honung/sylt** var kopplat till en **lägre risk** hos **män**.

Choklad var kopplat till en **ökad risk** hos **kvinnor**.

STUDIE II

CLUSTERS OF CARBOHYDRATE-RICH FOODS AND ASSOCIATIONS WITH TYPE 2 DIABETES INCIDENCE: A PROSPECTIVE COHORT STUDY

Olsson K, González-Padilla E, Janzi S, Stubbendorff A, Borné Y, Ramne S, Ericson U, Sonestedt E

Olsson et al. Nutrition Journal (2023) 22:71
https://doi.org/10.1186/s12937-023-00906-0

Nutrition Journal

RESEARCH Open Access

Clusters of carbohydrate-rich foods and associations with type 2 diabetes incidence: a prospective cohort study

Kjell Olsson[1*], Esther González-Padilla[1], Suzanne Janzi[1], Anna Stubbendorff[1], Yan Borné[1], Stina Ramne[1], Ulrika Ericson[2] and Emily Sonestedt[1]

Abstract

Background About one in ten adults are living with diabetes worldwide. Intake of carbohydrates and carbohydrate-rich foods are often identified as modifiable risk factors for incident type 2 diabetes. However, strong correlation between food variables can make it difficult to identify true associations. The purpose of this study was to identify clusters of carbohydrate-rich foods and analyse their associations with type 2 diabetes incidence in the Malmö Diet and Cancer Study cohort in southern Sweden.

Methods Dietary intake of 26 622 participants was assessed using a validated three-part diet history method: a 7-day food diary, a 168-item food frequency questionnaire, and a 60-minute interview. K-means clustering analysis identified five clusters from 21 food variables. The Cox proportional hazard regression model was applied to calculate hazard ratios (HR) and 95% confidence intervals (CI) of the association between clusters and incident type 2 diabetes.

Results The cluster analysis resulted in five clusters; *high vegetables/low added sugar*, *high sugar-sweetened beverages*, *high juice*, *high fruit*, and *high refined carbohydrates/low fruit & vegetables* (reference). During mean follow-up of 18 years, 4046 type 2 diabetes cases were identified. After adjustment for potential confounding (including lifestyle, body mass index, and diet), a *high fruit* cluster (HR 0.86; 95% CI 0.78, 0.94) was inversely associated with type 2 diabetes compared to the reference cluster. No other significant associations were identified.

Conclusions A dietary pattern defined by a high intake of fruits was associated with a lower incidence of type 2 diabetes. The findings provide additional evidence of a potential protective effect from fruit intake in reducing type 2 diabetes risk. Future studies are needed to explore this association further.

Keywords K-means clustering, Epidemiology, Malmö Diet and Cancer Study, Type 2 Diabetes, Diet, Nutrition

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BMC

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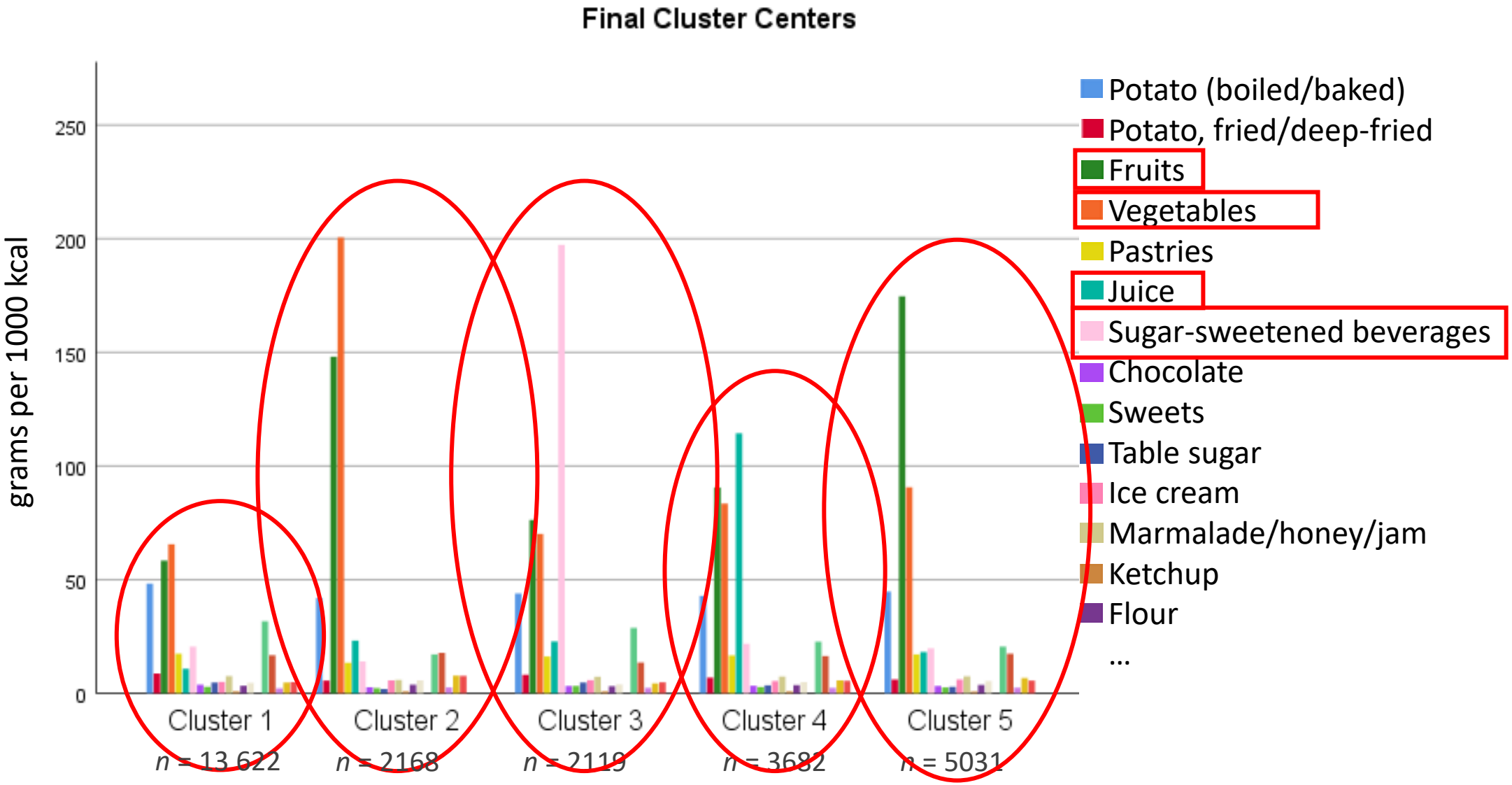
Syfte

Att identifiera kluster i intag av kolhydratrika livsmedel och analysera samband med incidens av typ 2-diabetes.

21 kostvariabler inkluderade i klusteranalys

- Potato, boiled/baked
- Potato, fried/deep-fried
- Fruits
- Vegetables
- Juice
- Sugar-sweetened beverages
- Pastries
- Chocolate
- Sweets
- Table sugar
- Ice cream
- Marmalade/honey/jam
- Ketchup
- Flour
- Rice/pasta
- Grain/cereals low fiber
- Grain/cereals high fiber
- Soft bread low fiber
- Soft bread high fiber
- Crisp bread low fiber
- Crisp bread high fiber

Results – Five Clusters



Results – Five Clusters

High refined carbohydrates/Low fruit and vegetables (Reference)

High vegetables/Low sugar

High sugar-sweetened beverages

High juice

High fruit

Results - Incidence of Type 2 Diabetes

	Model 1	Model 2	Model 3	Model 4
High refined carbs/Low fruit & veg	1.00	1.00	1.00	1.00
High vegetables/Low added sugar	1.02 (0.90, 1.15)	1.12 (0.99, 1.26)	0.98 (0.87, 1.11)	0.99 (0.88, 1.12)
High sugar-sweetened beverages	1.13 (1.01, 1.27)	1.08 (0.96, 1.21)	0.98 (0.87, 1.09)	0.97 (0.86, 1.08)
High juice	0.91 (0.83, 1.01)	0.96 (0.87, 1.06)	0.95 (0.86, 1.05)	0.95 (0.86, 1.05)
High fruit	0.87 (0.80, 0.96)	0.93 (0.84, 1.01)	0.85 (0.78, 0.93)	0.86 (0.78, 0.94)

Slutsats

Vi identifierade en **lägre risk** för **typ 2-diabetes** hos ett kostmönster primärt definierat av **ett högt fruktintag.**

STUDIE III

COMPARISONS OF DIFFERENT CARBOHYDRATE QUALITY INDICES FOR RISK OF TYPE 2 DIABETES IN THE MALMÖ DIET AND CANCER STUDY

Ramstedt M, Janzi S, Olsson K, González-Padilla E, Ramne S, Borné Y, Ericson U, Sonestedt E

nutrients

MDPI

Article

Comparisons of Different Carbohydrate Quality Indices for Risk of Type 2 Diabetes in the Malmö Diet and Cancer Study

Michaela Ramstedt [1], Suzanne Janzi [1], Kjell Olsson [1], Esther González-Padilla [1], Stina Ramne [1], Yan Borné [1], Ulrika Ericson [2] and Emily Sonestedt [1,*]

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[2] Diabetes and Cardiovascular Disease—Genetic Epidemiology, Department of Clinical Sciences Malmö, Lund University, SE-214 28 Malmö, Sweden; ulrika.ericson@med.lu.se
* Correspondence: emily.sonestedt@med.lu.se

Abstract: Carbohydrate quality might be more important than quantity to reduce type 2 diabetes (T2D) risk. Various metrics of carbohydrate quality exist; however, their associations with T2D have only been studied to a limited extent. Consequently, the aim was to investigate the association between four different pre-defined carbohydrate quality indices, with various amounts of fiber (≥1 g) and free sugar (<1 or <2 g) per 10 g of carbohydrates, and T2D risk among 26,622 individuals without diabetes from the Malmö Diet and Cancer cohort. Dietary data were collected through a food diary, diet frequency questionnaire, and interview. After a mean follow-up of 18 years, 4046 cases were identified through registers. After adjusting for potential confounders, no statistically significant associations were found for any of the indices. When excluding individuals with past dietary changes and potential misreporting of energy (36% of the population), lower risk was found for the following intake ratios: 10:1:2 carbohydrate:fiber:free sugar (HR = 0.82; 95% CI = 0.70–0.97), and 10:1&1:2 carbohydrate:fiber and fiber:free sugar, respectively (HR = 0.84; 95% CI = 0.72–0.97). Our findings indicate that adherence to a diet with high amounts of fiber and moderate amounts of free sugar in relation to total carbohydrate intake may be associated with a lower risk of T2D.

Keywords: type 2 diabetes; carbohydrates; free sugar; fiber; cohort

check for updates

Citation: Ramstedt, M.; Janzi, S.; Olsson, K.; González-Padilla, E.; Ramne, S.; Borné, Y.; Ericson, U.; Sonestedt, E. Comparisons of Different Carbohydrate Quality Indices for Risk of Type 2 Diabetes in the Malmö Diet and Cancer Study. *Nutrients* **2023**, *15*, 3870. https://doi.org/10.3390/nu15183870

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1. Introduction

Type 2 diabetes (T2D) is a chronic disease, and with its accompanying complications, such as cardiovascular disease, diabetic neuropathy, retinopathy, and nephropathy, it contributes to a wide range of public health problems around the world [1]. Today, over 400 million people have T2D [2]. T2D is characterized by prolonged hyperglycemia and an impaired metabolism of carbohydrates, proteins, and lipids [1]. Epidemiological evidence has shown that obesity is a major risk factor for T2D [1]. Other known risk factors include genetics, environmental factors, age, and lifestyle factors [3] such as diet, smoking, alcohol consumption, and a sedentary lifestyle [1,4,5]. Among the dietary factors, a higher intake of fiber, whole grains, legumes, fruits, vegetables, and coffee has been shown to be beneficial for the prevention of T2D, whereas a diet high in refined carbohydrates, sugar-sweetened beverages, processed meat, and alcohol has been associated with higher risk [1,6]. Carbohydrates in the diet have been thought to contribute to obesity, T2D, and other cardiometabolic diseases [7], but the relative proportion of total carbohydrate intake does not influence T2D noticeably [8]. Evidence from systematic reviews and meta-analyses suggests that carbohydrate quality might be more important than carbohydrate quantity in the reduction in cardiometabolic risk factors and incidence of T2D [7,9]. There are various markers of carbohydrate quality, including the content of dietary fiber, sugar, glycemic index, and glycemic load. Dietary fiber includes non-digestible carbohydrates and lignins that are

Syfte

Att utforska samband mellan **fyra olika kolhydratkvalitets-index,** med olika mängd fiber och fritt socker i relation till total mängd kolhydrater, och **risken för att utveckla typ 2-diabetes**.

Carbohydrate indices

Liu, J.; Rehm, C.D.; Shi, P.; McKeown, N.M.; Mozaffarian, D.; Micha, R. A comparison of different practical indices for assessing carbohydrate quality among carbohydrate-rich processed products in the US. *PLoS ONE* **2020**, *15*, e0231572.

Results – Incidence of Type 2 Diabetes

		Basic model	Multivariable model	Multivariable model + BMI	Excluding diet changers & misreporters Multivariable model + BMI
10:1 CHO:FI	**No**	1.00	1.00	1.00	1.00
	Yes	0.94 (0.86–1.02)	1.00 (0.92–1.08)	0.99 (0.91–1.08)	0.89 (0.79–1.01)
10:1:1 CHO:FI:FS	**No**	1.00	1.00	1.00	1.00
	Yes	1.26 (1.02–1.56)	1.27 (1.03–1.56)	1.08 (0.87–1.34)	0.79 (0.51–1.23)
10:1:2 CHO:FI:FS	**No**	1.00	1.00	1.00	1.00
	Yes	0.94 (0.85–1.03)	0.99 (0.89–1.09)	0.95 (0.86–1.05)	0.82 (0.70–0.97)
10:1 & 1:2 CHO:FI & FI:FS	**No**	1.00	1.00	1.00	1.00
	Yes	0.91 (0.83–1.00)	0.96 (0.88–1.06)	0.93 (0.85–1.02)	0.84 (0.72–0.97)

Slutsats

Trots att **lägre T2D risk** observerades hos de som åt i enlighet med kolhydratkvalitetsindexen, så var resultaten enbart statistiskt signifikanta för **10:1:2** och **10:1&1:2 indexen** efter exkludering av individer med potentiellt felrapporterat och/eller nyligen ändrat intag.

STUDIE IV

ADHERENCE TO THE EAT-LANCET DIET, GENETIC SUSCEPTIBILITY, AND RISK OF TYPE 2 DIABETES IN SWEDISH ADULTS

Zhang S, Stubbendorff A, Olsson K, Ericson U, Niu K, Qi L, Borné Y, Sonestedt E

Metabolism 141 (2023) 155401

Contents lists available at ScienceDirect

Metabolism

journal homepage: www.journals.elsevier.com/metabolism

Adherence to the EAT-Lancet diet, genetic susceptibility, and risk of type 2 diabetes in Swedish adults

Shunming Zhang [a,b,*], Anna Stubbendorff [b], Kjell Olsson [b], Ulrika Ericson [c], Kaijun Niu [d], Lu Qi [e,f], Yan Borné [b,1], Emily Sonestedt [b,*,1]

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[b] Nutritional Epidemiology, Department of Clinical Sciences Malmö, Lund University, Malmö, Sweden
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ARTICLE INFO

Keywords:
Type 2 diabetes
EAT-lancet diet
Polygenic risk score
Sustainable diet

ABSTRACT

Background and aims: In 2019, the EAT-Lancet Commission proposed a mainly plant-based diet that nurtures human health and supports environmental sustainability. However, its association with type 2 diabetes (T2D) has not been widely studied, and it remains unclear whether genetic susceptibility for T2D can modify this association. The aim was therefore to investigate the association between the EAT-Lancet diet and risk of T2D and assess whether the association differs by the genetic predisposition to T2D.

Methods: A total of 24,494 participants from the Malmö Diet and Cancer study were analyzed. Dietary intake was assessed using a modified diet history methodology, and an EAT-Lancet diet index (range from 0 to 42 points) was constructed based on the EAT-Lancet reference diet. National and local registers were used to identify T2D cases during follow-up. Cox proportional hazards regression model was applied to estimate the association between the EAT-Lancet diet index and risk of T2D. Genetic predisposition to T2D was captured based on 116 single nucleotide polymorphisms.

Results: During a median of 24.3 years of follow-up, 4197 (17.1 %) T2D cases were documented. Compared with those with the lowest adherence to the EAT-Lancet diet (≤13 points), participants who had the highest adherence (≥23 points) showed an 18 % (95 % CI: 4 %–30 %) lower risk of T2D (*P* for trend <0.01). There was no significant multiplicative interaction between genetic predisposition to T2D and the EAT-Lancet diet index (*P* = 0.59). Also, no significant additive interaction between the genetic risk and the EAT-Lancet diet was seen (*P* = 0.44). The highest risk was observed among the 22.9 % of the individuals with high genetic risk and low EAT-Lancet diet score (HR = 1.79; 95 % CI: 1.63, 1.96).

Conclusions: Our findings indicate that high adherence to the EAT-Lancet diet was associated with decreased risk of incident T2D among people with different genetic risks.

1. Introduction

Globally, the number of adults (20–79 years) living with diabetes is 537 million in 2021, and this figure is projected to rise to 783 million by 2045 [1]. Type 2 diabetes (T2D) is the most common type of diabetes, accounting for >90 % of diabetes cases. People with T2D are at increased risk of cardiovascular disease (CVD) and mortality [2]. Thus, the prevention of T2D is an urgent public health priority. Although the

Abbreviations: BMI, body mass index; CI, confidence interval; CVD, cardiovascular disease; FFQ, food frequency questionnaire; HR, hazard ratio; MDC, Malmö Diet and Cancer; MET, metabolic equivalent; PAR, population attributable risk; PRS, polygenic risk score; RERI, relative excess risk due to interaction; SD, standard deviation; SNP, single nucleotide polymorphism; T2D, type 2 diabetes.

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Syfte

Att utforska samband mellan **EAT-Lancetkosten** och **risken för typ 2-diabetes** och kartlägga huruvida ambandet skiljer sig beroende på **genetiskt anlag** för typ 2-diabetes.

Study IV

		EAT-Lancet Index Score			
		0	1	2	3
Emphasized	Vegetables	< 100 g	100-200 g	200-300 g	≥ 300 g
	Fruit	< 50 g	50-100 g	100-200 g	≥ 200 g
	Wholegrains	< 58 g	58-116 g	116-232 g	≥ 232 g
	Legumes	< 18.75 g	18.75-37.5 g	37.5-75 g	≥ 75 g
	Nuts	< 12.5 g	12.5-25 g	25-50 g	≥ 50 g
	Fish	< 7 g	7-14 g	14-28 g	≥ 28 g
	Unsaturated oils	< 10 g	10-20 g	20-40 g	≥ 50 g
Limited	Beef and lamb	≥ 28 g	14-28 g	7-14 g	< 7 g
	Pork	≥ 28 g	14-28 g	7-14 g	< 7 g
	Poultry	≥ 116 g	58-116 g	29-58 g	< 29 g
	Dairy	≥ 1000 g	500-1000 g	250-500 g	< 250 g
	Eggs	≥ 50 g	25-50 g	13-25 g	< 13 g
	Potatoes	≥ 200 g	100-200 g	50-100 g	< 50 g
	Added sugar	≥ 124 g	62-124 g	31-62 g	< 31 g

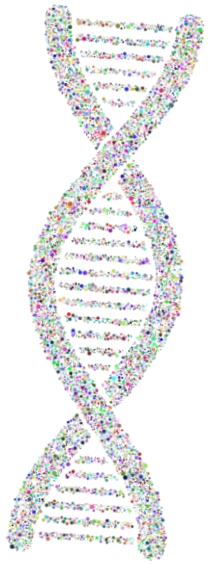
Stubbendorff A, Sonestedt E, Ramne S, Drake I, Hallström E, Ericson U (2022) Development of an EAT-Lancet index and its relation to mortality in a Swedish population. *Am J Clin Nutr* **115**:705–16.

Results – Incidence of Type 2 Diabetes

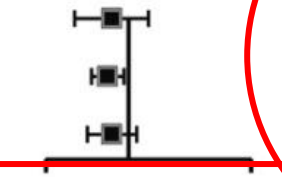
	Model 1	Model 2	Model 3	Model 4
EAT-Lancet score				
≤13	1.00	1.00	1.00	1.00
14-16	1.01 (0.90, 1.13)	1.09 (0.98, 1.22)	1.07 (0.96, 1.20)	1.04 (0.93, 1.16)
17-19	0.86 (0.77, 0.96)	0.98 (0.88, 1.10)	0.96 (0.86, 1.07)	0.90 (0.81, 1.01)
20-22	0.86 (0.76, 0.96)	1.00 (0.89, 1.13)	0.97 (0.86, 1.10)	0.94 (0.83, 1.06)
≥23	0.70 (0.60, 0.82)	0.84 (0.72, 0.99)	0.84 (0.72, 0.98)	0.82 (0.70, 0.96)
***P* for trend**	<0.0001	0.01	<0.01	<0.01

Results

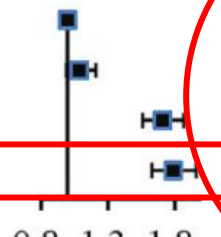
Type 2 diabetes – Polygenic Risk Score (PRS)



EAT-Lancet diet index	HR (95% CI)	*P* for interaction
Low genetic risk	0.96 (0.87, 1.05)	0.59
Medium genetic risk	0.95 (0.91, 0.99)	
High genetic risk	0.96 (0.90, 1.02)	



Joint analyses	HR (95% CI)	RERI (95% CI)
Low genetic risk-healthy diet	1.00 (reference)	
Low genetic risk-unhealthy diet	1.09 (0.99, 1.21)	-0.01 (-0.19, 0.16)
High genetic risk-healthy diet	1.71 (1.56, 1.87)	
High genetic risk-unhealthy diet	1.79 (1.63, 1.96)	



Slutsats

Vår studie indikerar att följsamhet till **EAT-Lancet diet index**, överensstämmande med EAT-Lancetkosten, var kopplat till en **lägre risk för T2D** oavsett **genetisk risk**.

STUDIE V

ASSOCIATIONS BETWEEN INTAKE OF SUB-TYPES OF FRUITS AND VEGETABLES WITH INCIDENT TYPE 2 DIABETES IN A COHORT IN SOUTHERN SWEDEN

Olsson K, Janzi S, Stubbendorff A, Borné Y, Ericson U, Sonestedt E

Associations between intake of sub-types of fruits and vegetables with incident type 2 diabetes in a cohort in southern Sweden

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Introduction

The global prevalence of adults living with diabetes is steadily increasing and is expected to grow from 537 million in 2021 to 783 million by 2045 [1]. The majority, nine out of ten, are living with diabetes type 2. Studies have associated reduced type 2 diabetes risk with a higher intake of both fruit and vegetables [2-4]. This is likely due to their high content of micronutrients, fiber and phytochemicals, as well as low energy density and glycemic load [5, 6]. Multiple studies have also shown a reduced risk of type 2 diabetes with adherence to diets that emphasize a higher fruit and vegetable intake [7-9]. In the Malmö Diet and Cancer Study (MDCS), we have previously shown that a higher fruit intake was associated with a lower risk of type 2 diabetes, while a higher intake of vegetables was associated with a lower risk in men only [10, 11]. However, only a few studies have looked at associations between consumption of specific fruits and vegetables and type 2 diabetes risk, and studies have shown heterogeneous outcomes, prompting the need for more studies [3, 12-15]. The aim of this study was to investigate the associations between intake of sub-types of fruits and vegetables with incidence of type 2 diabetes in a large, prospective cohort in southern Sweden.

Methods

Population

The study population comprised 28 098 participants enrolled in the MDCS, a prospective cohort study in southern Sweden. Recruitment and baseline assessments were conducted between January 1991 and September 1996, and included men born between 1923 and 1945, and women born between 1923 and 1950, in Malmö, Sweden. The source population encompassed 74 138 individuals, who were invited to participate in the study through advertisements and invitation letters. Only individuals with limited proficiency in Swedish or mental disabilities, hindering them from completing the baseline questionnaire, were excluded from participation. A comprehensive description of the recruitment process has been described elsewhere. For this study, further exclusion was conducted based on prevalent diabetes at baseline (*n* 1230), missing data on physical activity, smoking habits, or level of education (*n* 246), or insufficient data on fruit and vegetable intake (*n* 1991). Thus, the final study cohort consisted of 24 631 participants (61.5 % women). Ethical approval for the MDCS was obtained from the Regional Ethics Committee (LU 90-51).

Baseline assessments

The participants made two visits to the study centre during baseline assessments [16]. During their first visit, participants were briefed on the objectives of the study and the various parts of the assessments. Participants also provided their informed written consent. Anthropometric measurements were conducted, including height (to the nearest centimeter), weight (to the nearest 0.1 kg, without shoes and trousers), waist circumference, and body fat

Syfte

Att utforska samband mellan intag av **olika typer av frukt och grönsaker** och **incidens av typ 2-diabetes**.

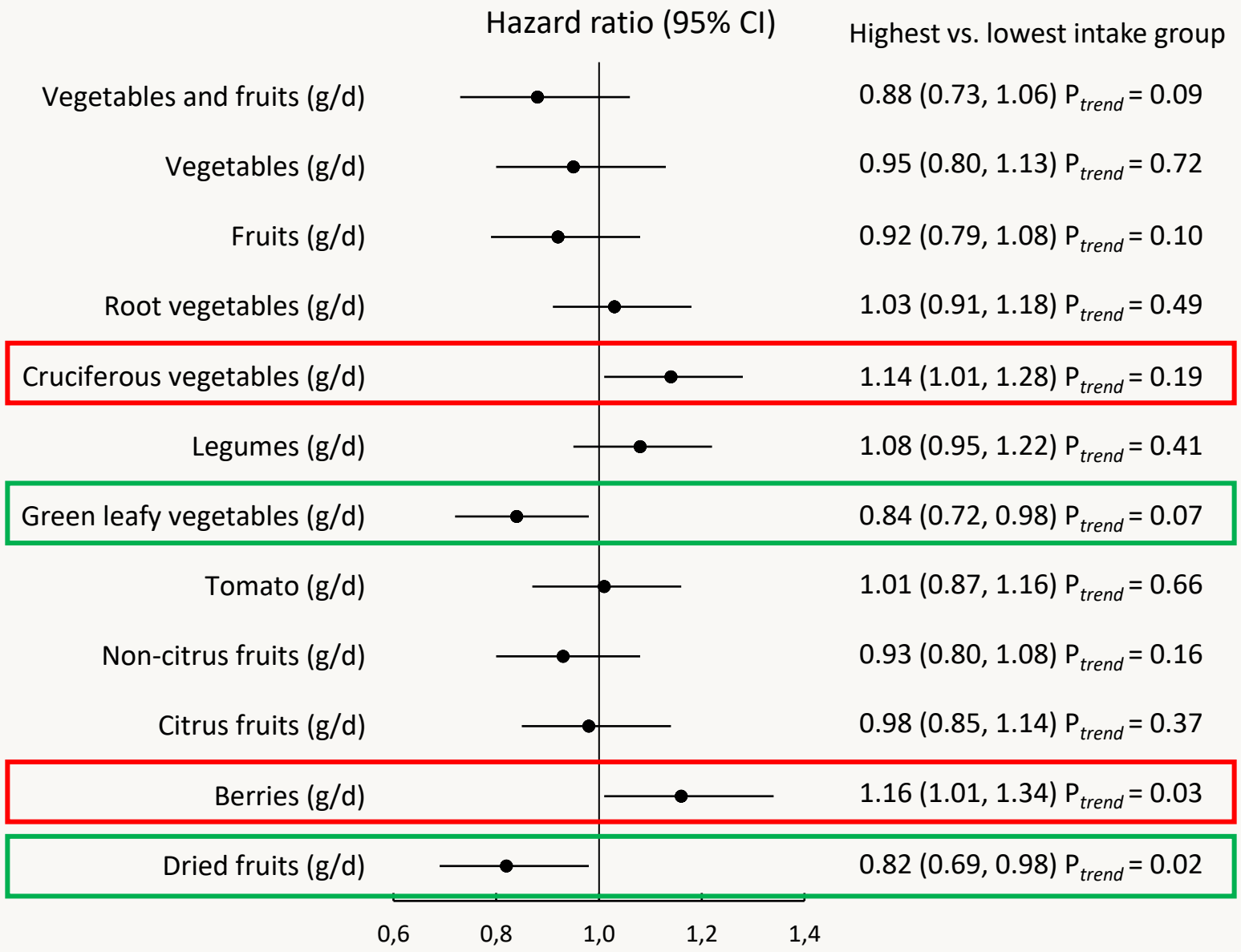
Results

♂

Root vegetables
HR 0.91 (0.74, 1.11) P_{trend} = 0.03

♀

Berries
HR 1.26 (1.05, 1.51) P_{trend} = 0.01



Slutsats

Ett högre intag av **gröna bladgrönsaker** och **torkad frukt** var båda kopplade till **lägre risk** att utveckla typ 2-diabetes. Ett högre intag av **kålgrönsaker**, å andra sidan, var kopplat till en **lägre risk**.

Ett högre intag av **bär** var kopplat till en **lägre risk** hos **kvinnor**, medan ett högre intag av rotfrukter var kopplat till **lägre risk** hos **män**.

Övergripande slutsats

Att främja ett högre intag av **frukt** och **grönsaker** (särskilt **gröna bladgrönsaker**), och **växtbaserade kostmönster** med fokus på **kolhydratkvalitet**, med ett högre intag av **kostfiber** begränsat intag av **fritt socker**, har möjlighet att **minska incidensen av typ 2-diabetes**. Detta gynnar sannolikt **hela befolkningen** samtidigt som det även gynnar **planetens hälsa**.