Master of Public Health

Master de Santé Publique

Thesis Report:
Lifestyle Changes Following Diagnosis of Cardiometabolic Diseases: A Case-Crossover Study from the NutriNet-Santé Study

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Table of Contents

Acknowledgments 1
List of Tables 4
List of Figures 4
List of Acronyms 5
Abstract (English) 6
Introduction 7
Background, Rational, Aims 7
Specific condition 9
Research questions 9
General objective 9
Specific objectives 10
Hypothesis 10
Methods 10
Study Design 10
Sample Design 11
Data Source 12
Data Collection 12
Exposure 12
Outcome 13
Other covariates 14
Ethics 14
Statistical Analyses 14
Result 16
Discussion 25
Conclusion and Recommendations 28
References 29
List of Appendices 33
Abstract (French) 37

List of Tables

Table 1. Characteristics of Patients with Cardiometabolic Diseases, at the Time of Diagnosis of the Cardiometabolic Disease, The NutriNet-Santé Cohort, France, 2009-2022 16
Table 2. Lifestyles Characteristics Before and After the Diagnosis of Cardiometabolic Diseases 17
Table 3. Count of Patients' Lifestyle Changes Before and After Diagnosis Among Hypertensive Patients 19
Table 4. Count of Patients' Lifestyle Changes Before and After Diagnosis Among Type 2 Diabetes Patients 20
Table 5. Association Between Lifestyle Factors and CMDs Diagnosis: Odds Ratios, 95% CI, (For Categorical Variables) and Mean or Median Pre-Post Diagnosis Changes (For Continuous Variables) 21

List of Figures

Figure 1. Sample selection for Hypertension 11
Figure 2. Sample selection for Type 2 Diabetes 12
Figure 3. Inclusion period of the study 14
Figure 4. Changes in physical activity (in MET in hours/week) stratified by employment status in Hypertension group 23
Figure 5. Changes in sedentary behaviour stratified by sex in Hypertension group 23
Figure 6. Changes in alcohol consumption (g/day) stratified by employment status in Type 2 Diabetes group 24
Figure 7. Changes in dietary intake (PNNS score) stratified by education in Type 2 Diabetes group 24

List of Acronyms

NCD	Non-Communicable Diseases
CVD	Cardiovascular Disease
CMD	Cardiometabolic Disease
MVPA	Moderate to Vigorous Physical Activity
EREN	Équipe de Recherche en Épidémiologie Nutritionnelle
IRB	Institutional Review Board
CNIL	Commission Nationale de l'Informatique et des Libertés
SNIIRAM	Système National d'Information Inter-Régimes de l'Assurance Maladie
MET	Metabolic Equivalent
IPAQ	International Physical Activity Questionnaire
PNNS	Programme National Nutrition Santé
BMI	Body Mass Index
BAC	Baccalauréat
SD	Standard Deviation
IQR	Interquartile Range
OR	Odds Ratio
CI	Confidence Interval

Abstract (*English*)

Background: Cardiovascular diseases (CVDs), are significant global health concerns. CVDs are attributable to cardiometabolic diseases (CMDs), which include hypertension and type 2 diabetes, and modifiable behavioural factors. Diagnosis of chronic diseases is a crucial "teachable moment," leading individuals to initiate risk-reducing behavioural changes. The existing literature provides mixed evidence on the relationship between disease diagnosis and lifestyle modifications.

Objectives: This study aims to assess the lifestyle changes (smoking, alcohol consumption, physical activity, sedentary behaviour, and dietary intake) after the diagnosis of CMDs (hypertension and type 2 diabetes) in French adult patients.

Methods: This case-crossover study analysed data from 6714 (hypertension group) and 1528 (type 2 diabetes group) volunteers from the NutriNet-Santé study, an ongoing French cohort study. Conditional logistic regression and McNemar tests were performed to assess lifestyle changes, comparing an individual's lifestyle after the diagnosis of CMDs with its lifestyle before the diagnosis of CMDs.

Results: In the hypertension group, patients had a lower odds of being current smokers (OR 0.34, 95% CI: 0.23-0.49, $p < 0.001$), a median alcohol consumption reduction of 0.35 (95% CI: 0.21-0.64, $p < 0.001$) and a lower odds of a being drinker post-diagnosis (OR 0.84, 95% CI: 0.72-0.99, $p = 0.038$). There were no significant changes in physical activity, dietary intake, and sedentary behaviour. In type 2 diabetes group, a median decreased of 0.79 (95% CI: 0.29-1.29, $p = 0.001$) in alcohol consumption and an increased odds of engaging high physical activity (OR 1.48, 95% CI: 1.05-2.09, $p = 0.026$) were observed post-diagnosis. There were no significant changes in smoking status, dietary intake, and sedentary behaviour. The extent of lifestyle changes varied according to sociodemographic factors, including employment status, education attainment, and gender.

Conclusion: A hypertension diagnosis promotes smoking cessation and decreased alcohol consumption, whereas a type 2 diabetes diagnosis leads to reduced alcohol intake and increased physical activity.

Key words: Lifestyle, Hypertension, Type 2 Diabetes

Introduction

Background, Rational, Aims

Chronic non-communicable diseases (NCDs) have become a major global health problem (1,2). They are the leading cause of reduced quality of life and are responsible for 41 million deaths per year, or about 74% of all deaths worldwide (2,3). In Europe, NCDs also account for 90% of deaths and 85% of years lived with disability (4). Among the most common type of NCDs are cardiovascular diseases (CVDs), such as stroke and ischaemic heart disease (17.9 million deaths per year) (2). In France in particular, these CVDs are one of the leading causes of death (5).

Evidence suggests that CVDs are attributable to cardiometabolic diseases (CMDs) and modifiable behavioural factors (2,6). CMDs, which include hypertension, hyperglycaemia and hyperlipidaemia, contribute to the metabolic changes that increase the risk of chronic disease (3). One study found that cardiometabolic diseases (hypertension and diabetes) are independently associated with cardiovascular incidents (6). The 10-year risk of CVD was significantly increased in the groups with elevated blood pressure (HR, 1.31), stage 1 hypertension group (HR, 1.35), and stage 2 hypertension (HR, 2.65) compared with the group with normal blood pressure (7). In people with diabetes compared to those without, the HR for coronary heart disease was 2.00 (8). In addition, chronic diseases such as CVDs share common modifiable behavioural risk factors associated with disability and early mortality. These factors include tobacco use, physical inactivity (sedentary lifestyle), excessive alcohol consumption and unhealthy diet (2,6,9,10). While medical interventions have greatly improved the control of metabolic risk factors, addressing behavioural risk factors requires changes in human behaviour (11).

Behavioural risk factors contribute significantly to mortality in France, accounting for about one third of all deaths in 2019 (5). Despite a decline over the last two decades, from 30% in 2010 to just over 25% in 2021, adult smoking rates in France remain high compared with most EU countries (5). The French National Public Health Agency reported that 23.6% of adults exceeded the recommended limit for alcohol consumption, with alcohol attributed to 41,000 deaths in France in 2017 (12,13). A similar trend was recorded in 2022, with over 20% of adults in France reported as regular heavy drinkers, a higher proportion than in most EU countries (5). Adult obesity rates were found to have increased from 9% in 2000 to 14% in 2019 (5). One study found that the prevalence estimate of overweight was 47.3%, while 17% were classified as obese (14). Obesity is an indicator of poor diet and low levels of physical activity (5,15). Adequate fruit and vegetable consumption as part of a healthy diet strengthens the immune

system, combats various forms of malnutrition, including overweight and obesity, and reduces the risk of chronic diseases at all ages (16,17). Although the percentage of adults in France reporting at least five daily portions of fruit or vegetables is among the highest in the EU, it was only 20% in 2019 (18). Moreover, French adolescents reported the second lowest levels of daily moderate physical activity among EU countries in 2022 (5).

The literature suggests that the diagnosis of a chronic condition can be a crucial "teachable moment", potentially leading individuals to initiate behavioural change towards risk-reducing health behaviours (19,20). Lifestyle changes following a diagnosis of chronic diseases are important to prevent complications, reduce the risk of developing further chronic conditions, improve quality of life, and avert premature death (21–23). Studies have shown that lifestyle modification after diagnosis of CMD may act as secondary prevention to reduce cardiovascular morbidity and mortality (24,25). In adults with type 2 diabetes, lifestyle factors play a significant role in the development of cardiovascular complications (26). Furthermore, an observational study found that participants who made at least two healthy behaviour changes after diabetes diagnosis had a reduced risk of CVD compared with those who made no changes (25). A Chinese prospective cohort study also found evidence that smoking cessation, regular physical activity, adherence to a healthy diet, and maintaining a normal BMI were associated with a lower risk of CVD, ischaemic heart disease, and ischaemic stroke among adults with hypertension (27).

Although the benefits of adopting positive health behaviours are widely recognised, initiating health behaviour change may be difficult for some people for a variety of reasons (28,29). A previous study suggests that socioeconomic status, such as income, education level and occupation, influences both health-related lifestyles and the risk of chronic diseases (30).

Previous studies have investigated the potential relationship between the diagnosis of various diseases and health-related lifestyle changes, but the evidence is mixed (3,31). An English longitudinal study found positive changes in health behaviours following a diagnosis of type 2 diabetes, including reduced smoking and alcohol consumption and improved healthy eating (32). In addition, a population-based study in the US found that having heart problems and diabetes was associated with higher odds of reduced heavy drinking (31). A recent study from China also suggested that the diagnosis of major chronic diseases, including cancer, heart disease, and stroke reduced smoking rates and smoking intensity and had long-lasting effects on smoking cessation behaviour (33). In contrast, a study found that most of individuals do not make major lifestyle changes after being diagnosed with a serious major chronic disease, either in the short or long-term, with minimal increases in physical activity and changes in alcohol consumption (34). Another US study also found a similar trend of decreased physical

activity after diagnosis of various chronic diseases (19). An Australian population-based study found that moderate to vigorous physical activity (MVPA), fruit consumption, and number of cigarettes smoked did not change significantly after diagnosis of chronic disease (35).

Despite the increasing number of studies on lifestyle changes following the diagnosis of chronic diseases, the findings have been inconsistent, highlighting the need for further investigation. The scientific literature provides mixed evidence on lifestyle changes following a diagnosis of type 2 diabetes, with only a handful of studies examining changes following a diagnosis of hypertension (3,31,32,35). Furthermore, there is a scarcity of longitudinal studies investigating multiple lifestyle changes both before and after the diagnosis of CMDs, particularly in France. Although it is crucial to consider different lifestyle changes, the majority of studies focus only on assessing the impact of one single lifestyle change after CMD diagnosis (3,31,36,37). The present study aims to investigate different lifestyle changes (smoking, alcohol consumption, physical activity, dietary intake and sedentary behaviour) before and after the diagnosis of CMDs (hypertension and type 2 diabetes) in the French adult population, based on a large population-based survey from the NutriNet-Santé cohort.

Specific condition

This work was conducted at the Équipe de Recherche en Épidémiologie Nutritionnelle (EREN) under the supervision of Dr. Léopold Fezeu as professional advisor and Rebecca Kehm, PhD as academic advisor. All data management, analyses, and writing were done by Asri Mutiara Putri with guidance from professional advisor as well as academic advisor. Dr. Léopold Fezeu is an associate professor at the Sorbonne Paris Nord University and researcher at the EREN. He is specialised in biostatistics applied to nutrition. His expertise includes the nutritional risk factors of cardiometabolic diseases, and more recently in respiratory diseases. Rebecca Kehm, PhD is an associate research scientist at the Columbia University, Mailman School of Public Health, who is specialised in cancer research.

Research questions

What is the impact of the diagnosis of CMDs (hypertension and type 2 diabetes) on the lifestyle changes (smoking, alcohol consumption, physical activity, dietary intake and sedentary behaviour) in French adult patients?

General objective

To assess the lifestyle changes (smoking, alcohol consumption, physical activity, dietary intake and sedentary behaviour) after diagnosis of CMDs (hypertension and type 2 diabetes) in French adult patients.

Specific objectives

1. Carry out analyses to determine the prevalence of lifestyle components (before and after diagnosis) of CMDs.
2. Carry out analyses to assess lifestyle changes following the diagnosis of CMDs.
3. Examine socio-economic factors that modulate the lifestyle changes after the diagnosis of CMDs.

Hypothesis

There is a positive change in the lifestyle of adult patients in France following the diagnosis of a CMD.

Methods

Study Design

The present study uses a case-crossover design with secondary analysis of data from the NutriNet-Santé study. This design is well suitable for examining lifestyle changes before and after the diagnosis of CMDs, with each participant serving as their own control. The association between lifestyle changes before and after diagnosis is estimated by comparing an individual's lifestyle after the diagnosis with their lifestyle before the diagnosis of CMDs (reference period).

The NutriNet-Santé study is a French web-based prospective, ongoing cohort study. Details of the NutriNet-Santé's study objectives, design, and methods have been reported elsewhere (38). Briefly, the NutriNet-Santé study was launched in May 2009 to investigate various determinants of dietary behaviour and the relationships between nutrition and health outcomes in the French general population. The eligibility criteria are adults aged ≥15 years with access to the Internet. Participants are recruited through multimedia campaigns and directed to a dedicated website (http://www.etude-nutrinet-sante.fr/) to complete questionnaires at baseline and every six months thereafter, covering dietary intake (24-hour recall), sociodemographic and lifestyle characteristics, health status, anthropometry and physical activity information. In addition, participants are invited to complete monthly supplementary questionnaires on factors influencing dietary behaviours and nutritional and health status. Informed electronic consent was obtained from all participants. The NutriNet-Santé study is registered at https://clinicaltrials.gov/ct2/show/NCT03335644; the study is conducted according to the Declaration of Helsinki guidelines and was approved by the Institutional Review Board of the French Institute for Health and Medical Research (IRB Inserm no 0000388FWA00005831) and the "Commission Nationale de l'Informatique et des Libertés" (CNIL no 908450/no 909216).

Sample Design

The eligible population consisted of volunteer participants included in the NutriNet-Santé cohort between the years 2009 and 2024. This study have two separate study population – one with participants who were diagnosed with hypertension and one with participants who were diagnosed with diabetes. For both populations, pregnant women and participants with a history of hypertension (for the hypertension group) and type 2 diabetes (for the diabetes group) prior to the study were excluded. Moreover, missing data for each of lifestyle factor were excluded separately. The details of the sample selection process are presented in Figures 1 and 2.

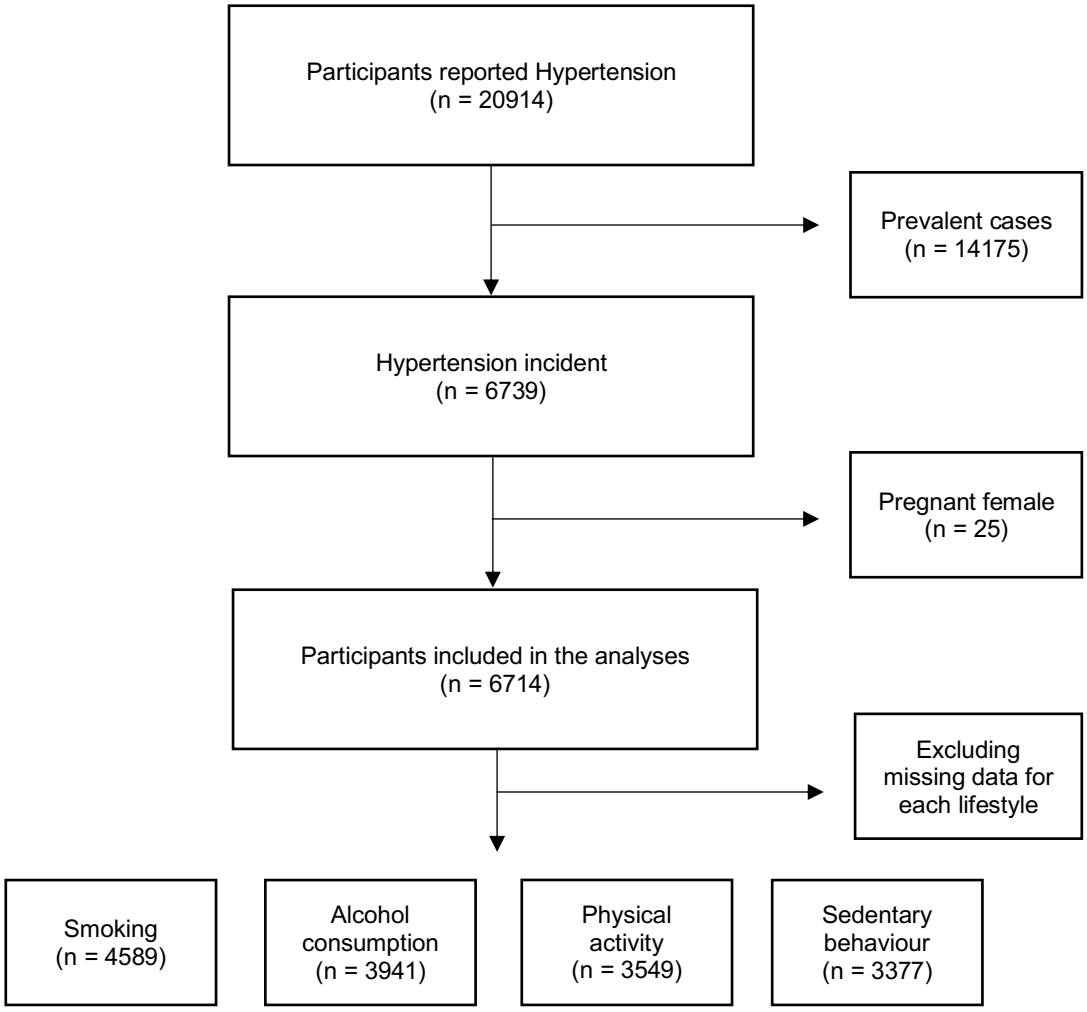

Figure 1. Sample selection for Hypertension

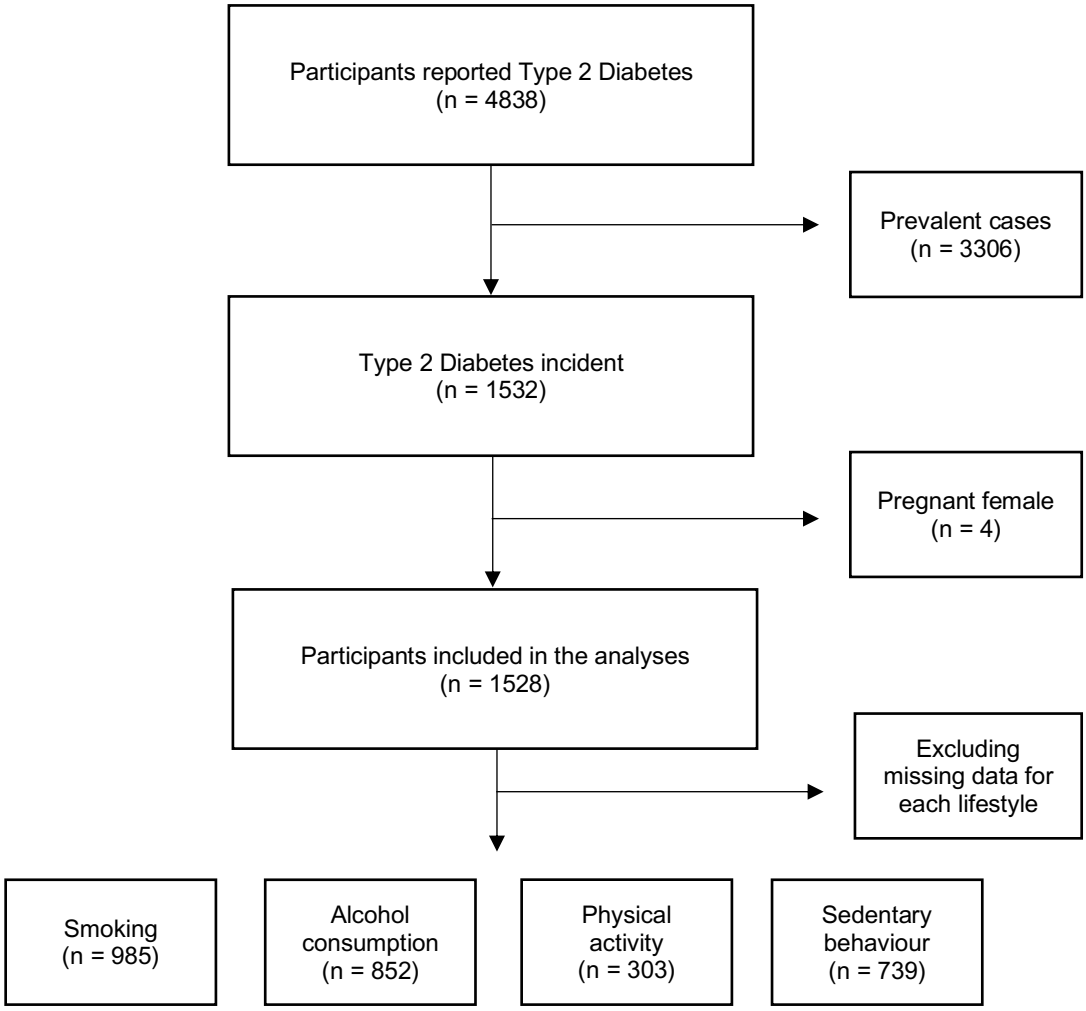

Figure 2. Sample selection for Type 2 Diabetes

Data Source

The present study utilised data extracted retrospectively from the NutriNet-Santé study, which was stored in the Équipe de Recherche en Épidémiologie Nutritionnelle (EREN) cloud system. The variables required for this study were retrieved from the EREN cloud system and assembled into a dataset using SAS programming. The data management tasks, including cleaning, imputation, and coding, as well as the subsequent analyses, were conducted using the R programming language.

Data Collection

Exposure

The exposure of this study was the diagnosis of hypertension or type 2 diabetes. Self-administered questionnaires were used at baseline to collect information on

participants' medical history, including diagnosis of chronic diseases. Afterwards, during the follow-up period, participants were requested to self-report any health events which were then validated by the medical team using pathology reports or other supplementary information, such as medical treatments reported in relation to their diseases. If necessary, the medical team also collected supplementary information from the participant's healthcare provider or from medical facilities they have visited. In addition to this process, which constituted the primary source of case ascertainment, the cohort data of the participants were linked to the medico-administrative databases of the National Health Insurance (SNIIRAM, authorisation by the Council of State no. 2013-175). Those who reported having been diagnosed with hypertension or type 2 diabetes after enrolment were included in the study. The first CMDs to occur were considered, when constituting each study population.

Outcome

The outcome of this study was the behavioural change, measured as lifestyle pre-diagnosis (control time window) and lifestyle post-diagnosis (case time window). The lifestyle behaviours included in this study were smoking, alcohol consumption, physical activity, dietary intake, and sedentary behaviour. Information on smoking, alcohol intake, physical activity, and sedentary behaviour was collected from self-administered questionnaires at baseline and at annual follow-ups. Meanwhile, the information on dietary intake data were collected from the three non-consecutive web-based 24-hour dietary records completed at baseline and every six months.

In this study, each habitual lifestyle was considered both before and after the diagnosis of the CMD. The participants were classified according to their smoking status into two categories: "smoker" and "non-smoker". The consumption of alcohol was assessed using two categories: "drinker" and "non-drinker". Moreover, the intake of alcohol was quantified in grams per day. Weekly energy expenditure was expressed in metabolic equivalent (MET) hours per week, as determined by the International Physical Activity Questionnaire in its short form (IPAQ-sf) and physical activity levels were classified as "low" for <600 MET-min/week, "medium" for 600-1500 MET-min/week, and "high" for >1500 MET-min/week and. Sedentary behaviour (number of hours sitting or lying down per week) was categorised as either "low" or "high" based on the median values. For females, the cutoff was 38.5 hours per week, while for males, it was 35 hours per week. Activity below these cutoffs was classified as low, while activity above was classified as high. Finally, dietary intake was evaluated by calculating the mean score of components aligned with the French Programme National Nutrition Santé (PNNS-GS2)

dietary recommendations-guidelines score 2 (ref), higher score indicating better adherence to French nutritional recommendations (appendix 1).

Other covariates

Socioeconomic and demographic data were collected at the outset of the study and at regular intervals thereafter. In this study, the participants were characterised using the closest socioeconomic and demographic data to the diagnosis of CMD. These variables were employed as potential interaction variables and included age, sex, education level, marital status, income, employment status, and Body Mass Index (BMI).

Age was dichotomized into <60 and ≥60 years old, while sex was categorized as “male” and “female”. Educational level was categorized as "<BAC" for less than high school, "≤BAC +3" for ≤ 3 years after high school, and ">BAC +3" for > 3 years after high school. Marital status was classified as "single" and "married". Income was defined as the monthly income per consumption unit in Euros and categorized into four groups: "≤1200", "1200-1800", ">1800-2700", and ">2700". Occupational status was categorized into five groups: "unemployed", "self-employed", "employees", "intermediate professions", "managerial staff". Body mass index was categorized as "<25 kg/m^2", "≥25 to <30 kg/m^2", and "≥30 kg/m^2".

Ethics

The present study was approved by the University of Sheffield Research Ethics Committee in accordance with ethical requirements for conducting a thesis (appendix 2).

Statistical Analyses

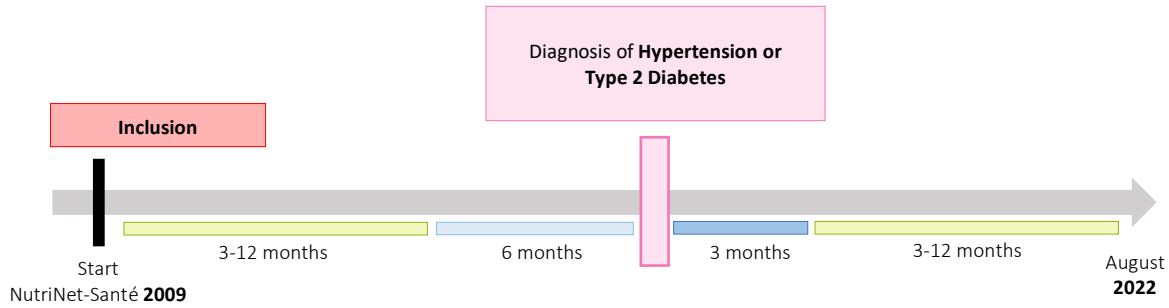

Figure 3. Inclusion period of the study

Transition lifestyle before the diagnosis (non-habitual lifestyles); excluded

Transition lifestyle after the diagnosis (non-habitual lifestyles); excluded

Habitual lifestyle before or after the diagnosis; included

To evaluate changes in lifestyle before and after the diagnosis of chronic diseases, the present study utilises data collected during the period ranging from six months to eighteen months before diagnosis, and data from three months to fifteen months following the diagnosis. The study did not utilise data within a 9-month window, spanning from six prior to diagnosis to three months post-diagnosis (Figure 3).

Descriptive analyses for quantitative variables were presented as mean (SD) for normally distributed data (dietary intake (PNNS-GS2 score)) and median (IQR) for non-normally distributed data (alcohol intake in grams per day and physical activity in MET hours per week). While categorical variables were summarised using frequencies and percentages. McNemar's test and conditional logistic regression were employed to compare categorical variables, while Wilcoxon test and paired t-test was used for numerical variables. The significance level was set at 0.05.

The covariates having less than 5% missing values were addressed through imputation, where means or medians were computed for continuous variables and modes for categorical variables. Missing values on covariates more than 5% were treated as NA categories. However, no imputation and deletion were conducted for the main exposure and outcome variables.

Bivariate analyses were performed using McNemar (for qualitative variables) and paired t-test (for normally distributed quantitative variables) or Wilcoxon tests for paired data (non-normally distributed quantitative variables). Multivariable analyses were performed using conditional logistic regression. The first model assessed the outcome (before and after diagnosis) and exposures (each of the lifestyles) separately. As the case-crossover design entails each of the individual serving as their own control (39), the characteristics of observations before and after were identical. Consequently, it eliminates confounding variables.

A series of interaction analyses were conducted with the objective of examining the potential effect modification between lifestyle and sociodemographic variables in relation to the outcome. Two models were developed for investigation: a crude model that excluded interaction terms and a second model that included interaction terms deemed significant at p-value of less than 0.10. To ascertain whether the inclusion of the interaction terms in the model resulted in a significant change in the model's predictive ability, contrast test were employed to compare the crude model with the model containing the interaction terms. If the contrast test indicated significance, a final model stratified by the interacting sociodemographic variable was presented to illustrate the effect within each stratum, with the p-value showing significance

included. In the absence of any compelling evidence to the contrary, the crude model was retained.

Result

The descriptive analyses (Table 1) indicate that in the hypertension group, there were 6714 participants, with 45% under the age of 60 and 55% aged 60 years and older. The majority of the group (68%) were female. In terms of educational attainment, 26% of the sample had achieved less than a BAC level, 47% had achieved BAC +3 or less, and 27% had achieved more than BAC +3. With regard to marital status, 73% of the respondents were married. The monthly income of the participants exhibited considerable variation, with 43.4% reporting income exceeding 2700 €/cu per month. In term of employment status, 60% of the participants were unemployed. The distribution of BMI was as follows: 42% had a normal BMI, 37% were overweight, and 21% were obese.

Table 1. Characteristics of Patients with Cardiometabolic Diseases, at the Time of Diagnosis of the Cardiometabolic Disease, The NutriNet-Santé Cohort, France, 2009-2022

	Hypertension (N = 6714)	Type 2 Diabetes (N = 1528)
Age (years)		
<60	3045 (45%)	663 (43%)
≥60	3669 (55%)	865 (57%)
Sex		
Male	2121 (32%)	612 (40%)
Female	4593 (68%)	916 (60%)
Education		
< BAC	1767 (26%)	473 (31%)
≤ BAC +3	3147 (47%)	664 (43%)
> BAC +3	1800 (27%)	391 (26%)
Marital Status		
Single	1825 (27%)	442 (29%)
Married	4889 (73%)	1,086 (71%)
Monthly Income		
<1200 €/cu	429 (6.4%)	157 (10%)
1200-1800 €/cu	669 (10.0%)	185 (12%)
>1800-2700€/cu	1712 (25.5%)	401 (26%)
>2700€/cu	2913 (43.4%)	579 (38%)
NA	991 (14.7%)	206 (14%)
Employment		
Unemployed	4022 (60%)	991 (64.8%)
Self-employed	112 (1.6%)	36 (2.3%)

Employees	850 (13%)	185 (12.1%)
Intermediate profession	689 (10%)	113 (7.4%)
Managerial staff	1015 (15%)	197 (13%)
NA	26 (0.4%)	6 (0.4%)
BMI		
Normal (<25 kg/m^2)	2837 (42%)	239 (15.6%)
Overweight (25-29.9 kg/m^2)	2477 (37%)	496 (32.5%)
Obese (≥30 kg/m^2)	1400 (21%)	677 (44.3%)
NA	-	116 (7.6%)

§Mean (standard deviation)

‡Median (interquartile range)

BAC: Baccalauréat, BMI: Body Mass Index (Weight (kg)/height (m)^2). CU: Consumption Unit.

The study included 1528 participants with type 2 diabetes, of whom 57% were aged 60 years and older. The percentage of females in the group was 60%. The educational attainment of the participants revealed that 31% had achieved less than a BAC level, 43% had achieved BAC +3 or less, and 26% had achieved more than BAC +3. Approximately 71% of the participants were married, and 38% earned more than 2700 €/cu per month. The employment status of the respondents revealed that 64.8% were unemployed. With regard to BMI, 15.6% of the sample exhibited a normal BMI, 32.5% were overweight, and 44.3% were obese.

Table 2. Lifestyles Characteristics Before and After the Diagnosis of Cardiometabolic Diseases

	Hypertension			**Type 2 Diabetes**		
	Before Diagnosis	After Diagnosis	P-value	Before Diagnosis	After Diagnosis	P-value
	(n = 6174)	**(n = 6174)**		**(n = 1528)**	**(n = 1528)**	
Smoking Status			<0.001[a]			0.571[a]
Non-smoker (reference)	4749 (90.4%)	5103 (92.3%)		1012 (90.4%)	1079 (91.5%)	
Current smoker	502 (9.6%)	423 (7.7%)		108 (9.6%)	100 (8.5%)	
Alcohol (g/day) ‡	4.286 (0.71-11.43)	4.286 (0.71-10.86)	<0.001[c]	3.643 (0.00-11.43)	2.857 (0.00-10.00)	0.001[c]
Alcohol Intake			0.042[a]			1.000[a]
Non-drinker (reference)	1056 (22%)	1174 (23%)		283 (27%)	330 (30%)	
Drinker	3775 (78%)	3853 (77%)		751 (73%)	756 (70%)	
MET‡	39.95 (18.20-77.30)	41.10 (18.60-78.60)	0.540[c]	33.58 (13.68-72.62)	35.55 (14.34-71.61)	0.527[c]
Physical Activity			0.633[b]			0.079[b]
Low (reference)	994 (22%)	1009 (21%)		268 (28%)	253 (24%)	

Medium	1665 (37%)	1765 (37%)		347 (36%)	395 (38%)	
High	1877 (41%)	2030 (42%)		356 (37%)	386 (37%)	
Dietary Intake (PNNS Score) §	0.84 (3.46)	0.92 (3.50)	0.640[d]	0.09 (3.33)	0.25 (3.36)	0.393[d]
Sedentary Behaviour			0.315[a]			0.945[a]
High (reference)	2170 (49%)	2282 (49%)		522 (56%)	580 (57%)	
Low	2215 (51%)	2413 (51%)		413 (44%)	437 (43%)	

‡Median (interquartile range)

§Mean (standard deviation)

MET: Metabolic equivalent (MET) hours per week. PNNS-GS2 Score: mean score of components aligned with the French Programme National Nutrition Santé (PNNS-GS2) dietary recommendations.

[a]McNemar test for categorical variable (≤2 categories). [b]Conditional logistic regression for categorical variable (>2 categories). [c]Wilcoxon test for non-normally distributed quantitative variable. [d]Paired t-test for normal distributed quantitative variable.

In the hypertension group (Table 2) , the proportion of current smokers decreased from 9.6% to 7.7% ($p < 0.001$). There was also a significant decrease in alcohol intake (grams per day) following diagnosis ($p < 0.001$). Although the median remained unchanged at 4.286 grams per day, the IQR exhibited a shift from 0.71-11.43 to 0.71-10.86. Additionally, the proportion of drinkers decreased from 78% to 77% ($p = 0.042$). The median MET hours per week of physical activity before the diagnosis was 39.95, while the median after the diagnosis was 41.10 ($p = 0.540$). The prevalence of physical activity levels was also relatively stable before and after diagnosis, with the prevalence of low activity at 22% before and 21% after, medium activity remaining steady at 37%, and prevalence of high activity at 41% before and 42% after ($p = 0.633$). With regard to dietary intake (mean of PNNS-GS2 score), the difference in mean before and after was not statistically significant ($p = 0.640$). Similarly, there was no statistically significant difference in sedentary behaviour before and after diagnosis ($p = 0.315$).

In the group of individuals diagnosed with type 2 diabetes (Table 2), the study observed a prevalence of current smokers of 9.6% before diagnosis and 8.5% after diagnosis ($p = 0.571$). The median of alcohol intake (grams per day) was found to have decreased significantly from 3.64 before diagnosis to 2.86 after diagnosis ($p = 0.001$). Upon categorisation, the prevalence of drinkers was found to be 73% before diagnosis and 70% after diagnosis ($p = 1.000$). The median of physical activity in MET hours per week was 33.58 before diagnosis and 35.55 after diagnosis ($p = 0.527$). The prevalence of physical activity levels were remained constant before and after diagnosis. The prevalence of low activity was 28% before and 24% after, medium activity was 36% before and 38% after, while high activity remained stable at 37% ($p = 0.079$). The dietary intake (mean of PNNS-GS2 score) did not show statistically significant changes

before and after diagnosis (p = 0.393). Additionally, no significant differences were observed in sedentary behaviour (p = 0.945) before and after diagnosis.

Table 3. Count of Patients' Lifestyle Changes Before and After Diagnosis Among Hypertensive Patients

Smoking status					
	After diagnosis			Test of pre-post diagnosis	
Before diagnosis	Non-smoker	Current smoker	Total	P-value	
Non-smoker	4133	36	4169	<0.001[a]	
Current smoker	107	313	420		
Total	4240	349	4589		
Alcohol Intake					
	After diagnosis			Test of pre-post diagnosis	
Before diagnosis	Non-drinker	Drinker	Total	P-value	
Non-drinker	568	276	844	0.042[a]	
Drinker	327	2743	3070		
Total	895	3019	3914		
Physical Activity					
	After diagnosis				Test of pre-post diagnosis
Before diagnosis	Low	Medium	High	Total	P-value
Low	378	130	260	768	0.633[b]
Medium	146	915	432	1493	
High	223	437	628	1288	
Total	747	1482	1320	3549	
Sedentary Behaviour					
	After diagnosis			Test of pre-post diagnosis	
Before diagnosis	Low	High	Total	P-value	
High	430	1268	1698	0.315[a]	
Low	1218	461	1679		
Total	1648	1729	3377		

[a]McNemar test for categorical variable (≤2 categories). [b]Conditional logistic regression for categorical variable (>2 categories)

Table 3 provides a comprehensive illustration of lifestyles changes observed in the Hypertension group. A notable shift was observed in smoking status before and after diagnosis, with 107 patients transitioning from current smokers to non-smokers and 36 patients transitioning from non-smokers to current smokers (p < 0.001). Alcohol intake also demonstrated a significant shift, with 327 drinkers transitioning to non-drinkers and 276 non-drinkers transitioning to drinkers (p = 0.042). However, there was no significant change in physical activity levels or sedentary behaviours post-diagnosis (p = 0.633 and p = 0.315, respectively). These findings indicate that while there are significant improvements in smoking and alcohol consumption among hypertension patients after

diagnosed with hypertension, physical activity and sedentary behaviours remain largely unchanged.

Table 4. Count of Patients' Lifestyle Changes Before and After Diagnosis Among Type 2 Diabetes Patients

Smoking status					
	After diagnosis			Test of pre-post diagnosis	
Before diagnosis	Non-smoker	Current smoker	Total	P-value	
Non-smoker	885	12	897	0.571[a]	
Current smoker	16	72	88		
Total	901	84	985		
Alcohol Intake					
	After diagnosis			Test of pre-post diagnosis	
Before diagnosis	Non-drinker	Drinker	Total	P-value	
Non-drinker	172	70	242	1.000[a]	
Drinker	71	539	610		
Total	243	609	852		
Physical Activity					
	After diagnosis				Test of pre-post diagnosis
Before diagnosis	Low	Medium	High	Total	P-value
Low	108	57	44	209	0.079[b]
Medium	52	147	88	287	
High	22	86	171	279	
Total	182	290	303	775	
Sedentary Behaviour					
	After diagnosis			Test of pre-post diagnosis	
Before diagnosis	High	Low	Total	P-value	
High	306	107	413	0.945[a]	
Low	105	221	326		
Total	411	328	739		

[a]McNemar test for categorical variable (≤2 categories). [b]Conditional logistic regression for categorical variable (>2 categories).

In the diabetes group (Table 4), no significant changes were observed in smoking status ($p = 0.571$), alcohol intake ($p = 1.000$), physical activity levels ($p = 0.079$), or sedentary behaviour ($p = 0.945$) before and after diagnosis. These findings indicate that lifestyle behaviours related to smoking, alcohol consumption, physical activity, and sedentary habits remained consistent among diabetes patients post-diagnosis.

Table 5. Association Between Lifestyle Factors and CMDs Diagnosis: Odds Ratios, 95% CI, (For Categorical Variables) and Mean or Median Pre-Post Diagnosis Changes (For Continuous Variables)

	Hypertension			Type 2 Diabetes		
	OR/β	95% CI	*P-value*	OR/β	95% CI	*P-value*
Smoking Status*						
Non-smoker (reference)	1	1		1	1	
Current smoker	0.34	0.23-0.49	<0.001[a]	0.75	0.35-1.59	0.451[a]
Alcohol (g/day)**	0.35	0.21-0.64	<0.001[b]	0.79	0.29-1.29	0.001[b]
Alcohol Intake*						
Non-drinker (reference)	1	1		1	1	
Current drinker	0.84	0.72-0.99	0.038[a]	0.99	0.71-1.37	0.933[a]
MET (in hours/week)**	0.41	-0.92-1.76	0.540[b]	-0.92	-3.75-1.97	0.527[b]
Physical Activity*			0.633[a]			0.079[a]
Low (reference	1	1		1	1	
Medium	1.07	0.92-1.24	0.369[a]	1.30	0.95-1.78	0.104[a]
High	1.03	0.88-1.21	0.693[a]	1.48	1.05-2.09	0.026[a]
Dietary Intake (PNNS Score)***	-0.03	-0.17-0.10	0.640[c]	0.24	0.99-1.14	0.393[c]
Sedentary Behaviour*						
High (reference)	1	1		1	1	
Low	1.07	0.94-1.22	0.299[a]	1.02	0.78-1.33	0.891[a]

MET: Metabolic equivalent (MET) hours per week. PNNS-GS2 Score: mean score of components aligned with the French Programme National Nutrition Santé (PNNS-GS2) dietary recommendations.

*OR for qualitative variable; [a]Conditional logistic regression

**Beta for quantitative variable (Median for non-normally distributed quantitative variable); [b]Wilcoxon test

***Beta for quantitative variable (mean for normal distributed); [c]Paired t-test

The conditional regression model was used to examine lifestyle changes before and after diagnoses for categorical variables, while the Wilcoxon or paired t-test were employed to study the lifestyle changes before and after diagnoses for continuous variables (Table 5). In the case of hypertension, patients exhibited a 0.34 (95% CI: 0.23-0.49, p < 0.001) lower odds of being a current smoker following the diagnosis in comparison to before diagnosis. With regard to alcohol consumption (g/day), patients showed a median decreased of 0.35 (95% CI: 0.21-0.64, p < 0.001) in alcohol consumption following a diagnosis of hypertension compared to before diagnosis. Furthermore, when categorised as non-drinkers and current drinkers, patients had a 0.84 (95% CI: 0.72-0.99, p = 0.038) lower odds of being drinkers after diagnosis compared to before diagnosis. In contrast, there was no significant changes in median physical activity, measured in MET (hours per week), comparing before and after diagnosis (median 0.41, 95% CI: -0.92-1.76, p = 0.540). There were no significant changes in physical activity levels before and after diagnosis. The odds ratio for medium activity was 1.07 (95% CI: 0.92-1.24, p = 0.369) while the odds for high activity was 1.03 (95% CI: 0.88-1.21, p = 0.693). There was also no

significant changes in the mean of dietary intake after diagnosis compare to before diagnosis (mean -0.03, 95% CI: -0.17-0.10, p = 0.640). Similarly, there was no significant changes in the level of sedentary behaviour after diagnosis compare to before diagnosis (OR 1.07, 95% CI: 0.94-1.22, p = 0.299).

Meanwhile, the regression model indicated that there were no significant changes in the smoking status among individuals with diabetes (OR 0.75, 95% CI: 0.35-1.59, p = 0.451). For alcohol consumption (g/day), patient had a statistically significant median decreased of 0.79 (95% CI: 0.29-1.29, p = 0.001) after diagnosis compare to before diagnosis. However, when categorised as non-drinkers and current drinkers, there was no significant changes before and after diagnosis (OR 0.99, 95% CI: 0.71-1.37, p = 0.933). No changes were observed in physical activity, as measured in MET (hours per week), with a median of median -0.92 (95% CI: -3.75-1.97, p = 0.527). When physical activity was categorised, patients demonstrated a 1.48 (95% CI: 1.05-2.09, p = 0.026) higher odds of engaging in high-level physical activity following diagnosis compared to before diagnosis. No significant changes were observed in the medium level. Moreover, there were no significant changes in the mean of dietary intake following diagnosis of diabetes (mean 0.24, 95% CI: 0.99-1.14, p = 0.393). There was also no significant changes in sedentary behaviour following diagnosis compare to before diagnosis (OR 1.02, 95% CI: 0.78-1.33, p = 0.891).

A series of interaction analyses were conducted with the objective of investigating potential interactions between lifestyle factors and sociodemographic variables in relation to the outcomes. The results of the ANOVA test comparing the model with and without interaction terms in hypertension group revealed significant results for physical activity (MET in hours per week) and employment status, and sedentary behaviour and sex. In the case of diabetes group, significant models were observed between alcohol consumption (g/day) and employment status, and between dietary intake and education level. Differences were calculated as lifestyles before minus lifestyles after diagnosis. Thus, positive results indicidate a decrease and negative results indicate an increase.

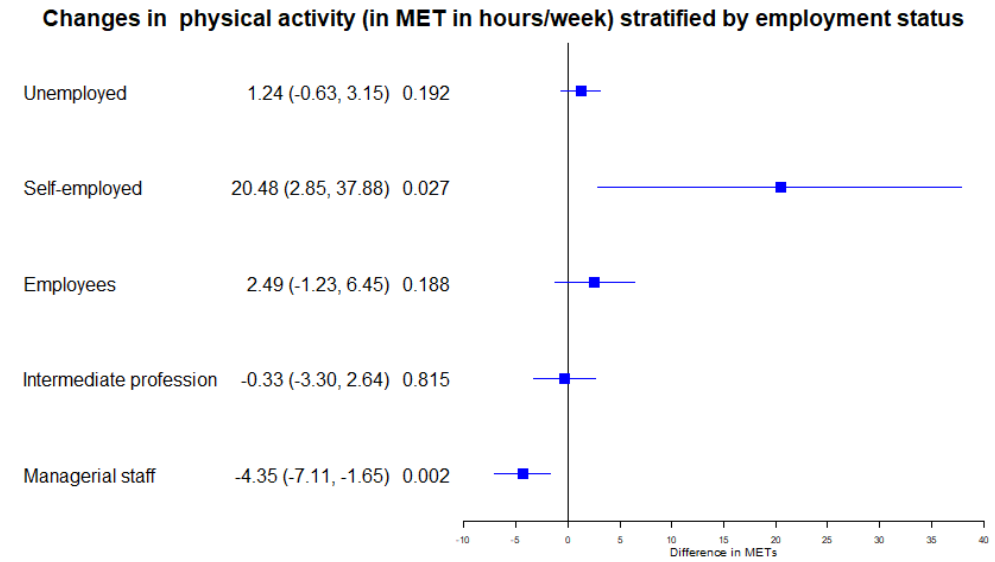

Figure 4. Changes in physical activity (in MET in hours/week) stratified by employment status in Hypertension group
(P-value of interaction terms = <0.001. Differences were calculated as lifestyles before minus lifestyles after diagnosis)

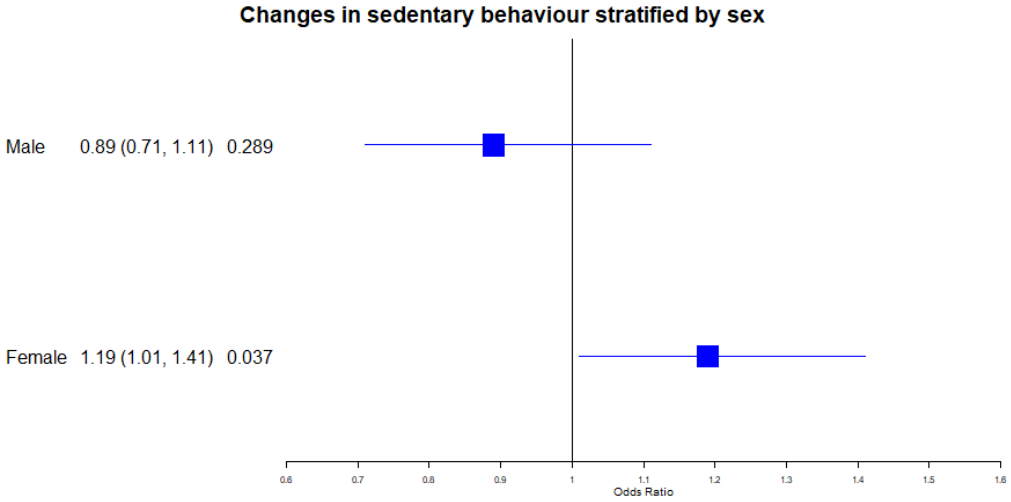

Figure 5. Changes in sedentary behaviour stratified by sex in Hypertension group
(P-value of interaction terms = 0.035)

The stratified analyses of lifestyle changes before and after diagnosis revealed significant changes in various subgroups. In the hypertension group, for physical activity (MET in hours per week) stratified by employment status (Figure 4), a significant change was found for the self-employed patient with a median decreased of 20.48 (95% CI: 2.85-37.88, p = 0.027) in MET in hours per week following diagnosis. Conversely, there was a significant median increased of 4.35 MET in hours per week (95% CI: -7.11- -1.65, p = 0.002) for managerial staff patients following diagnosis. However, no significant changes were found for the unemployed, employees, or those in intermediate professions, indicating that changes in physical activity

levels were influenced by employment status, particularly among the self-employed and managerial staff following a diagnosis.

For sedentary behaviour by sex (Figure 5), males showed no significant change (OR: 0.89, 95% CI: 0.71-1.11, p = 0.289), while females had a significant result (OR: 1.19, 95% CI: 1.01-1.41, p = 0.037). This suggests that sedentary behavior changes after diagnosis were significantly influenced by sex. In particular, female patients had 1.19 higher odds of doing low sedentary behaviour after diagnosis compared to before diagnosis.

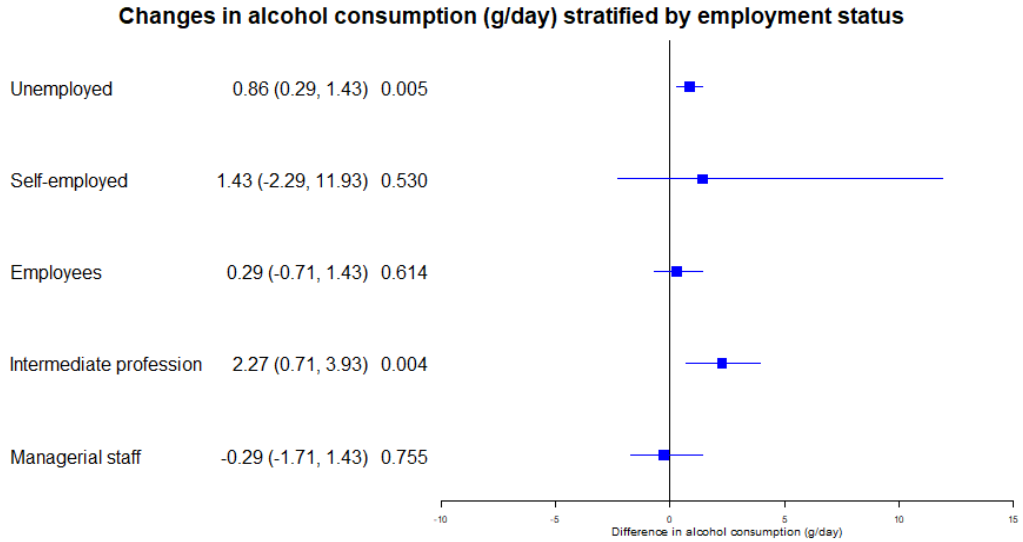

Figure 6. Changes in alcohol consumption (g/day) stratified by employment status in Type 2 Diabetes group
(P-value of interaction terms = 0.06. Differences were calculated as lifestyles before minus lifestyles after diagnosis)

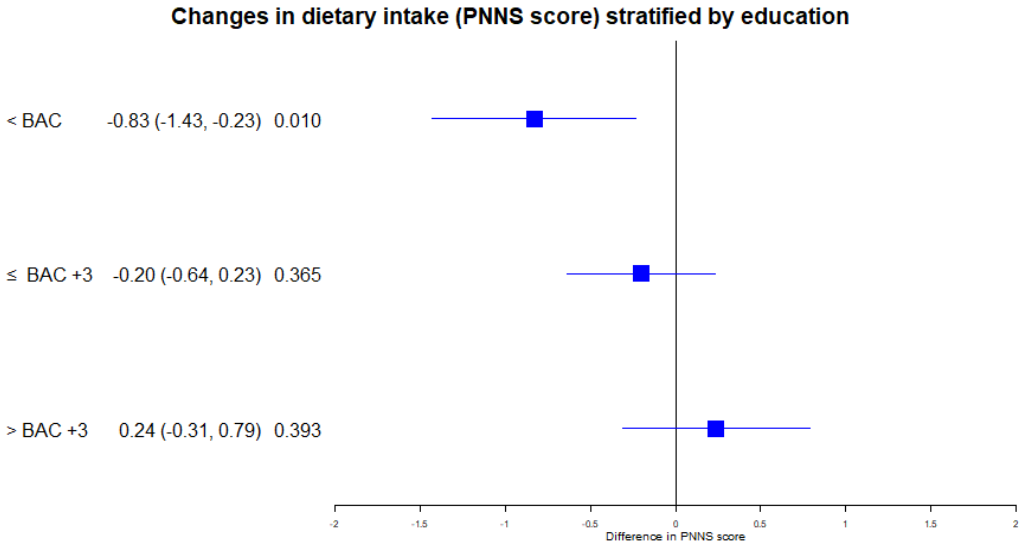

Figure 7. Changes in dietary intake (PNNS score) stratified by education in Type 2 Diabetes group
(P-value of interaction terms = 0.05. Differences were calculated as lifestyles before minus lifestyles after diagnosis)

In the diabetes group, a stratified analysis of alcohol consumption (g/day) before and after diagnosis by employment status (Figure 6) revealed a significant median decreased of 0.86 (95% CI: 0.29-1.43, p = 0.005) in the unemployed and a significant median decreased of 2.27 in intermediate professions (95% CI: 0.71-3.93, p = 0.004) after diagnosis. Nevertheless, there were no significant changes in alcohol consumption among the self-employed, employees, and managerial staff.

Regarding dietary intake (PNNS-GS2 score) (Figure 7), a significant mean increased of 0.83 (95% CI: -1.43- -0.23, p = 0.010) was observed among individuals with less than BAC level education. No significant mean changes were observed in other education levels.

Discussion

To the best of our knowledge, this is the first study to investigate various lifestyle changes in individuals diagnosed with hypertension and type 2 diabetes, particularly using a case-crossover design for a large population sample of French adults. The results of the study, based on data collected at two points in time, 6-18 months prior to diagnosis and 5-15 months post-diagnosis, indicated that a diagnosis of hypertension was associated with a positive change in health behaviour, including smoking and alcohol consumption. These changes were quantified in grams per day and in categories. Similarly, a diagnosis of type 2 diabetes diagnosis also encourages positive lifestyle changes in alcohol consumption (grams per day) and physical activity levels.

Our findings on the positive lifestyle changes in smoking status following a diagnosis of hypertension are consistent with the Canadian longitudinal study, which reported an 18.6% relative risk reduction in smoking cessation among newly diagnosed hypertensive patients (40). However, a longitudinal study in China suggested that minor chronic diseases such as hypertension do not significantly decrease smoking rates. The Chinese study indicated that the effect of minor diseases on smoking cessation is weaker compared to that of major chronic diseases such as cancer, heart disease, and stroke (33). This discrepancy highlights the variability in smoking cessation outcomes contingent on the perceived severity of the disease.

It has been demonstrated in other studies that individuals who have been diagnosed with hypertension tend to make positive adjustments to their alcohol consumption habits (41). One study found that 40% of individuals at risk of alcohol consumption reduced their alcohol intake following the provision of feedback on elevated blood pressure. This suggests that blood pressure screening can motivate lifestyle modifications and enhance awareness of and treatment for hypertension (41). However, our findings diverge from those of a US population study which found that the onset of hypertension did not significantly impact alcohol

consumption (31). The findings of this study indicate that the impact of different health condition on lifestyle changes varies. In particular, the onset of diabetes and heart problems is associated with a greater reduction in heavy drinking than hypertension. (31).

Furthermore, positive changes in alcohol consumption following diagnosis of type 2 diabetes in line with the majority of previous studies (31) (32) (42). A study indicated that individuals diagnosed with diabetes were more likely to reduce their consumption of alcohol over the long term, with a higher probability of decreasing their alcohol intake over a decade (31). Those who are diagnosed with diabetes are more likely to reduce or quit drinking, as the management of diabetes is strongly associated with dietary recommendations (43). In contrast, a study revealed that the increase in the proportion of people who abstain from or reduce alcohol consumption after diagnosis was only statistically significant in cases of cancer, stroke, and lung disease, not among those diagnosed with diabetes. Nevertheless, when the average daily alcohol consumption was examined in individuals diagnosed with diabetes, a significant decrease was observed (34).

The favourable changes in physical activity observed in individuals diagnosed with type 2 diabetes are consistent with previous research (42) (44), which found that diagnosed individuals were more likely to increase their overall physical activity, walking, and the number of physical activity episodes (44). This indicates that the diagnosis of type 2 diabetes serves as a significant health alert, prompting individuals to improve their physical activity levels, in an attempt to assuage health concerns (44). The benefits of increased physical activity benefits extend to other chronic conditions such as heart disease and stroke, thereby emphasising the importance of promoting healthy behaviours post-diagnosis (34). However, our findings diverge from those of some studies, such as an English study that found no significant change in physical activity levels following a diabetes diagnosis (32). A study explained that minimal changes or even declines in exercise patterns for some chronic conditions may be attributable to functional limitations (34). These differences highlight the necessity for the implementation of tailored interventions aimed at facilitating the enhancement of physical activity among individuals with chronic diseases.

In patients with hypertension, the present findings suggests that physical activity (MET in hours per week) varies by employment status. A significant decrease of physical activity was found in the self-employed patients, while an increase was observed in managerial staff patients. One possible explanation for this variation is the potentially higher educational attainment among managerial staff. Those with higher levels of education are evidently more likely to understand the significance of nutrition and diet, as well as the role of physical activity in preventing and managing their disease (45). Previous research has also indicated that

working-class men may initially engage in higher levels of 'unhealthy' physical activity, which may increase the likelihood of transitioning to healthier behaviours. Conversely, if working-class social norms promote 'unhealthy' behavior, a diagnosis may provide justification for adopting 'healthy' behaviors (32). A notable shift in sedentary behaviour was observed in female patients, but not for male patients. Female patients were more likely to reduce their sedentary behaviour after diagnosis. It is possible that gender differences may influence the manner in which individuals respond to a ‘teachable moment’. Previous research has documented that women tend to exhibit a more pronounced response to such moments (46).

In patients with type 2 diabetes, the stratified analysis of alcohol consumption by employment status showed a significant decrease in alcohol consumption among unemployed and intermediate-level professionals. Unemployment results in a decreased in income, which can impose financial constraints, potentially leading to a decrease in overall demand for food as well as alcohol consumption and changing preferences for certain goods (47). For certain individuals, unemployment may result in having more leisure time, which could be utilised to engage in health-promoting activities such as physical activity. This could potentially lead to weight loss or reduced alcohol consumption (47). The reduction in alcohol consumption among intermediate professionals, including teachers, health professionals, and civil servants, can be attributed to their educational attainment. Education enhances comprehension of healthy lifestyle practices in the context of chronic disease management, which in turn has a positive impact on behavioural change (35,45). Dietary intake also varied by education level, with those with less than BAC level education exhibiting a mean increased in dietary intake following diagnosis. While the reasons for this relationship may be complex, one possible explanation is that patients with lower education likely had lower PNNS-GS2 scores at baseline, making it more probable for them to experience a significant increase in their mean score.

This study has several strengths. Firstly, the study employs a case-crossover design, utilising each subject as their own control. This method effectively eliminates confounding variables that tend to remain relatively constant within subjects, such as age, sex, educational attainment, socioeconomic status, and other unrecorded clinical characteristics. Secondly, the study examines two distinct time points for each individual: before diagnosis and after diagnosis. This temporal comparison enhances the robustness of the findings. Thirdly, by the utilisation of a large sample derived from a national population-based cohort study dataset enables the study to yield results that are generalisable and applicable to the broader population, enhancing the interpretability and relevance of its findings. Nevertheless, it is important to acknowledge the existence of several limitations. Firstly, it should be noted that the NutriNet-Santé study relies on self-reported data, which may introduce inaccuracies in

lifestyle reporting, depending on the responses of the participants. Additionally, the present study did not assess the trend before and after diagnosis; instead, it only took into account the lifestyle value closest to the inclusion period criteria. Moreover, this study does not consider other significant risk factors, particularly major chronic diseases, which could have a more profound impact on lifestyle changes.

Conclusion and Recommendations

In conclusion, a diagnosis of hypertension is associated with smoking cessation and decreased alcohol consumption, whereas a diagnosis of type 2 diabetes is associated with reduced alcohol intake (grams per day) and increased high-intensity physical activity. The extent of lifestyle changes following diagnosis varies according to sociodemographic factors, including employment status, educational attainment, and gender. These findings highlight the importance of chronic disease diagnosis and the potential efficacy of tailored interventions that incorporate sociodemographic factors in health behaviour change programs.

Further analyses are required to determine whether the diagnosis of cancer and CVDs serve as effect modifiers in the present association. Furthermore, the influence of the number of CMDs in individuals examined should be considered. It may also be important to consider other CMDs, such as dyslipidaemia.

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List of Appendices

Appendix 1: PNNS-GS2 components and scoring

Dietary components	Recommendation [a]	Criteria [b]	Score
Fruits and vegetables (weight=3)	At least 5 servings/day, with 1 max as juice and 1 max as dried	[0 - 3.5[[3.5 - 5[[5 - 7.5[≥7.5	0 0.5 1 2
	Prefer organic fruits	Most of the time Occasionally Never	0.5 0.25 0
	Prefer organic vegetables	Most of the time Occasionally Never	0.5 0.25 0
Nuts (weight=1)	A handful/day	0]0 – 0.5[[0.5- 1.5[≥1.5	0 0.5 1 0
Legumes (weight=1)	At least 2 servings/week	0 /week]0-2[/week ≥2 /week	0 0.5 1
	Prefer organic legumes	Most of time Occasionally Never	0.5 0.25 0
Bread, cereals, potatoes and legumes		_	
Whole-grain food (weight=2)	Every day	0]0 - 1[[1 - 2[≥2	0 0.5 1 1.5
	Prefer organic bread	Most of the time Occasionally Never	0.5 0.25 0
	Prefer organic grains	Most of the time Occasionally Never	0.5 0.25 0
Milk and dairy products (weight=1)	2 servings/day	[0 - 0.5[[0.5 - 1.5[[1.5 - 2.5[≥2.5	0 0.5 1 0
Red meat (weight=2)	Limit consumption	[0 - 500[g/week [500 - 750[g/week ≥750 g/week	0 -1 -2
Processed meat (weight=3)	Limit consumption	[0 - 150[g/week [150 - 300[g/week ≥300 g/week	0 -1 -2
	Prefer white ham over other processed meat [c]	Ratio <50% Ratio ≥50%	0 0.5
Meat and poultry, seafood and eggs		_	
Fish and seafood (weight=2)	2 servings/week	[0 - 1.5[servings /week [1.5 - 2.5[servings /week [2.5 - 3.5[servings /week ≥3.5 servings /week	0 1 0.5 0
	Fatty fish 1 serving/week	[0 - 0.5[servings/week [0.5 - 1.5[servings/week ≥1.5 servings/week	0 1 0

Dietary components	Recommendation [a]	Criteria [b]	Score
Added fat (weight=2)	Limit consumption	>16% of EIWA [f]	0
		≤16% of EIWA	1.5
	Prefer vegetal fat over animal fat	Ratio >50%	0
		Ratio ≤50%	1
	Prefer ALA-rich and olive oils over other oils	Ratio <50%	0
		Ratio ≥50%	1
Sugary foods (weight=3)	Limit consumption	<10 % of EIWA	0
		[10-15[% of EIWA	-1
		≥15% of EIWA	-2
Sweet-tasting beverages [d] (weight=3)	Limit consumption	0 mL/day	0
		]0 - 250[mL/day	-0.5
		[250 - 750[mL/day	-1
		≥ 750mL mL/day	-2
Alcoholic beverages (weight=3)	Limit consumption	0 g/day	0.5
		]0-100] g/day	0
		]100-200] g/day	-1
		>200 g/day	-2
Salt (weight=3)	Limit consumption	≤6 g/day	1
		]6-8] g/day	0
		]8-10] g/day	-0.5
		]10-12] g/day	-1
		>12 g/day	-2
Physical activity		_	

Abbreviations: EIWA = energy intake without alcohol; ALA = α-linolenic acid; PNNS-GS2,

[a] Principal guidelines are written in bold.

[b] Servings per day unless otherwise is stated

[c] Conditional: the 0.5 bonus point only occurs if total processed meat consumption is more than 150 g/week

[d] Sweetened beverages are specifically sugary sweeten beverages, artificially sweetened beverages and fruit juices

The computation and development of the dietary score PNNS-GS2, as well as its validation, have been extensively described (Chaltiel D et al. PNNS-GS2 - Development and validation of a diet quality score reflecting the 2017 French dietary guidelines. BJN. 2019; HCSP. Statement related to the revision of the 2017-2021 French Nutrition and Health Programme's dietary guidelines for adults [Internet]. Paris: Haut Conseil de la Santé Publique; 2017 Feb [cited 2019 Feb 5]. Available from: https://www.hcsp.fr/explore.cgi/avisrapportsdomaine?clefr=653). In summary, the PNNS-GS2 comprises 13 components, comprising six adequacy components and seven moderation components. The components, scorings, and weights are presented in **Error! Reference source not found.**.

For the adequacy and moderation components, achieving or not achieving a guideline component was allocated 1, 0, and 0, -1 points respectively. In order to improve the discrimination between individuals, half-points were allocated in a linear fashion. For milk and dairy products and for fish, a parabolic relationship was employed to allocate points. In order to prevent overrating multi-item components, each component was subjected to standardisation and weighting. A score was calculated for each participant as the sum of each component i multiplied by its associated weight and divided by its maximum absolute value:

$$Score\ \text{PNNS-GS2} = \sum_i \left(component_i \times \frac{\text{weight}_i}{\max(abs(component_i))} \right).$$

In order to prevent overrating among overconsumers, PNNS-GS2 was obtained after a penalization on energy intake. Those participants who reported energy intake in excess of

105% of their theoretical energy expenditure had their score reduced by the same proportion (29). The theoretical range of PNNS-GS2 is -∞ to 14.25.

Appendix 2: Research Ethics Approval from the University of Sheffield

Downloaded: 04/06/2024
Approved: 30/05/2024

Asri Mutiara Putri
Registration number: 220198295
Population Health
Programme: European Public Health

Dear Asri Mutiara

PROJECT TITLE: Lifestyles Changes Following Diagnosis of Cardiometabolic Diseases: A Case-Crossover Study from the NutriNet-Santé
APPLICATION: Reference Number 061040

This letter confirms that you have signed a University Research Ethics Committee-approved self-declaration to confirm that your research will involve only existing research, clinical or other data that has been robustly anonymised. You have judged it to be unlikely that this project would cause offence to those who originally provided the data, should they become aware of it.

As such, on behalf of the University Research Ethics Committee, I can confirm that your project can go ahead on the basis of this self-declaration.

If during the course of the project you need to deviate significantly from the above-approved documentation please inform me since full ethical review may be required.

Yours sincerely

Email Scharr Rec
Departmental Ethics Administrator

Abstract (French)

Contexte : Les maladies cardiovasculaires (MCV) constituent un problème de santé mondial important. Les maladies cardiovasculaires sont dues à des maladies cardiométaboliques (CMD), qui comprennent l'hypertension et le diabète de type 2, ainsi qu'à des facteurs comportementaux modifiables. Le diagnostic des maladies chroniques est un « moment d'apprentissage » crucial, conduisant les individus à initier des changements de comportement réduisant les risques. Les études existantes fournissent des preuves mitigées sur la relation entre le diagnostic de la maladie et les modifications du mode de vie.

Objectifs : Cette étude vise à évaluer les changements de mode de vie (tabagisme, consommation d'alcool, activité physique, apport alimentaire et comportement sédentaire) après diagnostic de DMC (hypertension et diabète de type 2) chez des patients adultes français.

Méthodes : Cette étude cas-cross-over a analysé les données de 6 714 (groupe hypertension) et 1 528 (groupe diabète de type 2) volontaires de l'étude NutriNet-Sante, une étude de cohorte française en cours. Une régression logistique conditionnelle et un test de McNemar ont été réalisés pour évaluer les changements de mode de vie, en comparant le mode de vie d'un individu après le diagnostic avec son mode de vie avant le diagnostic de DMC.

Résultats : Dans le groupe hypertendu, les patients avaient une probabilité plus faible d'être fumeurs actuels (RC 0,34, IC à 95 % : 0,23-0,49, $p < 0,001$), une consommation médiane d'alcool diminuée de 0,35 (IC à 95 % : 0,21-0,64, $p < 0,001$) et une probabilité plus faible de devenir buveur après le diagnostic (RC 0,84, IC à 95 % : 0,72-0,99, $p = 0,038$). Aucun changement significatif dans l'activité physique, l'apport alimentaire et le comportement sédentaire. Dans le groupe diabétique de type 2, une diminution médiane de 0,79 (IC à 95 % : 0,29-1,29, $p = 0,001$) de la consommation d'alcool et une augmentation des chances de pratiquer une activité physique intense (RC 1,48, IC à 95 % : 1,05-2,09, $p = 0,026$).) ont été observés après le diagnostic. Aucun changement significatif dans le statut tabagique, l'apport alimentaire et le comportement sédentaire. L'ampleur des changements de mode de vie varie en fonction de facteurs sociodémographiques, notamment l'emploi, l'éducation et le sexe.

Conclusion : Un diagnostic d'hypertension favorise l'arrêt du tabac et une diminution de la consommation d'alcool, alors qu'un diagnostic de diabète de type 2 entraîne une diminution de la consommation d'alcool et une augmentation de l'activité physique.

Mots clés: Mode de vie, Hypertension, Diabète de type 2