DTU National Food Institute

Public health impact and greenhouse gas emissions (GHG) of current and alternative scenarios of consumption of various bread types in the Danish population

Authors: Research Group for Risk-benefit
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National Food Institute
Technical University of Denmark
Henrik Dams Allé
2800 Lyngby

Preface

The work described in present report was carried out at the Research Group for Risk-Benefit, National Food Institute, DTU.

The aim of the work was to quantify the health impact of changes in bread consumption in the Danish population and map the health impact against different types of bread's contribution to greenhouse gas emission.

The work was co-funded by DTU and Lantmännen Schulstad A/S. Lantmännen Schulstad A/S did not participate in any discussions relating to research methods, data, or results, and did not review or comment on the report.

Kgs. Lyngby, March 2024

Research Group for Risk-Benefit

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Summary

Quantitative evidence on the health and sustainability aspects of foods and diets are necessary to support and guide transition of food systems. Bread is a stable food in Denmark where traditional rye bread is regularly consumed. Bread can be a considerable source of dietary fiber where intakes are associated with decreased risk of different important life style chronic diseases. Industrially produced bread, may also be a considerable source of dietary sodium, which is associated to increased risk of high systolic blood pressure and cardiovascular diseases. Food system's contribution to greenhouse gas emission and climate change is well established. Therefore, the aim of this project was to quantify the health impact of changes in bread consumption in the Danish population and map the health impact against different types of bread's contribution to greenhouse gas emission. Relying on Danish data for food consumption and composition, we estimated the number of healthy life years lost or gained in the Danish population when shifting from the currently consumed bread to five different scenarios of intake of bread with different formulations of fiber and sodium content. Data on CO2-equivalent emission was obtained for Danish produced wheat and rye bread. We estimated that shifting to a bread type with a lower fiber than currently consumed, resulted in a loss of 200 healthy life years per 100,000 annually, despite an also lower sodium content, and at the same time slightly increased the CO2-equivalent emission per kg bread. In contrast, transitioning to consumption of bread types with a higher fiber content resulted in a gain of approximately 250 per 100,000 healthy years annually. Shifting consumption to rye bread categories would result in a slight decrease in CO2-equivalent emission. Thus, our results suggest that a shift towards bread formulations with higher fiber content despite a concomitant higher sodium content would likely both benefit population health and climate. However, our estimates suffer from different limitations that should be considered with interpretation of the results.

1. Background

Two of today's major challenges are malnutrition in all its forms and the climate and environmental degradation crisis. The two challenges are interlinked, and it is acknowledged that part of the solution lies in a transition of food systems to provide diets that are both healthy and sustainable. Mapping dietary risk factors and individual foods according to health impact and sustainability will guide the reformulation of foods and dietary recommendations in the transition of food systems.

1.1 Aim and objectives

The aim of this project was to assess the public health impact and greenhouse gas emission (GHG) of current consumption and alternative scenarios of reformulation of various bread types in the Danish population. The specific objectives were:

- To identify existing data on consumption and composition of different bread types, effect sizes for relevant dietary risk factors, and relevant climate indicators for bread production systems.
- To assess the health impacts and environmental impacts of current consumption and scenarios of reformulation of various bread types in the Danish population.

- To present outputs of the assessments in a visual mapping of different bread types' impact on healthy life years lost or gained in the Danish population against their contribution to GHG emission.

2. Methods

2.1 Scope and scenario formulation

We estimated the health impact of different scenarios of consumption of bread types in the Danish population; obtained the environmental impact of consumption scenarios in terms of CO_2 equivalent (CO_2-eq) emission; and compared all alternatives in a visual matrix.

Five alternative scenarios were defined based on product composition, with bread types grouped under two general categories: "wheat bread", and "ryebread" (Table 1.). Each scenario corresponds to a bread type, with a specific nutrient profile. In each alternative scenario, we assumed that the current mean consumption (g/day) of all types of bread in the Danish population was replaced by one of the specific types of bread in the same amount. We considered consumption in the overall Danish population and did not distinguish between age and sex groups.

To measure the health impact of each scenario, we assessed the change in intake of dietary fiber and sodium from the current overall consumption of bread to each of the five scenarios.

Table 1. Bread category and nutritional composition of each alternative scenario. Data collected from nutritional facts labels on selected bread types.

Scenario	Bread category*	Dietary fibre (g/100g)	Sodium (mg/100g)	Energy (kJ/100 g)	Protein (g/100g)	Fat (g/100g)	Carbohydrates (g/100g)
1	Wheat bread	2.7	340	1186	9.3	7.9	42
2	Wheat bread	8.1	384	967	9.7	2	39
3	Ryebread	8.9	480	867	6.1	1.7	37
4	Ryebread	8	440	981	6.5	7.1	32
5	Ryebread	8.7	640	891	6.4	4.6	32

*Scenario 1:"Det Gode – Solsikke boller"; Scenario 2:"Leverbrød – multikerne boller", Scenario 3: "Levebrød – kernegrov"; Scenario 4: "Det Gode – Solsikke rugbrød"; Scenario 5: "Signaturbrød – Gillelejehavn".

Data

For the **health impact assessment**, we collected data on the current bread intake in the Danish population from the Danish National survey of Diet and Physical Activity 2011-2013 (DANSDA) (Pedersen et al., 2015), food composition data from FRIDA (http://www.frida.fooddata.dk/) and relevant exposure response functions for each risk factor – disease pair obtained from the scientific literature. DANSDA is a nationwide, cross-sectional survey, conducted by DTU Food, using 7-day dietary records in a representative sample of the Danish population. A total of 3847 consumers between the ages of 4 and 75 years old participated in the study. The database Frida Food Data is published and maintained by DTU Food includes data on nutrient content of various foods, reflecting up to date data on the food supply in Denmark. FRIDA is maintained in cooperation with industry associations and retail companies, Nordic and international colleagues, and the Danish Veterinary and Food Administration.

For the **sustainability assessment**, we collected data on CO_2-eq emission of different bread types from the publicly available *Climate Database version 1* (CONCITO, 2024). The *Climate Database version 1* is a publicly available repository of CO_2-eq of a large range of foods available on the Danish market. CO_2-eq's are derived based on life cycle assessment and with the base assumption that the food production facilities are located in Denmark. 34 bread and bread products are included in the database.

The total disability adjusted life years (DALY) caused by a given health effect, which is estimated for the Danish population for 2019 in the GBD project, was retrieved from the Institute for Health Metrics and Evaluation (*VizHub - GBD Compare*, n.d.).

2.2 Health impact assessment

The impact on public health was expressed in terms of disability adjusted life years (DALY) per 100,000 inhabitants, indicating the number of healthy life years lost in the population due to a given risk factor. We selected relevant dietary risk factors from the Global Burden of Disease (GBD) dietary risk factor study (Abbafati et al., 2020). The following dietary risk factors were considered: "too high sodium", and "too low dietary fiber", both associated with different chronic diseases. We assessed the number of healthy life years lost from these diseases attributed to the current intake of sodium and dietary fiber (from all sources including bread), and how the impact changes by intake of bread that is reformulated in terms of its content of sodium and dietary fiber.

2.2.1 Intake assessment

In DANSDA, the intake of several bread categories is reported as the mean daily intake in grams. We only considered the bread types that we interpreted as industrially produced wheat or ryebread, which included 13 wheat and 6 rye bread categories (Table 2. Bread types described in DANSDA categorized as either ryebread or wheat bread. Bread types are listed in Danish, as originally described in the DANSDA data base.). In the reference scenario, we estimated the mean daily intake of sodium and dietary fiber from all foods, including bread, by multiplying the daily intake of foods by their content of sodium and dietary fiber obtained from FRIDA. In the alternative scenarios, we substituted the content of sodium and dietary fiber in bread as reported in the FRIDA database for the values of sodium and dietary fiber presented in Table 1. Bread category and nutritional composition of each alternative scenario. Data collected from nutritional facts labels on selected bread types.. The substitution of bread consumption was done while intake of all other foods was kept constant. The sodium and dietary fiber content of the other foods was also not changed.

Table 2. Bread types described in DANSDA categorized as either ryebread or wheat bread. Bread types are listed in Danish, as originally described in the DANSDA data base.

Bread type	**Bread category**
Rugbrød, mørkt	Ryebread
Rundstykke	Wheatbread
Rugbrød med fedtrige frø og hele kerner	Ryebread
Hvedebrød, groft uden fedtrige frø, uden kerner	Wheatbread
Flûte, fint, industrifremstillet	Wheatbread
Softrugbrød (uden fedtrige frø)	Ryebread
Softrugbrød med fedtrige frø og hele kerner	Ryebread
Bondebrød, uden fedtrige frø, industrifremstillet	Ryebread
Bondebrød med fedtrige frø, industrifremstillet	Ryebread
Hvedebrød, fint, store	Wheat bread
Hvedebrød, bolle, grov, industrifremstillet	Wheat bread
Hvedebrød, bolle, grov, med fedtrige frø, industri	Wheat bread
Hvedebrød, store, med fedtrige frø	Wheat bread
Hvedebrød, store, italiensk	Wheat bread
Hvedebrød, toastbrød, fint, industrifremstillet	Wheat bread
Hvedebrød, toastbrød, groft, industrifremstillet	Wheat bread
Hvedebrød, sandwich/toastbrød med fedtrige frø, in	Wheat bread
Hvedebrød, bolle, fin, industrifremstillet	Wheat bread
Hvedebrød, bolle, italiensk, industrifremstillet	Wheat bread

2.2.2 Health effects and dose-response relationships

We identified the health effects associated with sodium and dietary fiber based on findings of other studies and international expert reports (Abbafati et al., 2020; Blomhoff et al., 2023; WCRF, 2018). Additionally, we performed a literature search for systematic reviews of epidemiological studies, including meta-analyses, to obtain information on dose-response of the included health outcomes. The literature search was limited to an update to identify potential new systematic reviews and dose response meta-analyses since the already identified studies, i.e. since 2019 (Abbafati et al., 2020; Reynolds et al., 2019)(Reynolds, 2019).

The health effects associated with dietary sodium are primarily mediated by sodium's influence on systolic blood pressure, where evidence is established for a positive association between too high intake of salt and high systolic blood pressure (NNR, 2023). High systolic blood pressure is a risk factor for a range of health effects, including stroke and coronary heart disease (CHD) (NNR, 2023; GBD, 2019). We chose to include cardiovascular disease (CVD) as an overall health effect for sodium. While several studies have investigated the association between sodium intake and systolic blood pressure, few systematic reviews and dose response meta-analysis linking dietary sodium directly to CVD are available. We based our assessment on the systematic review and dose response meta-analysis published by (Wang et al., 2020), who report a CVD risk increase of 6% per 1 g sodium intake.

Dietary fiber intake has been associated with a reduced risk of colorectal cancer (CRC), type 2 diabetes (T2D), stroke and CHD (Abbafati et al., 2020; Blomhoff et al., 2023; WCRF, 2018). We followed a recent study by Outzen et al. (2024) and included the health effects of CRC, CHD and T2D (Outzen et al., 2024). The dose response relationships were obtained from Reynolds et al. (2019), who estimated a risk decrease of 19 %, 15 % and 8 % for CHD, T2D and CRC, respectively, per 8 g increase in dietary fiber intake per day. The included health effects and selected dose response relationships are shown in Table 3. Included components, health effects, dose response relationships, and disability adjusted life years (DALY) envelopes of each health effect.

Table 3. Included components, health effects, dose response relationships, and disability adjusted life years (DALY) envelopes of each health effect.

	Health effect	**Dose***	**Relative risk* (95%CI)**	**Observed range***	**DALY envelope ****
Sodium***	Cardiovascular disease (CVD)	per 1 g/d	1.06 (1.01-1.11)	1-7.5 g/d	3929.4 DALY/100,000
Fibre***	Fatal coronary heart disease (CHD)	per 8 g/d	0.81 (0.73-0.90)	0-43 g/d	1637.6 DALY/100,000
	Type II diabetes (T2D)	per 8 g/d	0.85 (0.82-0.89)	0-63 g/d	763.4 DALY/100,000
	Colorectal cancer (CRC)	per 8 g/d	0.92 (0.89-0.95)	0-41 g/d	823.0 DALY/100,000

*References: sodium: Wang et al. (2020); fibre: Reynolds et al. (2019).

**Values for the Danish population, 2019, from IHME (IHME 2019).

***For sodium, the risk increases per 1 g/d increase in intake. For fibre, the risk decreases per 8 g/d increase in intake.

2.2.3 Disability-adjusted life years

We applied the potential impact fraction (PIF) to estimate the proportion of DALY of each health outcome that is attributable to the change in sodium and fibre intake due to changing the intake of bread to the reformulated bread in each alternative scenario.

Specifically, PIF was estimated by:

$$PIF_h = \frac{RR_{h,alt} - RR_{h,ref}}{RR_{h,ref}},$$

where $RR_{h,alt}$ is the relative risk for the health outcome *h* at the intake in an alternative scenario, and $RR_{h,ref}$ is the relative risk at the intake in the reference scenario. For each of the alternative scenarios, the alternative intake is the resulting intake of sodium and dietary fiber from the scenarios defined in Table 1. Bread category and nutritional composition of each alternative scenario. Data collected from nutritional facts labels on selected bread types.. The RR for any intake level *x* is derived from the assumption that RR = 1 at zero intake, and that the RR is loglinearly associated with *x* (Barendregt and Veermann, 2010):

$$\ln(RR) \;= \beta\, x\,,$$

where β is a constant, estimated from the RR of a given *x* (as given in Table 3. Included components, health effects, dose response relationships, and disability adjusted life years (DALY) envelopes of each health effect.) to estimate RR at any intake level of *x*, by:

$$RR \;=\; e^{\beta x}.$$

DALY in the reference scenario is equal to the current DALY envelopes in the Danish population (i.e. the total DALY per 100,000 inhabitants of each disease (here called “health effect”), irrespective of risk factors (IHME 2019). To derive the difference in DALY attributed to the change in intake of sodium and dietary fiber in each alternative scenario, we multiplied the PIFs for each health effect with the DALY envelopes for the same health effects. The DALY per 100,000 inhabitants for each scenario was calculated by adding the DALY difference to the DALY envelopes. The total DALY for all health effects included were estimated as the sum across health effects for each scenario, and reflect how the disease burden in the Danish population would change with the potential changes in the contribution of salt and sodium from consumption of bread.

2.3 Environmental indicators

The CO_2 emission was expressed in terms of CO_2 equivalents (CO_2-eq) per kg bread. 34 bread and bread products are included in the Climate Database. For the purpose of this report, we obtained information on the two bread categories: “industrially produced wheat bread” and “industrially produced ryebread”. The composition and CO_2-eq of each bread type are shown in Table 4.

Table 4. Energy, protein, fat, carbohydrate and CO_2 equivalents of industrially produced rye and wheat bread obtained from the big Climate database (Concito, 2024).

Indicator	**Ryebread**	**Wheat bread**	**Unit**
Energy	843	1077	kJ/100g
Protein	5.5	8.7	g/100g
Fat	1.4	2.8	g/100g
Carbohydrate	36.5	47	g/100g
CO2eq	0.62	0.74	per kg

We applied the CO2-eq for wheat bread to scenarios 1 and 2, and the CO2-eq for ryebread to scenarios 3-5. For the reference scenario, we calculated the mean of the CO2-eq for wheat- and ryebread, weighted by the contribution of wheat- and ryebread to total bread intake in the reference scenario, i.e. 36% for ryebread and 64% for wheat bread.

3. Results

3.1 Intake assessment

The mean intake of sodium and dietary fiber in the Danish population at the current bread intake and in alternative scenarios 1-5 are shown in Table 5. The current intake (Reference Scenario) of sodium and fiber from all dietary sources including bread is 3.5 and 21.1 g/day, respectively. It is seen that the change in bread intake to the reformulated bread in Scenario 1 and 2 resulted in a decrease in the total sodium intake. On the other hand, Scenarios 3-5 resulted in no change (Scenario 4) or an increase in total sodium intake. A decrease in total dietary fiber intake from the Reference Scenario was seen only in scenario 1. In Scenarios 2-5, the total dietary fiber intake increased.

Table 5. Mean intake of sodium and dietary fiber from all sources and contribution from bread in the Danish population (age 4-75) in the reference and alternative scenarios.

	Sodium		Dietary fibre	
Scenario	Intake (g/day)	Contribution from bread (%)	Intake (g/day)	Contribution from bread (%)
Reference	3.53	15.8%	21.1	31.0%
Scenario 1	3.40	12.6%	18.0	19.5%
Scenario 2	3.46	14.0%	24.6	40.4%
Scenario 3	3.58	16.8%	25.6	42.5%
Scenario 4	3.53	15.7%	24.5	40.1%
Scenario 5	3.77	21.1%	25.3	42.0%

Bread contributes approximately to 16 % of total sodium intake and 31 % of total fiber intake in the Danish population in the Reference Scenario. The change in bread intake to the reformulated bread in Scenario 5 increased the contribution of bread to total sodium intake to 21%. The highest contribution of bread to fiber was seen in Scenario 3.

3.2 Health impact assessment

The potential impact fractions (PIF) for Scenarios 1-5 is shown in Table 6. A positive PIF indicates that the burden attributable to the risk factor (sodium or fibre) increase when the intake changes compared to the reference scenario; a negative PIF indicates that the burden decreases. Table 7shows the total DALY per 100,000 inhabitants for each health effect and all health effects combined for the Reference Scenario and each alternative scenario.

Table 6. Potential impact fractions for each health effect associated with sodium and fibre at each alternative scenario. CVD: Cardiovascular Disease. CHD: Coronary Heart Disease. T2D: Type 2 Diabetes. CRC: Colorectal Cancer.

	Sodium	**Fibre**		
Scenario	**CVD**	**CHD**	**T2D**	**CRC**
Scenario 1	-0.007	0.087	0.066	0.033
Scenario 2	-0.004	-0.088	-0.068	-0.036
Scenario 3	0.003	-0.111	-0.087	-0.045
Scenario 4	0.000	-0.085	-0.066	-0.034
Scenario 5	0.014	-0.105	-0.082	-0.043

Table 7. Disability adjusted life years (DALY) per 100,000 inhabitants in the Danish population for each health effect and summed across health effects at the reference and each alternative scenario. The DALY in the Reference Scenario corresponds to the DALY envelopes for each health effect, which is the total disease burden in Denmark for the included health effects. The DALY in the alternative scenarios is then the theoretical change in the DALY envelopes due to the change in sodium and fibre intake from change in bread intake. CVD: Cardiovascular Disease. CHD: Coronary Heart Disease. T2D: Type 2 Diabetes. CRC: Colorectal Cancer.

	Sodium	**Fibre**			
Scenario	CVD	CHD	T2D	CRC	Total DALY
Reference	3929.41	1637.59	763.39	822.97	7153.36
Scenario 1	3900.56	1779.63	813.97	850.51	7344.66
Scenario 2	3912.88	1494.01	711.23	793.62	6911.74
Scenario 3	3939.89	1455.78	697.15	785.53	6878.36
Scenario 4	3928.62	1498.86	713.01	794.64	6935.12
Scenario 5	3985.33	1465.25	700.65	787.54	6938.77

3.3 Health versus climate impact

Figure 1. DALY per 100,000 for the current consumption of bread in the Danish population (reference scenario) and five alternative scenario, plotted against the CO_2 equivalents per kg of bread. Note that the Y-axis starts at 0.6 CO_2-eq per kg bread and not 0.0 CO_2-eq per kg. plots the health impact given in DALY/100,000 against the CO_2 eq/kg bread for the reference and scenarios 1-5. The DALY per 100,000 inhabitants for the reference and each scenario correspond to the values presented in Table 7. Disability adjusted life years (DALY) per 100,000 inhabitants in the Danish population for each health effect and summed across health effects at the reference and each alternative scenario. The DALY in the Reference Scenario corresponds to the DALY envelopes for each health effect, which is the total disease burden in Denmark for the included health effects. The DALY in the alternative scenarios is then the theoretical change in the DALY envelopes due to the change in sodium and fibre intake from change in bread intake. CVD: Cardiovascular Disease. CHD: Coronary Heart Disease. T2D: Type 2 Diabetes. CRC: Colorectal Cancer.. Therefore, the DALY/100,000 for Scenarios 1-5 reflect how the disease burden changes from the Reference Scenario if sodium and dietary fibre intakes are changed according to the specified substitution of bread. The CO_2-eq indicates the emission per

kg bread, where CO2-eq for the Reference Scenario is the mean of CO_2-eq emission of wheat and ryebread, weighted by the contribution of the two bread types to the total intake of bread. Compared to the Reference Scenario, Scenario 1 resulted in both a higher burden and a higher CO_2-eq per kg; Scenario 2 resulted in a lower health burden but higher CO_2-eq per kg; and Scenarios 3-5 resulted in both a lower burden and a lower CO_2-eq per kg.

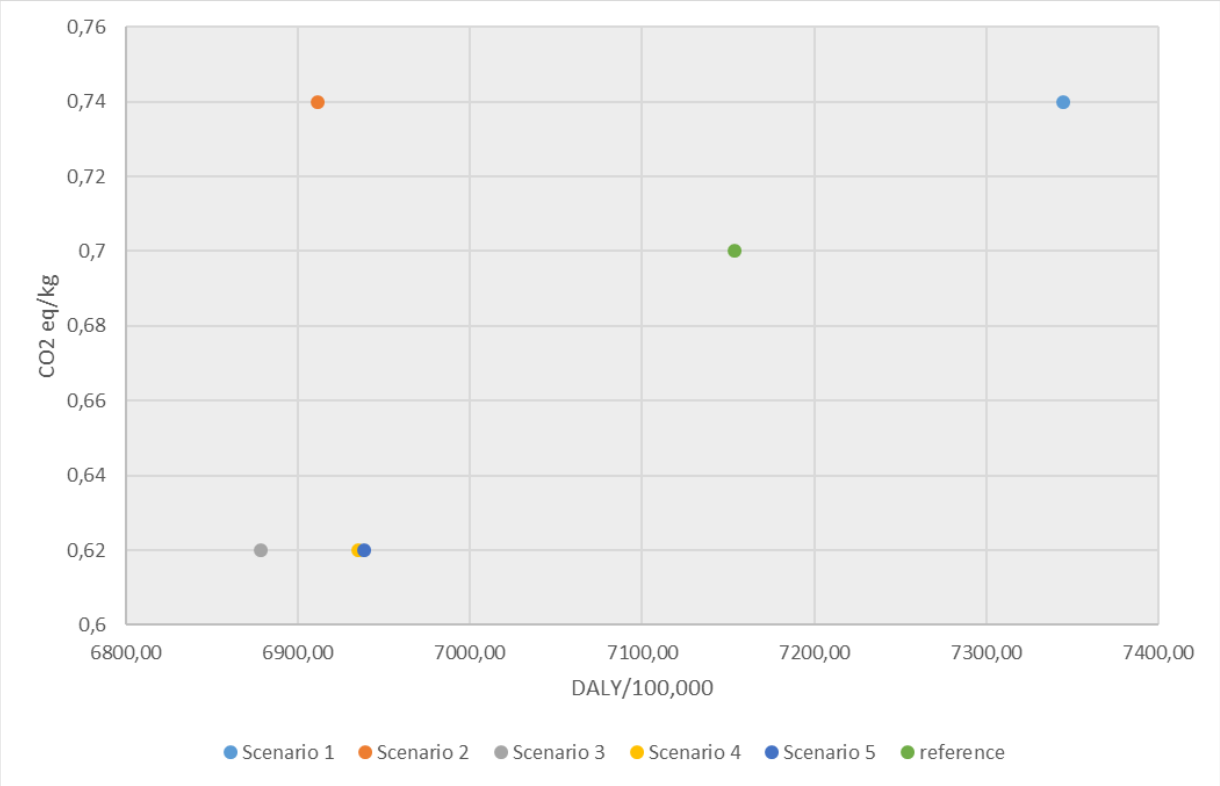

Figure 1. DALY per 100,000 for the current consumption of bread in the Danish population (reference scenario) and five alternative scenario, plotted against the CO_2 equivalents per kg of bread. Note that the Y-axis starts at 0.6 CO_2-eq per kg bread and not 0.0 CO_2-eq per kg.

Figure 2 plots the change in healthy life years per 100,000 inhabitants against the CO_2-eq per kg bread of each scenario compared to the reference scenario. We observed that Scenario 5 resulted in a loss of approximately 200 healthy live years per 100,000 inhabitants annually with an increase in CO_2-eq per kg bread of 0.04, compared to the Reference Scenario. Scenarios 1-4 resulted in gains of approximately 250 healthy life years annually compared to the reference scenario. However, Scenarios 3-5 led to a decrease in CO_2-eq per kg bread of 0.08.

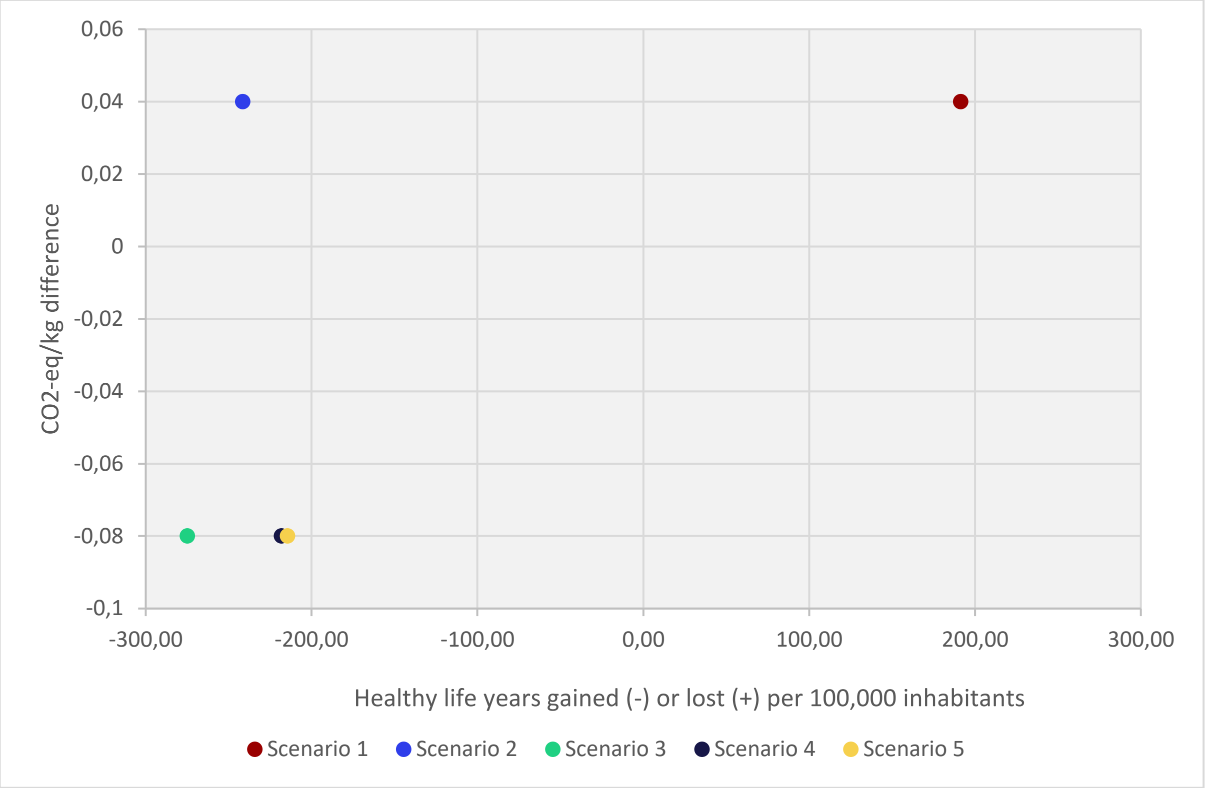

Figure 2. Healthy life years gained (negative sign) or lost (positive sign) compared to the reference scenario per 100,000 for each alternative scenario, plotted against the CO_2 equivalents per kg of bread. The negative sign indicates that healthy life years are gained compared to the current situation; the positive sign indicates that healthy life years are lost compared to the current situation.

4. Discussion

We present an estimation of the public health impact and greenhouse gas emission (GHG) of current consumption and alternative scenarios of reformulation of various bread types in the Danish population. Our results showed that, compared to the current consumption of bread in the Danish population, shifting to only consuming the breads defined in Scenario 1 (wheat bread with 2.7 g fiber and 340 mg sodium per 100g) resulted in both a higher health burden and a higher CO_2-eq per kg; and Scenarios 3-5 resulted in both a lower health burden and a lower CO_2-eq per kg. Shifting to only consuming bread as defined in scenario 2 (wheat bread with 8.1 g fiber and 384 mg sodium per 100 g), resulted in a lower health burden but higher CO_2-eq per kg. Scenario 1 resulted in approximately 200 healthy life years lost per 100,000 inhabitants annually, along with an increase in CO_2-eq per kg bread of 0.04, when compared to the Reference Scenario. Remaining scenarios resulted in gains of approximately 250 healthy life years annually compared to the reference scenario, where shifts towards breads defined in scenario 3 (rye bread with 8.9 g fiber and 480 mg sodium per 100g) resulted in the largest gain in healthy life years. Concomitantly, for Scenarios 3-5 the shift also led to a decrease in CO_2-eq per kg bread of 0.08. It should be noted that the overall gain in healthy life years estimated for scenario 3-5 is due to the relative higher fiber content and despite the also higher sodium content. These estimates suggest that a change towards the breads defined in scenarios 3-5 would result in overall positive health and environmental impacts, whereas a change towards scenarios 1 and 5 would result in either detrimental health and climate impacts or detrimental climate impact only, respectively.

Limitations

Our assessment of the health impact of different scenarios of consumption of bread types only consider two risk factors: "too high consumption of salt", and "too low consumption of dietary fiber". These are important contributors to burden of disease globally, and relevant for the bread given different types of product formulation. However, other dietary risk factors could be considered for bread, specifically "too low wholegrain" (not in combination with fiber), and "too high saturated fat". These should be included in future iterations of the model for a more comprehensive health impact assessment as they would influence the magnitude of the public health impact.

There are also specific limitations related to each of the health impact models and to the environmental assessment. For the model estimating health impacts of intake of sodium model, there were few studies establishing a direct relation between sodium and CVD. Furthermore, we did not perform quality assessment on Wang et al. (2020), the study providing the effect size for sodium-CVD association. We also acknowledge that, based on the data available, it would have been preferable to model sodium via systolic BP, even though it is unsure to which degree and in which direction, this would impact the estimated DALY.

Besides, the included risk factors were associated with the same outcome, i.e. fatal IHD and CVD and should be combined in a multiplicative model. In this study, they are added, which leads to an overestimation of the combined overall impact of different risk factors on the same outcome.

The food intake data available to form the basis of our assessments is relatively old, having been collected between 2011 and 2013. Therefore, changes in bread intake in the last 10 years have not been reflected. When updated data are available, it will be useful to update our assessments and provide a timelier estimation of potential health and environmental impacts of the investigated changes in consumption.

CO2 emission indicators' data were applied in a simplistic fashion. Only two categories of industrially produced bread were extracted from the climate database and applied to a range of bread types in the intake assessment. Especially the CO_2-eq emission estimated for the reference scenario might be flawed and the difference in emission between the reference scenario and alternative scenarios should be interpreted with care.

Due to above mentioned limitations, our results should be interpreted with care. However, our findings suggest the direction of the impact on health and climate of the investigated bread formulations in comparison to the combination of bread currently consumed.

5. Disclaimer

This work was co-funded by DTU and Lantmännen Schulstad A/S. Lantmännen Schulstad A/S provided information to formulate scenarios investigated. They did not participate in any discussions relating to research methods, data, or results. They did not review or comment on the report.

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DTU National Food Institute
Henrik Dams Allé
2800 Lyngby

Tel: 35 88 77 00

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