Ultra-processed food consumption, depression, and diabetes: results from the CARTaGENE Study

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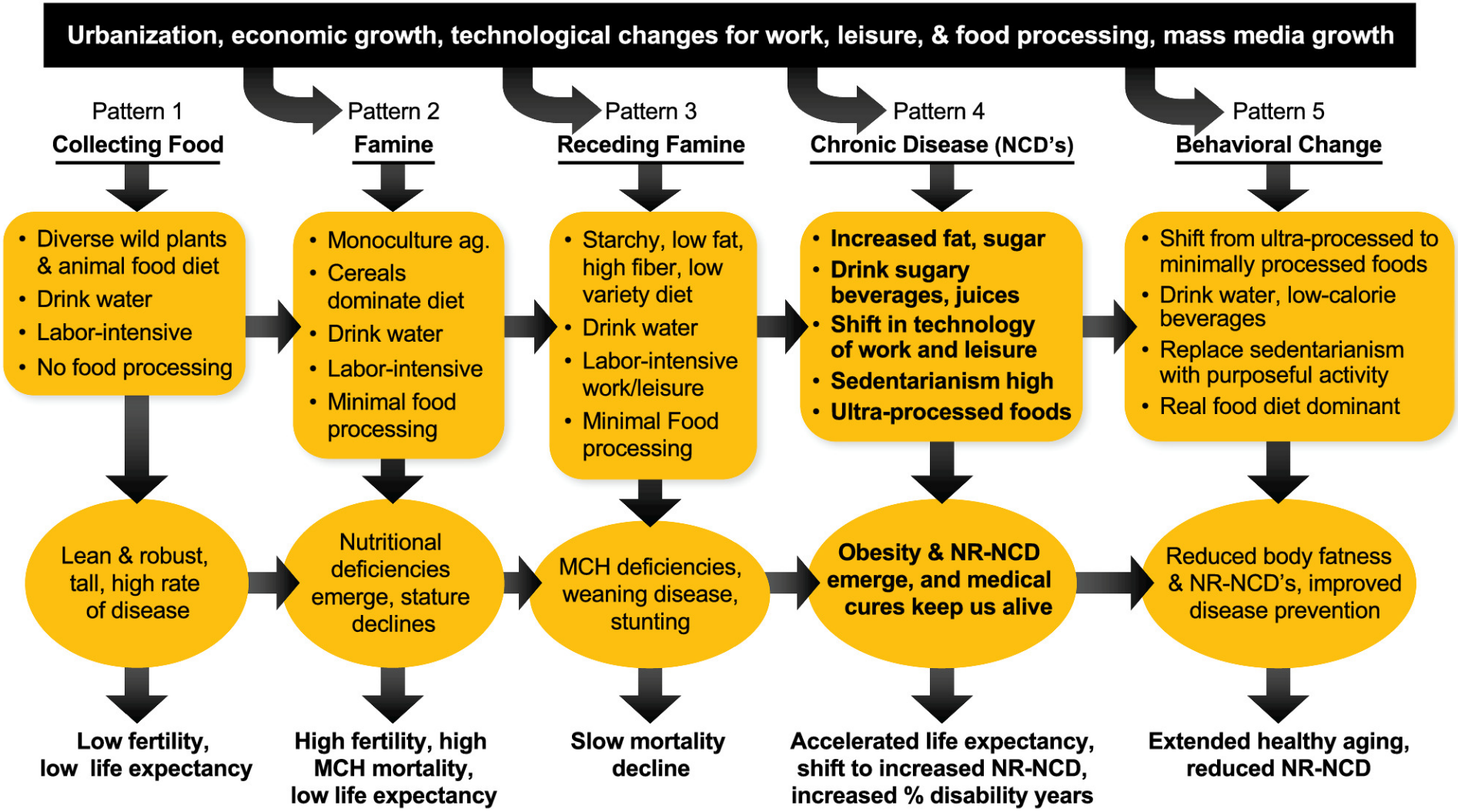
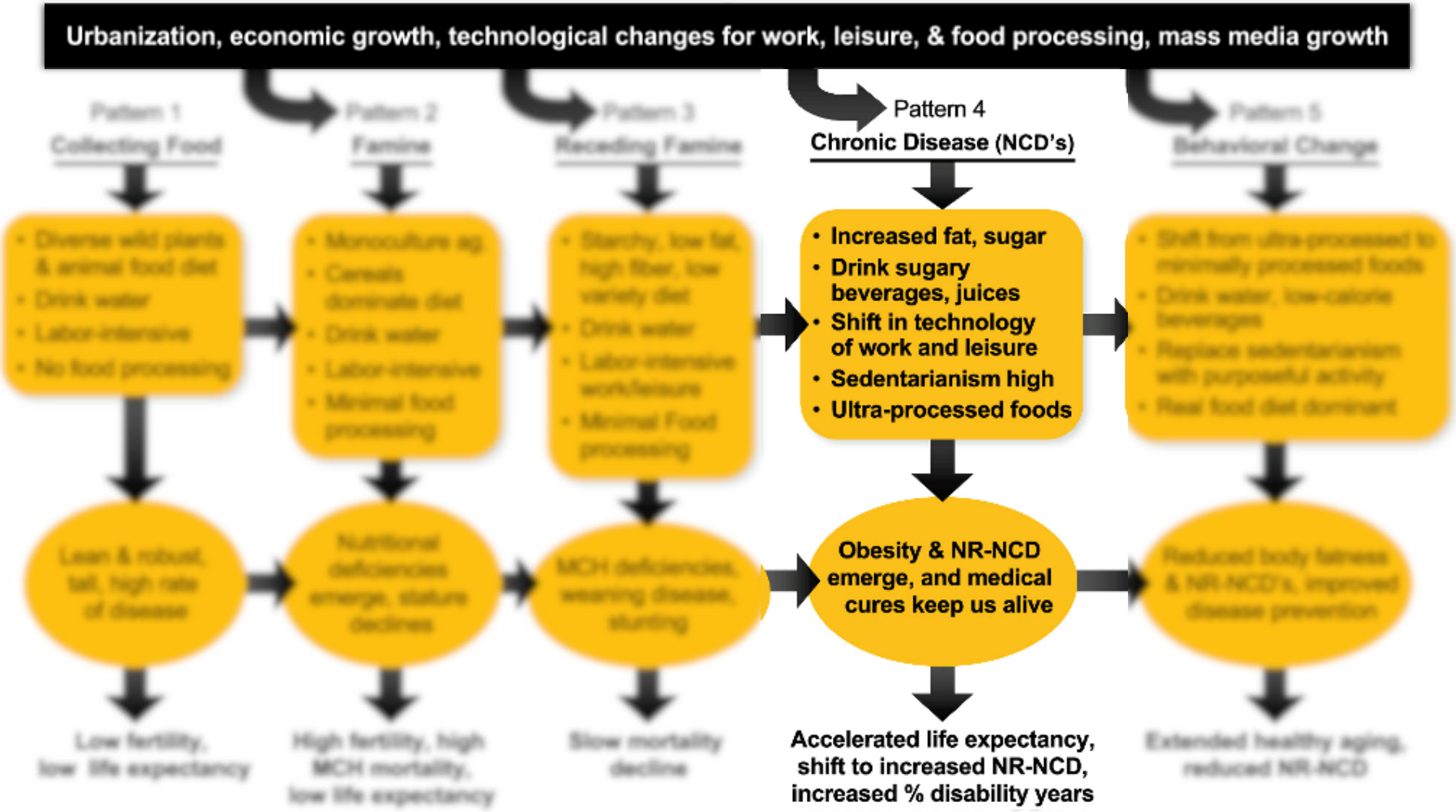
Stages of nutritional transition



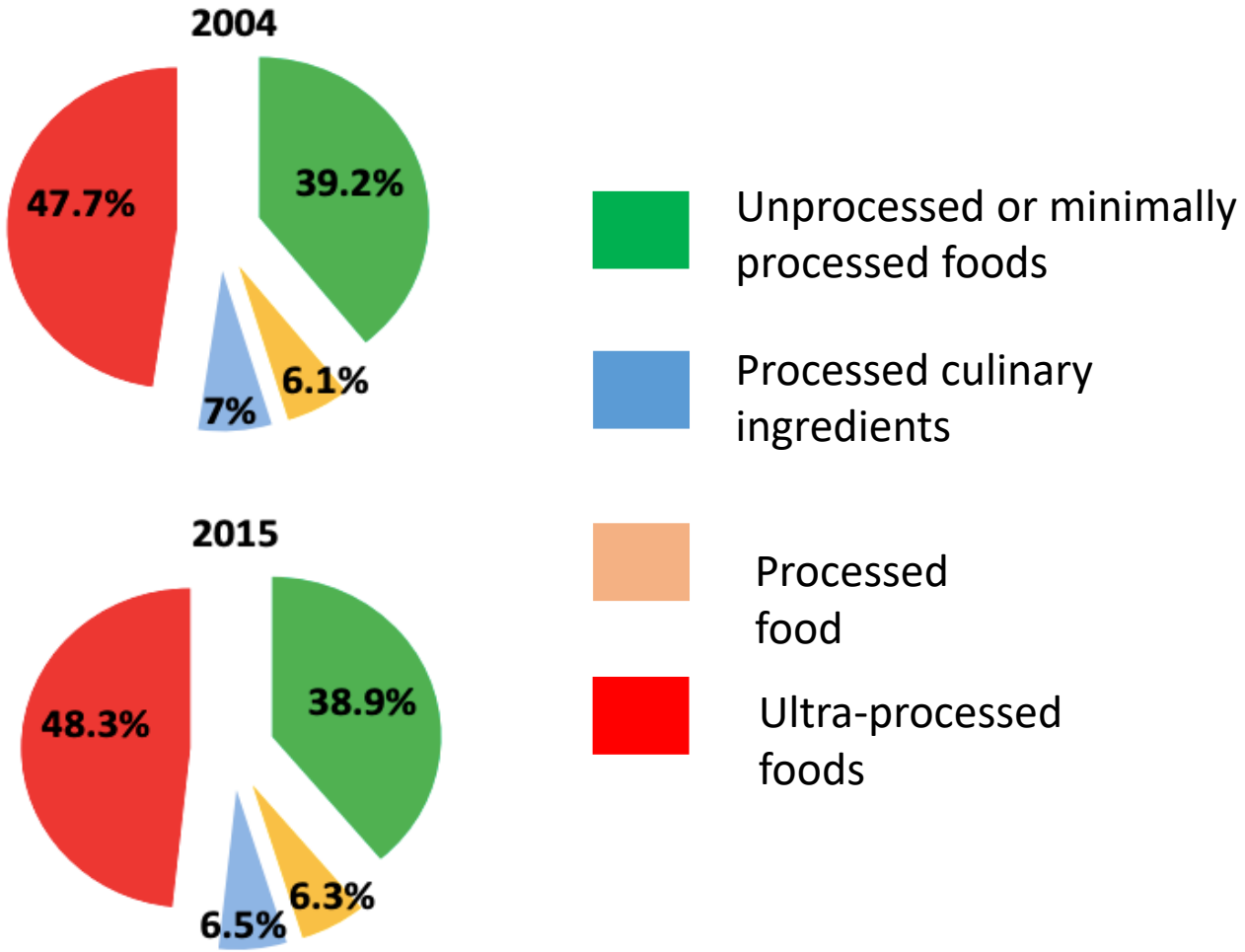
Popkin, B., & Ng, S. W. 2022 Obesity Reviews, 23(1), e13366.

Nutritional transition



Popkin, B., & Ng, S. W. 2022 Obesity Reviews, 23(1), e13366.

Distribution (%) of total daily energy intake (kcal) by NOVA food groups, Canadian population 2 years and older, 2004 and 2015



Data source: Statistics Canada: CCHS Nutrition 2004 and 2015- FID file

Overall objective

To understand how the UPF consumption in combination with depression can increase the risk of T2D incidence and its complications

STUDY ONE

Public Health Nutrition: page 1 of 10 doi:10.1017/S1368980022002373

The role of ultra-processed food consumption and depression on type 2 diabetes incidence: a prospective community study in Quebec, Canada

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To prospectively investigate the potential additive interaction between ultra processed food consumption and depression on the incidence of T2D in a Canadian community sample

Baseline data

- CARTaGENE health survey study
- Population-based, prospective cohort health study of Quebec residents
- Genetic, lifestyle, and environmental determinants of disease progression

participants

20 000

aged 40-69

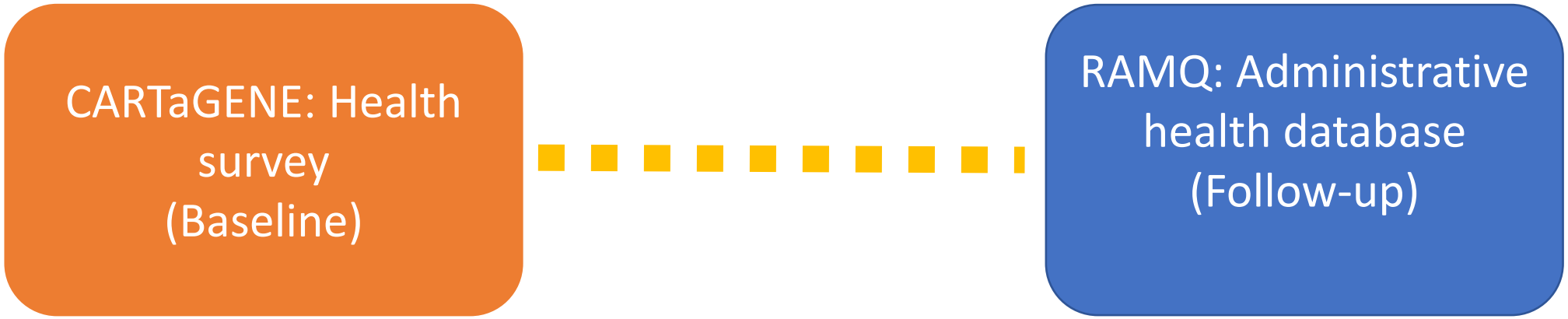
CARTaGENE

Phase A
~ 20,000 participants
(2009-2010)

Metropolitan areas	Montréal, Québec Sherbrooke, Saguenay
Sampling frame	FIPA**
Collected data	
Physical measures	☑
Health questionnaire	☑
Genealogy questionnaire***	☑
Food frequency questionnaire	☑
Residential and occupational questionnaire	☑
Biological samples	
Blood	☑
Urine	☑

* Follow-ups are done annually using a web-based portal
** Fichier d'inscription des personnes assurées (list of individuals cove
*** In collaboration with BALSAC (UQAC)

https://www.cartagene.qc.ca/en


CARTaGENE: Health survey (Baseline)
RAMQ: Administrative health database (Follow-up)

Measures

Depression : Defined either using a score of 6 and higher on the Patient Health Questionnaire-9 (PHQ-9) or antidepressant use

PATIENT HEALTH QUESTIONNAIRE-9 (PHQ-9)

Over the last 2 weeks, how often have you been bothered by any of the following problems? *(Use "✔" to indicate your answer)*	Not at all	Several days	More than half the days	Nearly every day
1. Little interest or pleasure in doing things	0	1	2	3
2. Feeling down, depressed, or hopeless	0	1	2	3
3. Trouble falling or staying asleep, or sleeping too much	0	1	2	3
4. Feeling tired or having little energy	0	1	2	3
5. Poor appetite or overeating	0	1	2	3
6. Feeling bad about yourself — or that you are a failure or have let yourself or your family down	0	1	2	3
7. Trouble concentrating on things, such as reading the newspaper or watching television	0	1	2	3
8. Moving or speaking so slowly that other people could have noticed? Or the opposite — being so fidgety or restless that you have been moving around a lot more than usual	0	1	2	3
9. Thoughts that you would be better off dead or of hurting yourself in some way	0	1	2	3

FOR OFFICE CODING 0 + _____ + _____ + _____

=Total Score: _____

If you checked off any problems, how difficult have these problems made it for you to do your work, take care of things at home, or get along with other people?

Not difficult at all	Somewhat difficult	Very difficult	Extremely difficult
☐	☐	☐	☐

1 Deschênes, S. S et al Psychosomatic Medicine 2020; 82(3), 296-304

Measures

Dietary assessment: Canadian Diet History Questionnaire II (C DHQ-II)

- 165 questions related to food, portion size, frequency, and nutritional supplement use during the last 12 months
- DHQ II recorded a typical Canadian portion size for each item
- Consumption frequencies were measured into ten categories ranging from: 1-6 times per year to 2 or more times per day
- Daily consumption of each items was calculated
- Portions of consumed food items were converted into grams by using the nutrient database for the C-DHQII
- Consumed amount for every food item: Frequency per day **X** Grams of consumption
- NOVA classification

NOVA classification

- Extent and purpose of food processing
- First proposed by a team of investigators at the University of São Paulo led by Prof Carlos Monteiro in 2009
- Canada, the United States, Europe, and many Latin American

Monteiro, C. A et al Public health nutrition 2017; 21(1), 5-17
https://www.heartandstroke.ca/-/media/pdf-files/canada

NOVA classification system

Unprocessed or minimally processed foods

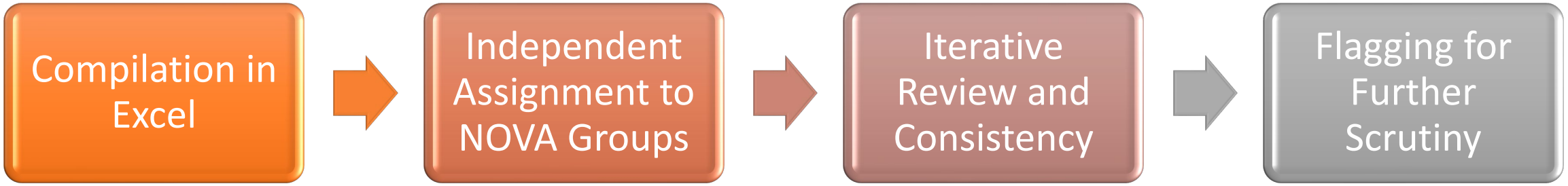
Processed culinary ingredients

Processed foods

Ultra-processed foods

NOVA classification system

Four-Stage Identification Process



Inclusion and exclusion criteria

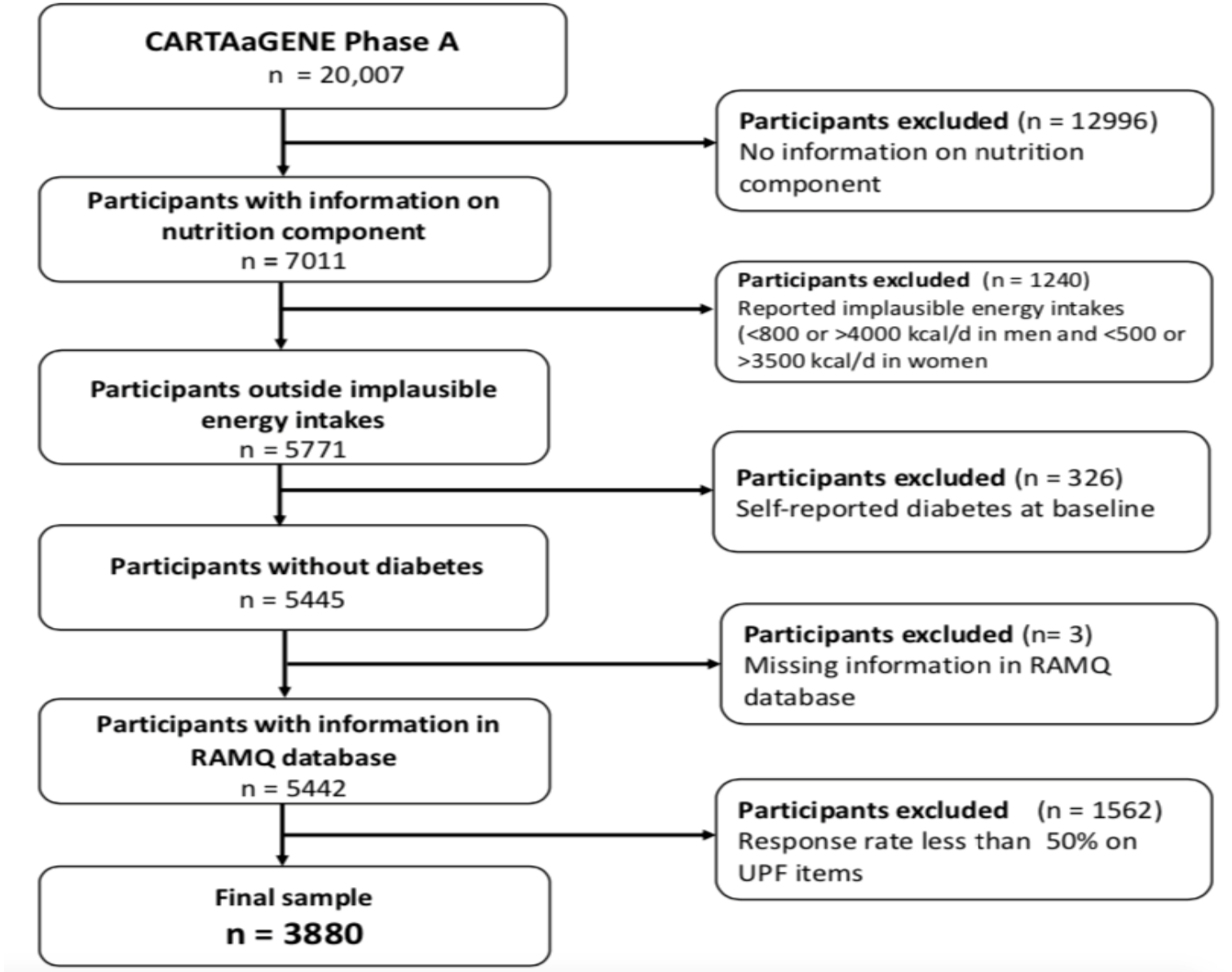


Fig. 1 Flow diagram of the final sample for the analysis. RAMQ, Régie de l'Assurance Maladie du Québec; UPF, ultra-processed foods

Cox proportional hazards

Exposure

a) Lower/middle tertile of UPF and low depressive symptoms (LUND as the reference group)
b) Lower/middle tertile of UPF and high depressive symptoms (LUD)
c) Higher tertile of UPF and low depressive symptoms (HUND)
d) Higher tertile of UPF and high depressive symptoms (HUD)

CARTaGENE
Baseline (2009-2010)

7 year of follow-up

Outcome

Incidence of T2D

Hazard ratios and 95% confidence intervals

RAMQ
Administrative health database
2016

Survival analyses was be performed in unadjusted models and models adjusted for covariates

Cox proportional hazards

Exposure

a) Lower/middle tertile of UPF and low depressive symptoms and no antidepressant use (LUNDA as the reference group)
b) Lower/middle tertile of UPF and high depressive symptoms or antidepressant use (LUDA)
c) Higher tertile of UPF and low depressive symptoms and no antidepressant use (HUNDA)
d) Higher tertile of UPF and high depressive symptoms or antidepressant use (HUDA)

CARTaGENE
Baseline (2009-2010)

7 year of follow-up

Outcome

Incidence of T2D

Hazard ratios and 95% confidence intervals

RAMQ
Administrative health database
2016

Survival analyses was be performed in unadjusted models and models adjusted for covariates

Baseline characteristics of the study sample

- The sample was on average 54·2 years old
- Participants in the higher tertile of UPF and high depressive symptoms group (HUD) had a higher mean intake of UPF: 605 (711·5) g/d
- A total of 263 (6·8 %) individuals developed T2D during the observation period

Contribution of each food group to total amount of ultra-processed foods consumed in the CARTaGENE study cohort

Food groups (*n* 37)	Contribution to total ultra-processed foods intake (%)*	Daily amount consumed mean g/d	SD
Beverages (*n* 7)			
Dairy beverages	5·3	11·8	38·3
Soft/isotonic drinks	44·0	99·3	294·6
Fruit drinks	4·5	10·2	87·4
Solid foods (*n* 30)			
Processed meat	4·5	10·2	15·2
Fast food and ready to eat	11·2	25·4	27·9
Breakfast cereals	4·5	10·1	14·5
Cookies, biscuits, muffins and cake	11·7	26·5	37·7
Potato chips and salty snacks	3·4	7·6	10·5
Confectionery and chocolate	2·8	6·3	15·3
Ketchup, salad dressing and similar	4·5	10·2	12·3
Ice-cream	2·3	5·2	10·6
Jelly and jams products	1·4	3·1	6·1
Total	100	225·8	331·8

*Contribution (%) of each food group/beverage to the total consumption of ultra-processed food was calculated by dividing the amount (g/d) of each food group by the total amount of ultra-processed foods (g/d) multiplied by 100.

Results of Cox regression for UPFs consumption and depression assessed using PHQ9 and anti-depressant for incident type 2 diabetes

Groups	N	Fully Adjusted Model, HR (95% CI) *
Model 1: UPFs consumption univariate association		
Lower tertile Of UPFs consumption	1293	Reference
Middle tertile Of UPFs consumption	1294	1.26 (0.91. -1.74)
Higher tertile Of UPFs consumption	1293	1.47 (1.07-2.03)
Model 2: Depression univariate association		
PHQ-9 summary score (< 6) Low	3441	Reference
PHQ-9 summary score (>= 6) High	439	1.22 (0.85-1.76)
Model 3: Anti-depressant use univariate association		
Anti-depressant use NO	3599	Reference
Anti-depressant use YES	281	1.32 (0.85-2.01)

UPFs, Ultra-processed foods; PHQ-9, Patient Health Questionnaire-9.

*Fully adjusted model is adjusted for the following variables: age, sex, household income, education, ethnicity, born in Canada, smoking status, physical activity, daily alcohol consumption.

Results of Cox regression for UPF consumption and depression assessed using PHQ-9 and anti-depressant joint association for incident type 2 diabetes

Model 1 UPFs consumption lower & middle tertile combined and depressive symptoms joint association			
Groups	**N**	**Incident T2D (N)**	**Fully Adjusted Model, HR (95% CI)**
LUND	2327	138	Reference
LUD	260	18	1.21 (0.73-1.98)
HUND	1114	91	1.28 (0.97 -1.69)
HUD	179	16	1.58 (0.93 - 2.68)

LUND, lower/middle tertile of ultra-processed foods consumption and low depressive symptoms; LUD, lower/middle tertile of ultra-processed foods consumption and high depressive symptoms; HUND, higher tertile of ultra-processed foods consumption and low depressive symptoms; HUD, higher tertile of ultra-processed foods consumption and high depressive symptoms

Fully adjusted model is adjusted for the following variables: age, sex, household income, education, ethnicity, born in Canada, smoking status, physical activity, daily alcohol consumption

Results of Cox regression for UPF consumption and depression assessed using PHQ-9 and anti-depressant joint association for incident type 2 diabetes

Model 2 UPFs consumption lower & middle tertile combined and depressive symptoms/Antidepressant use joint association			
Groups	**N**	**Incident T2D (N)**	**Fully Adjusted Model, HR (95% CI)**
LUNDA	2207	127	Reference
LUDA	380	29	1.38 (0.92 -2.07)
HUNDA	1046	85	1.31 (0.98-1.74)
HUDA	247	22	1.62 (1.02 -2.57)

LUNDA, lower and middle tertile of ultra-processed foods consumption and low depressive symptoms and no antidepressant use; LUDA, lower and middle tertile of ultra-processed foods consumption and high depressive symptoms or antidepressant use; HUNDA, higher tertile of ultra-processed foods consumption and low depressive symptoms and no antidepressant; HUDA, higher tertile of ultra-processed foods consumption and high depressive symptoms or antidepressant.

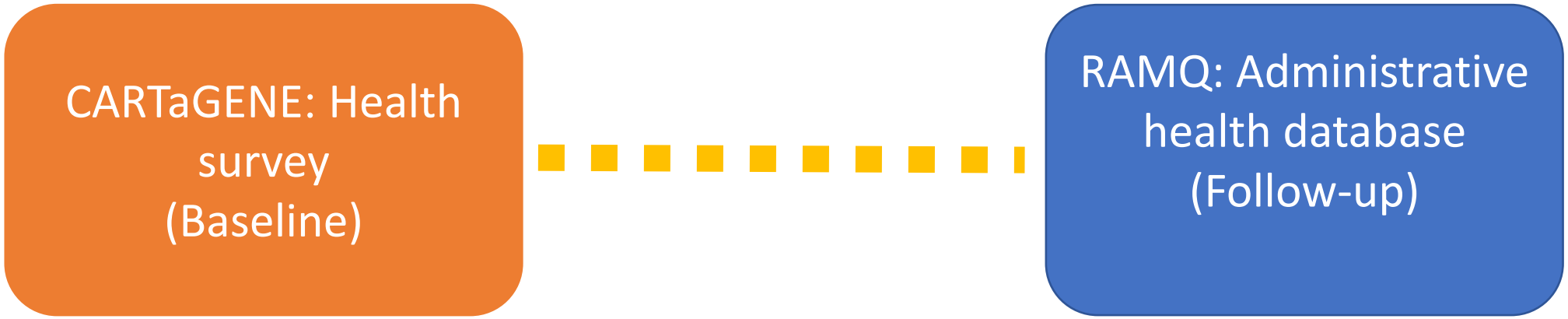
*Fully adjusted model is adjusted for the following variables: age, sex, household income, education, ethnicity, born in Canada, smoking status, physical activity, daily alcohol consumption

STUDY TWO

Ultra-processed foods consumption, depression, and the risk of diabetes complications in the CARTaGENE project: A prospective cohort study in Quebec, Canada

Akankasha Sen, Anne-Sophie Brazeau, Sonya Deschênes , Hugo Ramiro Melgar-Quiñonez , Norbert Schmitz

To investigate a potential additive interaction between ultra processed food consumption and depressive symptoms on the incidence of diabetes-related complications in adults with T2D


CARTaGENE: Health survey (Baseline)
RAMQ: Administrative health database (Follow-up)

Study 1

- Participants without diabetes
- More female (60%) than male

Study 2

- Participants with diabetes
- Proportion of male and female were same

Measures

Depression : Defined either using a score of 6 and higher on the Patient Health Questionnaire-9 (PHQ-9) or antidepressant use

Dietary assessment: Canadian Diet History Questionnaire II (C DHQ-II)

- Daily consumption of each items was calculated
- Portions of consumed food items were converted into grams by using the nutrient database for the C-DHQII
- Consumed amount for every food item: Frequency per day **X** Grams of consumption
- NOVA classification

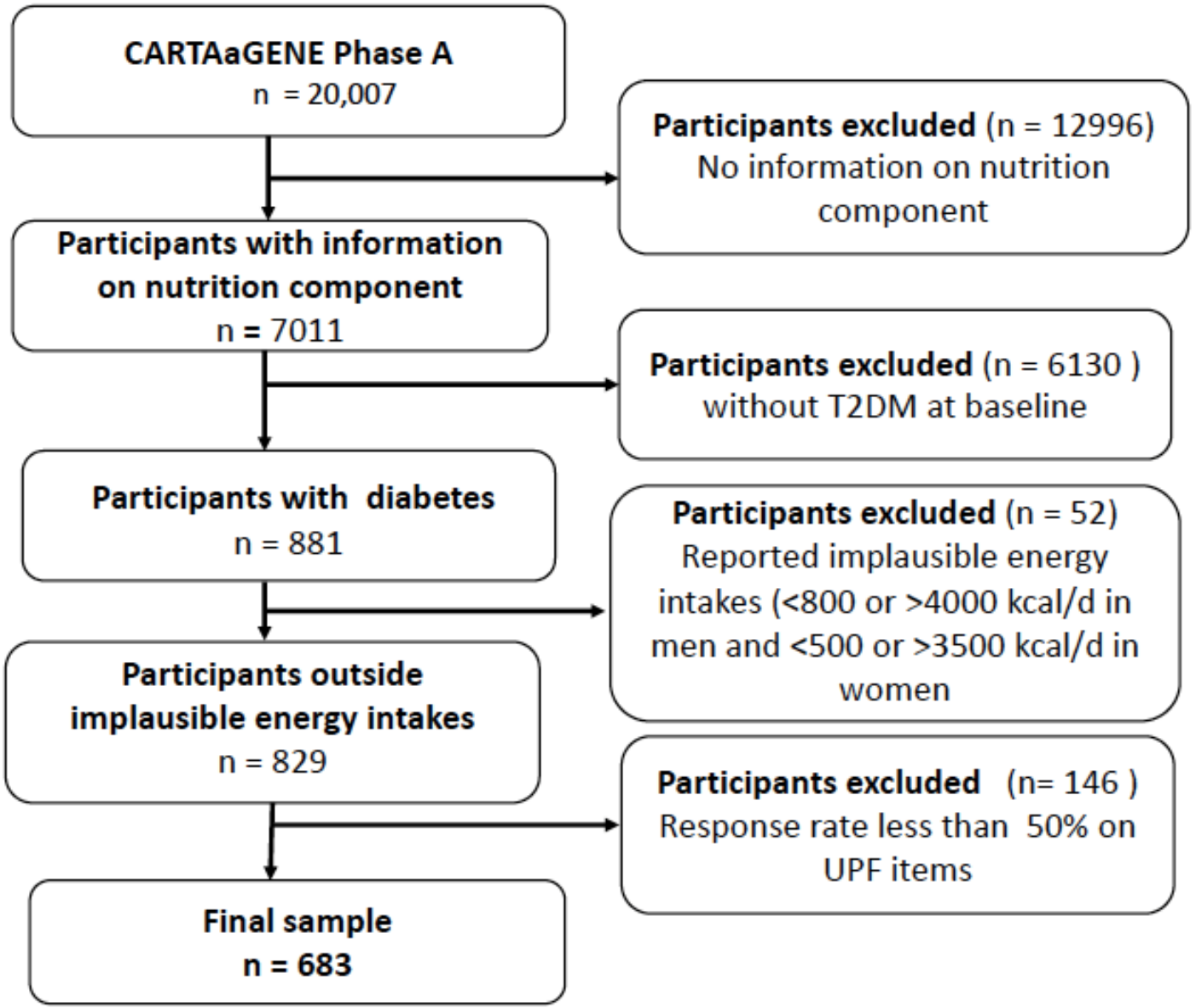
Measures

Outcome: Microvascular diabetes complications

- Diabetic retinopathy
- Nephropathy
- Neuropathy

- **Outcome:** Macrovascular diabetes complications
  - Cerebrovascular
  - Cardiovascular
  - Peripheral vascular disease (PVD)

Inclusion and exclusion criteria



Cox proportional hazards

Exposure

a) Lower/middle tertile of UPF and low depressive symptoms (LUND as the reference group)
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CARTaGENE
Baseline (2009-2010)

7 year of follow-up

Outcome

Incidence of T2D complications
Hazard ratios and 95% confidence intervals

RAMQ
Administrative health database
2016

Survival analyses was be performed in unadjusted models and models adjusted for covariates

Cox proportional hazards

Exposure

a) Lower/middle tertile of UPF and low depressive symptoms and no antidepressant use (LUNDA as the reference group)
b) Lower/middle tertile of UPF and high depressive symptoms or antidepressant use (LUDA)
c) Higher tertile of UPF and low depressive symptoms and no antidepressant use (HUNDA)
d) Higher tertile of UPF and high depressive symptoms or antidepressant use (HUDA)

CARTaGENE
Baseline (2009-2010)

7 year of follow-up

Outcome

Incidence of T2D complications
Hazard ratios and 95% confidence intervals

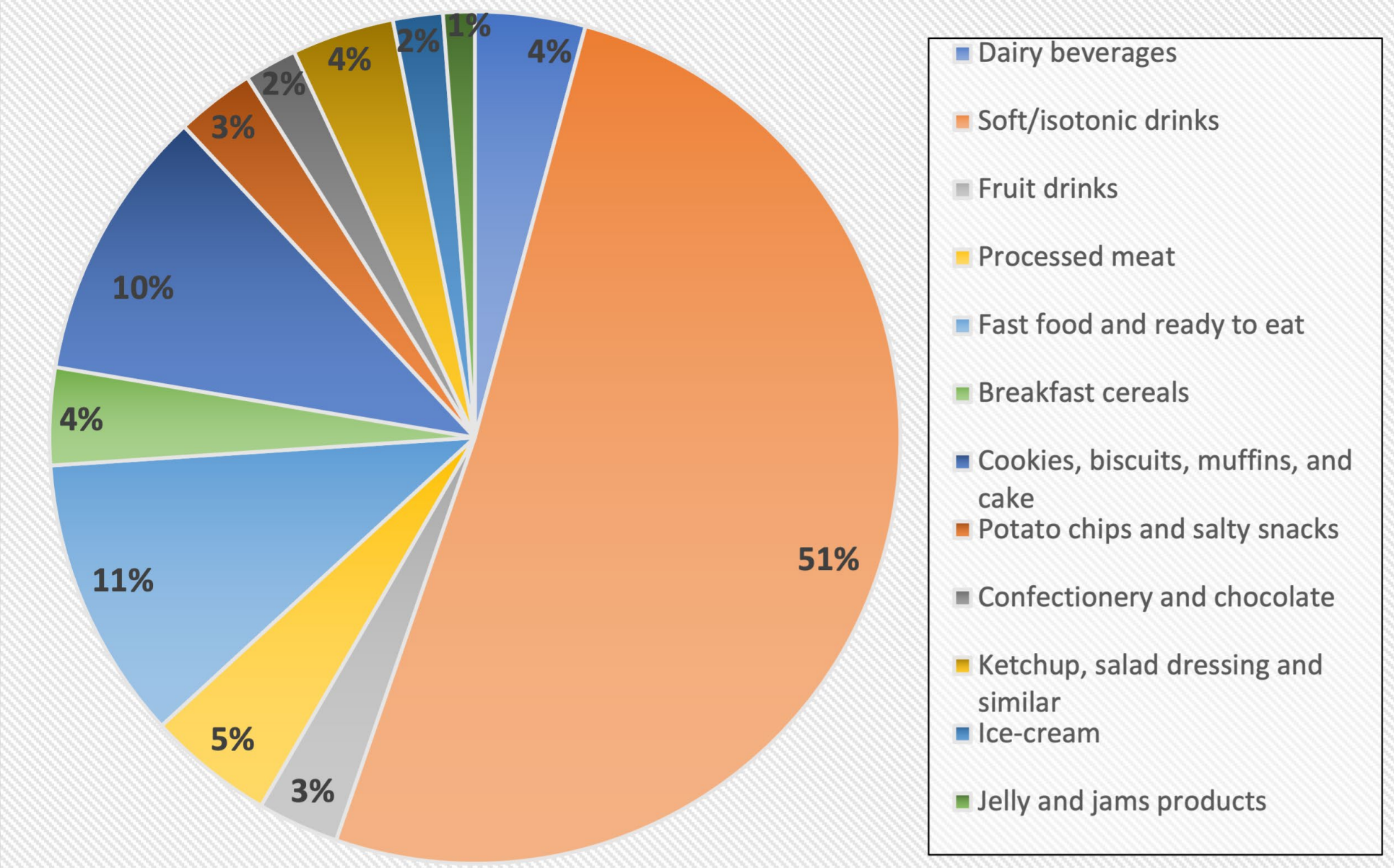
RAMQ
Administrative health database
2016

Survival analyses was be performed in unadjusted models and models adjusted for covariates

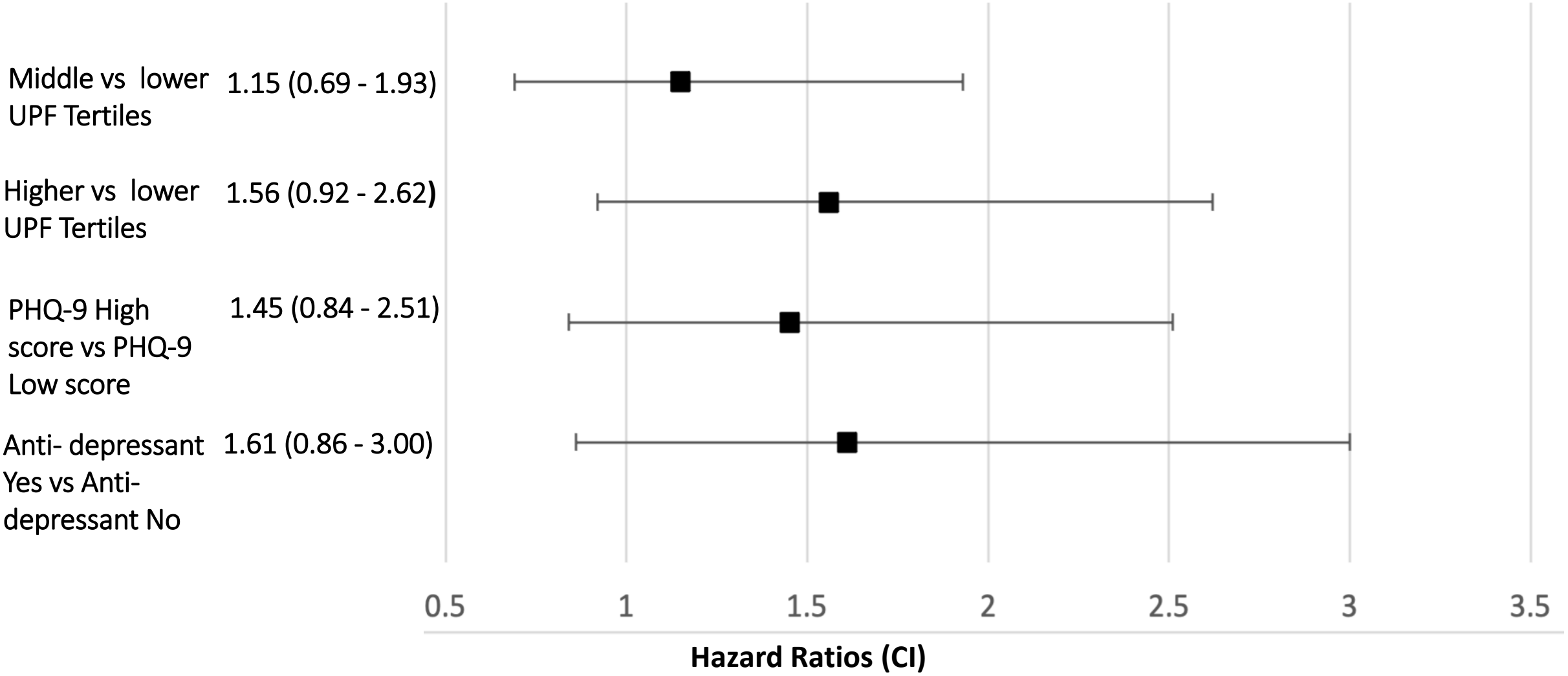
Baseline characteristics of the study sample

- The mean age of the sample was 55.5 (SD = 7.5) years
- A total of 105 (15.4%) individuals developed diabetes-related complications
- Participants in the HUD group had a higher mean intake of the UPFs 615.2 (478.2) g/d, and a higher BMI 31.0 (6.2)

Contribution of each food group to total amount of ultra-processed foods consumed in the CARTaGENE study

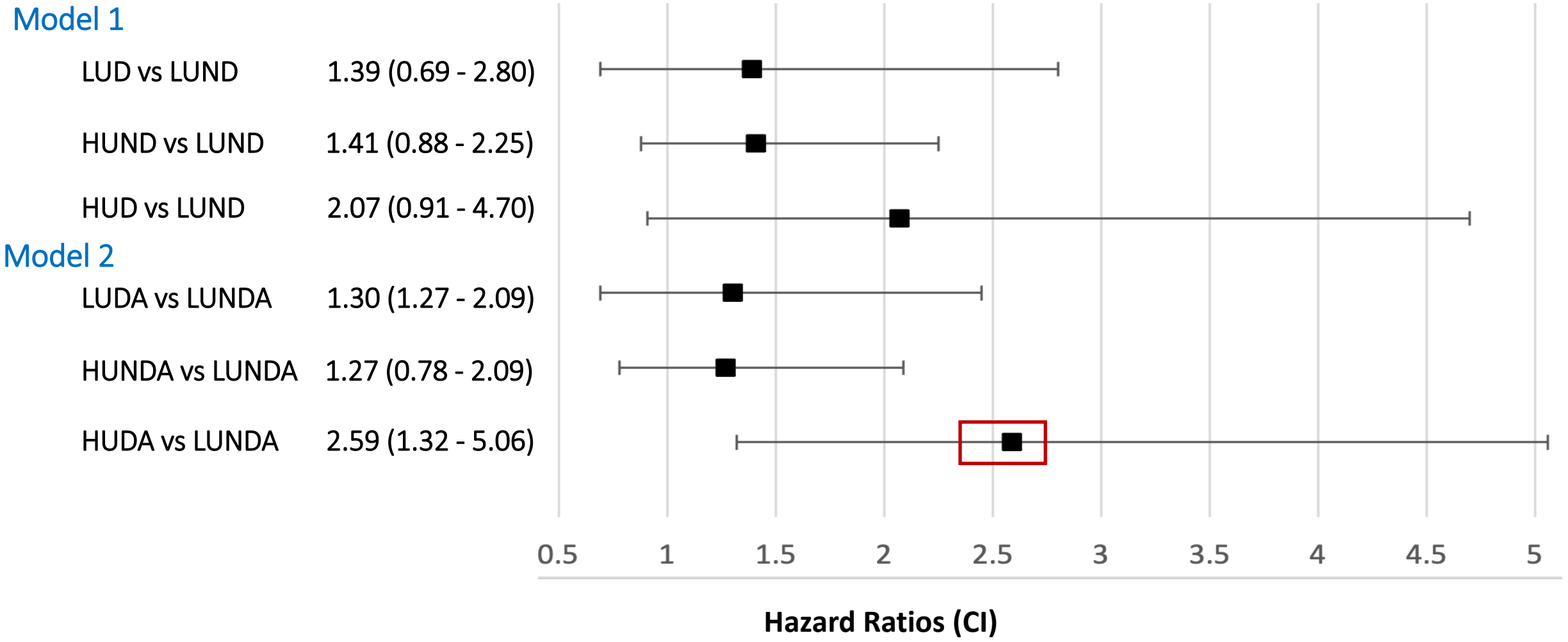


Forest plot for adjusted hazard ratios for incident type 2 diabetes complications in univariate associations



Model is adjusted for the following variables: age, sex, household income, education, ethnicity, smoking status, physical activity, daily alcohol consumption and BMI

Forest plot for adjusted hazard ratios for incident type 2 diabetes complications in joint associations



Model is adjusted for the following variables: age, sex, household income, education, ethnicity, smoking status, physical activity, daily alcohol consumption and BMI

Overall conclusion

- Individuals with co-occurring depression and high UPF consumption may represent a sub-group at risk of T2D and its complications

- In clinical practice, early management and monitoring of both risk factors might be an important step in the diabetes prevention strategy

Limitation

- Food frequency questionnaire
- Administrative database
- CARTaGENE respondents were also limited to mostly white participants (93%)

Research and policy

- Identifying individuals at higher risk of type 2 diabetes
- Implementing regulations related to the marketing, advertising, and labeling of UPF
- Integrated care models that incorporates mental health treatment and addresses behavioral risk factors like UPF consumption

Acknowledgments

- Study participants
- Supervisors: Dr Hugo Melgar-Quinonez & Dr Norbert Schmitz

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