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Dietary and lifestyle habits of drinkers with preference for alcoholic beverage: does it really matter for public health? A review of the evidence

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ABSTRACT

Although the detrimental effects of heavy drinking in terms of health are well-documented in the literature, there are inconsistent findings regarding the safety of light-to-moderate alcohol consumption. In particular, little is still known about the consumption of specific alcoholic beverages in combination with dietary habits and lifestyle, which in turn could influence health status. Thus, the aim of this review is to summarise and critically evaluate the evidence of a relationship between preference for alcoholic beverages and consumer dietary and lifestyle habits. A literature search retrieved 3,887 articles. By removing duplicates and articles which were not relevant, the final number of articles was 26. The adherence to a healthier diet and lifestyle was generally observed in light-to-moderate alcohol consumers, especially when wine was the preferred beverage. Considering the potentially strong impact of drinking patterns on health and the risk of developing chronic diseases, the data summarised in this review highlight that alcoholic beverage preferences, drinking patterns, dietary patterns and lifestyle should be studied together. Any future epidemiological studies should analyse the relationship between alcohol consumption and the abovementioned correlations with respect to impact on health.

KEYWORDS

Dietary habits, alcohol, lifestyle, wine, beer, spirits, health

INTRODUCTION

Although current epidemiological evidence is largely consistent as to the detrimental effects of heavy drinking in terms of health, the public in particular receives inconsistent and confusing message regarding the safety of light-to-moderate alcohol consumption (Kunzmann *et al.*, 2018). In a SUN (Seguimiento Universidad de Navarra) prospective study, the authors concluded that the effect on mortality of the overall healthy alcohol-drinking pattern is more important than the total quantity of alcohol consumed (Gea *et al.*, 2014), while other studies either suggested that "there were no clear risk thresholds below which lower alcohol consumption stopped being associated with lower disease risk" (Wood *et al.*, 2018) or restricted the beneficial effects to people with no genetic predisposition (Au Yeung *et al.*, 2013). Moreover, in a recent prospective population-based study, (Schutte *et al.* (2020) highlighted that only wine could be associated with a protective role with regards to ischemic heart disease, whereas the consumption of beer/cider and spirits, even in low levels, was associated with an increased risk for all health outcomes (Schutte *et al.*, 2020). Furthermore, the findings from an ecological US study in a nationally representative cohort of households showed that, compared to non-drinkers, participants who purchased high levels of wine or beer, but not liquor, were less likely to be diagnosed with diabetes mellitus, while participants who purchased moderate levels of wine were 25 % less likely to be diagnosed with heart disease (Adjemian *et al.*, 2015).

Thus surprisingly little is known about the risks or benefits of moderate consumption of specific alcoholic beverages in terms of the health status of adults. The interpretation of the conclusions of epidemiological studies which examine the effects of alcohol consumption on human health will be unclear, limited and unsustainable, if they are not evaluated from a wider and more holistic perspective. Any discrimination related to type of alcoholic beverage has to be based on more than differences in chemical composition (Osorio-Paz *et al.*, 2019), mainly because choice of beverage type usually reflects a particular lifestyle, which can be defined as healthy, less healthy or even unhealthy.

Indeed, the combined impact of lifestyle-related factors on all-cause or cause-specific mortality has been the subject of much research, shedding light on the link between alcohol and health. In particular the "HALE" project, a longitudinal European study, concluded that the combined influence of four lifestyle habits, namely Mediterranean diet, moderate alcohol use, physical activity and absence of smoking, is associated with a more than 50 % lower rate of all-cause and cause-specific mortality (Knoops *et al.*, 2004). Moreover, another recently conducted meta-analysis suggested that the management of multiple lifestyle risk factors should be the cornerstone for combating the global burden of disease (Zhang *et al.*, 2021).

Thus, in line with the holistic approach (Hu, 2002), instead of asking "to drink or not to drink"?, a better question - which needs further investigation - might be "What is my lifestyle and "What do I usually eat with my favourite drink?" Therefore, when evaluating the relationship between alcohol and health outcomes, dietary pattern and other lifestyle habits should be studied in combination and not individually. The answer to the question will thereby elucidate many factors which may have been underestimated or misinterpreted in numerous epidemiological studies. Indeed, the authors from the most recently conducted systematic review on the same topic (Sluik *et al.*, 2016a), concluded that alcohol consumption alone may not be related to health outcomes, but rather the underlying dietary habits.

In light of this, the aim of this study was to conduct an updated review and critical evaluation of studies found in the literature on the relationship between alcoholic beverage preference/choice and dietary and lifestyle patterns in adults.

METHODS

1. Literature search

The most important scientific databases of references and abstracts on life sciences (PubMed, and ISI Web of Science Core Collection) were systematically searched (from database inception up to 11 April 2021). In this updated review, we used wider selection of search criteria than that used in a previous systematic review conducted by Sluik *et al.* (2016a). Used search strings were: #1 "beverage" AND ("diet*" OR "food*" OR "lifestyle") AND ("wine" OR "beer" OR "spirits" OR "liquor") #2 "alcoholic beverages" AND ("preference" OR "choice") AND ("diet*" OR "nutr*"OR "food*" OR "lifestyle") # 3 "alcohol" AND ("preference" OR "beverage" OR "choice") AND ("diet*" OR "nutr*" OR "food*" OR "lifestyle") #4 ("wine" OR "beer" OR "spirits" OR "liquor") AND ("preference" OR "choice") AND ("diet*" OR "nutr*" OR "food*"
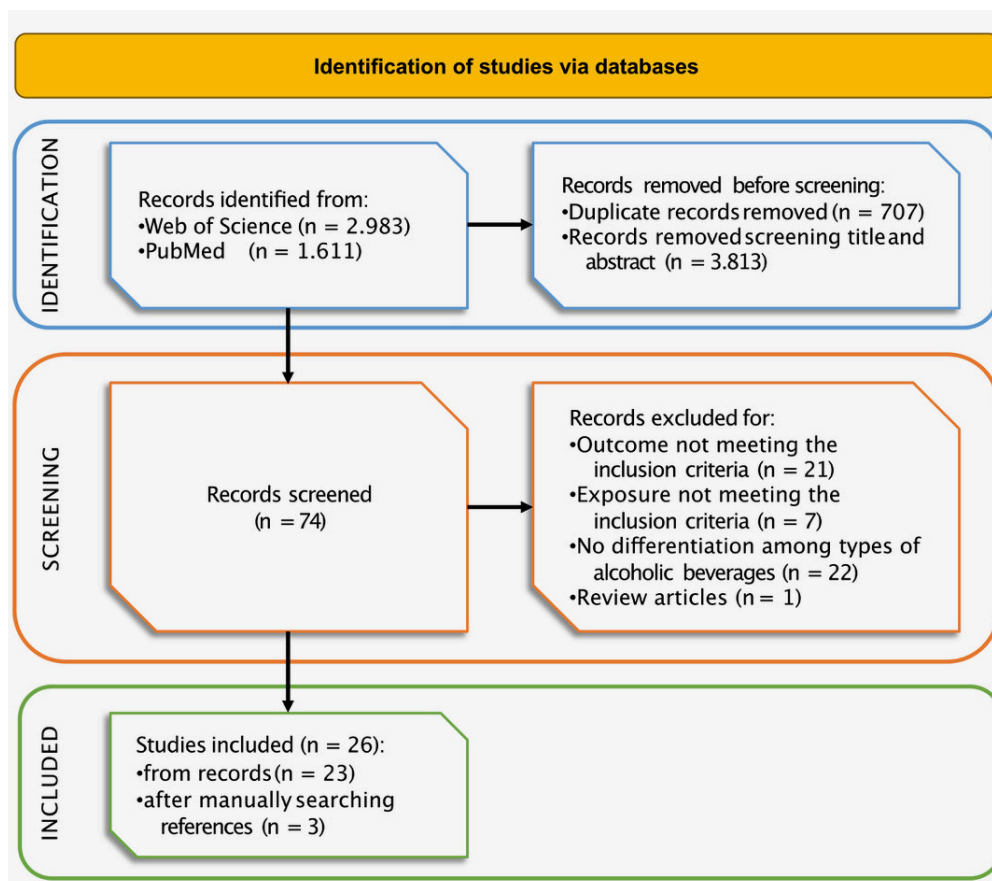
FIGURE 1. Flowchart of the selection process of the literature search for studies on relationship between alcoholic beverage preference/choice and diet/lifestyle, published up to 11 April 2021.

OR "lifestyle"). The flow-chart of the selection process of the literature search is shown in Figure 1. Restricted to humans and the English language, 1.611 hits were obtained from the PubMed search. Moreover, 2.983 hits for the ISI Web of Science were retrieved using the same strings (restricted to the English language and document types (Article)), thus corresponding to a total of 3,887 unique hits after the removal of duplicates. By removing articles on alcohol as such, and articles not relevant (i.e., articles excluded upon screening the "title", articles where no distinction between the type of alcoholic beverages was considered, reviews, and articles not meeting the inclusion criteria), the number of studies retained for this review was 23. Furthermore three more eligible articles (Forshee and Storey, 2006; Herbeth *et al.*, 2012; Johansen *et al.*, 2006) - which had been included in the previous systematic review (Sluik *et al.*, 2016a) - were identified by manual screening, resulting in a total of 26 articles. Two reviewers (R.I.K. and C.D.L.) independently selected the articles, and any discrepancies between them were solved by consensus or by consulting with a third researcher (P.R.).

2. Eligibility criteria

In this review, only study designs published in peer-reviewed journals were included. Eligible studies had to meet the following inclusion criteria: i) to have been conducted on healthy adults, ii) to have clearly distinguished the different alcoholic beverage types (consumption or preference), iii) to have defined the exposure as being the consumption of a specific alcoholic beverage, and iv) to have assessed diet, either as food or nutrient intake, or diet quality index, alone or in combination with lifestyle. Given that there is no definition of preferred/chosen alcoholic beverage, the most chosen or consumed beverage among wine, beer, spirit or liquor was considered to be the preferred/chosen beverage in the reviewed studies. Restriction applied only to alcoholics and hospitalized patients with diseases or treatments associated with diet, in accordance with the restriction criteria set in a previous systematic review (Sluik *et al.*, 2016a).

3. Data Extraction

From each study, the following relevant data were extracted: first author/year of publication, country

of study population, subjects' characteristics (number, sex and age), objectives of the study, method for assessing alcohol consumption, diet and lifestyle, and assessment employed, choice/ types/preference of alcoholic beverages or drinking patterns, adjustments and main results.

RESULTS

1. General Characteristics of the included studies

Table 1 shows the general characteristics of the 21 cross-sectional and five ecological studies included in this review. In the ecological studies, the observations had been made on supermarket transactions and shopping events/purchases, rather than on individuals (Berger *et al.*, 2020; Gell and Meier, 2012; Hansel *et al.*, 2015; Johansen *et al.*, 2006; Uusitalo *et al.*, 2019). In the cross-sectional studies, the size of the studied population varied between 423 (Herbeth *et al.*, 2012) and 48,763 (Tjønneland *et al.*, 1999), with an age range of > 18 years old (Ferreira-Pêgo *et al.*, 2017) to 85 years old (González-Rubio *et al.*, 2016), and they had been conducted in the following countries between 1997 and 2020: Spain (Alcácera *et al.*, 2008; Carmona-Torre *et al.*, 2008; Ferreira-Pêgo *et al.*, 2017; González-Rubio *et al.*, 2016; Sánchez-Villegas *et al.*, 2009; Scholz *et al.*, 2016; Valencia-Martín *et al.*, 2011), Italy (Chatenoud *et al.*, 2000), France (Hansel *et al.*, 2015; Herbeth *et al.*, 2012; Rouillier *et al.*, 2004; Ruidavets *et al.*, 2004), the Netherlands (Sluik *et al.*, 2014; Sluik *et al.*, 2016b; Sluik *et al.*, 2016c), Denmark (Johansen *et al.*, 2006; Tjønneland *et al.*, 1999), Finland (Männistö *et al.*, 1997; Uusitalo *et al.*, 2019), Belgium (Mullie and Clarys, 2015), the United Kingdom (Berger *et al.*, 2020; Gell and Meier, 2012), and the United States (Barefoot *et al.*, 2002; Forshee and Storey, 2006; McCann *et al.*, 2003; Paschall and Lipton, 2005).

For their assessment, seven studies measured nutrient intake across beverage preference categories (Alcácera *et al.*, 2008; Barefoot *et al.*, 2002; Männistö *et al.*, 1997; McCann *et al.*, 2003; Ruidavets *et al.*, 2004; Sluik *et al.*, 2014; Sluik *et al.*, 2016c), eleven studies assessed intake according to food group (Alcácera *et al.*, 2008; Barefoot *et al.*, 2002; Carmona-Torre *et al.*, 2008; Chatenoud *et al.*, 2000; Herbeth *et al.*, 2012; McCann *et al.*, 2003; Ruidavets *et al.*, 2004; Sluik *et al.*, 2014; Sluik *et al.*, 2016b; Sluik *et al.*, 2016c; Tjønneland *et al.*, 1999), and fourteen assessed diet via degree of adherence to food guidelines (Alcácera *et al.*, 2008; Valencia-

Martín *et al.*, 2011), dietary patterns (Herbeth *et al.*, 2012; Sánchez-Villegas *et al.*, 2009; Sluik *et al.*, 2016b), and diet quality indexes (Alcácera *et al.*, 2008; Carmona-Torre *et al.*, 2008; Ferreira-Pêgo et al., 2017; Forshee and Storey, 2006; Mullie and Clarys, 2015; Ruidavets *et al.*, 2004; Scholz *et al.*, 2016; Sluik *et al.*, 2014; Sluik *et al.*, 2016b). In one study, a cluster analysis was performed to determine how drinking patterns and socioeconomic and lifestyle variables are related, including mean caloric intake and distribution of energy intake throughout the day (Rouillier *et al.*, 2004). Meanwhile, other studies were based on quality of life, using for their assessment the Mediterranean diet adherence score and physical activity habits (González-Rubio *et al.*, 2016), or diet and lifestyle (Barefoot *et al.*, 2002; Ferreira-Pêgo *et al.*, 2017; McCann *et al.*, 2003; Mullie and Clarys, 2015; Paschall and Lipton, 2005; Ruidavets *et al.*, 2004). All five of the ecological studies used expenditures/purchases on food/beverage items (Berger *et al.*, 2020; Gell and Meier, 2012; Hansel *et al.*, 2015; Johansen *et al.*, 2006) and food and tobacco expenditures (Uusitalo *et al.*, 2019).

2. Preferred type of Alcoholic beverage and socio-demographic characteristics

In general, it is worth noting that there are substantial differences in socio-demographic characteristics, whether between drinkers and non–drinkers or between drinkers of different preferred alcoholic beverages. Most findings show that wine consumers have a higher income and are more likely to follow a diet, and that wine is more popular among women than men. Men consume alcoholic beverages in higher quantities and at a higher frequency than women do, with a preference for beer. Smoking is more prevalent among beer consumers, who tend to be younger. The educational level of wine, beer and spirit consumers varies between the studies. As a general observation, spirits were the least preferred alcoholic beverage in all studies and were associated with less healthy dietary and lifestyle habits.

2.1. Wine preference/choice

Wine as the preferred alcoholic beverage seems to be associated with an overall healthier diet and lifestyle, although the influence of bias should not be underestimated.

When summarising the results from the reviewed publications related to wine as the alcoholic beverage of choice, it seems that in the majority

TABLE 1. Characteristics of the 26 retained studies which assess the relationship between alcoholic beverage choice/preference and dietary patterns/diet quality/lifestyle.

Country	Study (design, name)	Subject characteristics (n, sex, age)	Objectives of the study	Alcohol assessment	Methods used to assess dietary patterns /purchase of different food types	Types of preference for alcoholic beverages or drinking patterns	Confounding factors (adjustment)	Main results	Ref.
UK	Ecological study. Data from the Expenditure and Food Survey for 2005-2006.	3146 UK adult-only households.	To identify the nature and strength of the association between alcohol and diet through the analysis of household expenditure on food and drink.	Questionnaire and a 2-week individual-level diary recording all purchases.	Expenditures relevant to healthy food (fruit and vegetables) and unhealthy foods and neutral foods through the use of Questionnaire and a 2-week individual-level diary recording all purchases.	Beer, wine and spirits. The preferred beverage was that on which the household spent the most combined off- and on-trade.	No adjustments made, controlled for income.	Adults who purchased wine were related to healthier expenditure patterns than those that preferred to buy beer or spirits.	(Gell and Meier, 2012)
FI	Ecological study. Data consisted of 1,527,217 shopping events in grocery stores (2016).	13,274 customers with loyalty cards of supermarket groups (67 % women) and (33 % men). mean ± SD age: 46.2 ± 14.7. Age range: 16-90	To assess alcohol expenditure and associations with food and tobacco expenditures.	Registration of relevant information on the purchase (items and expenditure) of alcohol via the loyalty card.	Food and tobacco expenditures assessed through the customers' loyalty card.	Beer, cider and non-alcoholic options. Preference beverage was not defined. The estimated approximate volumes were based on typical prices of alcoholic beverages in group supermarkets.	No adjustments made.	The expenditure on alcohol beverages (cider and beer) were associated with expenditure on tobacco and foods rich in saturated fat, salt and added sugar.	(Uusitalo et al., 2019)
FR	Ecological study. Retrospective analyses of the data collected on regular customers of a large supermarket chain (2010-2011).	196,604 loyal supermarket customers.	To describe the relationship between the consumption of alcoholic beverages and individual profiles of objective food purchases.	Registration of relevant information on the purchase of food and beverage items via the loyalty card.	Purchased food items classified as: (1) healthy foods; (2) unhealthy foods; and (3) others. Food items purchase and total budget was obtained on each occasion when a customer passes the check out for payment through the use of the registrations of the loyalty customers' card.	Anises, Grand wines /Champagne, Whisky PGII, Modern aperitifs, Table wine, Beer, Bordeaux, Non-alcohol buyers, Multi-wines.	No adjustments made.	The highest consumption of healthy foods was observed among wine consumers and the lowest consumption of healthy foods among beer and aniseed-based beverages consumers.	(Hansel et al., 2015)
DK	Ecological study/cross-sectional analysis. (September 2002 -February 2003).	3.5 million random transactions from two large Danish supermarkets.	To examine if people who buy wine buy healthier food items than those who buy beer.	Alcoholic beverage transactions.	Food items/transactions. 40 food categories.	Wine only, beer only, mixed, and non-alcohol buyers. Preferred beverage defined as the alcoholic beverage included in the transactions.	Number of items bought (stratification).	Wine buyers bought more olives, fruit and vegetables, poultry, cooking oil, and low-fat cheese, milk, and meat than beer buyers. Beer buyers bought more ready cooked dishes, sugar, cold cuts, chips, pork, butter or margarine, sausages, lamb, and soft drinks than wine buyers.	(Johansen et al., 2006)
UK	Ecological study/ cross-sectional latent class analysis (January 2016 - January 2017).	Data used from the 2016 GB Kantar Fast-Moving Consumer Goods (FMCG) panel, a large representative household purchase panel for food and beverages brought home - analyses restricted to consumers who purchase beverages regularly (>52 L per household member annually). 8,675 households with 14,007,226 product purchases	To determine a typology of regular beverage consumers on the basis of household purchasing behaviour.	Purchases of beverages assessed through scanned take-home purchases using hand-held barcode scanner.	Purchases of foods assessed through scanned take-home purchases using hand-held barcode scanner.	SSBs, diet beverages, fruit juices and milk-based beverages, beer and cider, wine, and bottled water. No definition of preference was provided.	No adjustments made, but sensitivity analyses conducted to ensure that the exclusion criteria and the categorisation of the latent class indicators did not affect the results.	Wine dominant households had the lowest percentage of energy from less healthy foods, energy from saturated fats and sugar and the higher protein content of purchases.	(Berger et al., 2020)
ES	The SUN cohort study, cross sectional analyses. (2000-2003).	10,526 male and female (recruited during the period 2000-2003) University graduates. Age: M: (mean ± SD) 40.5 ± 12.3) and F: 34.1 ± 10.4).	To evaluate the association between alcohol beverage preference and dietary habits between wine drinkers, other alcoholic beverage drinkers and non-drinkers.	136-item validated FFQ. Total alcohol was calculated as the sum of all types of alcohol consumed (grams of alcohol/day.	Nutrient score and MedDiet score excluding wine.	Wine, beer, spirits. The preferred beverage was defined when its intake was ≥50% of total alcohol intake.	Age and total energy intake.	No relevant differences were found in adherence to the Mediterranean food pattern according to alcoholic beverage preference.	(Alcácera et al., 2008)
FR	A cross-sectional survey on cardiovascular risk factors and nutrition by the French MONICA Centres (1995 – 1997)	1110 middle-aged men. Age: 45-64.	To investigate among others the associations between alcohol consumption, beverage type preference and diet.	With the use of a 3-consecutive day food intake diary and a quantitative questionnaire, total alcohol was calculated as the sum of all the types of alcohol consumed (grams of alcohol/day).	Energy, selected nutrients, selected foods and Food group intake and Diet quality index through the use of a 3-consecutive day food intake diary.	Wine, beer, cider, aperitifs and spirits. The preferred beverage was defined as that representing > 70 % of total alcohol intake. When both beer and wine consumption varied between 20 % and 70 %, whatever the amount of other alcoholic beverages, the alcohol drinker pattern was considered as mixed preference.	Age, schooling, tobacco consumption, physical exercise, BMI, dieting, and alcohol consumption.	Healthy diet and behaviours were found in moderate alcohol drinkers or wine drinkers compared to other drinkers or abstainers.	(Ruidavets et al., 2004)

Country	Study	Sample	Aim	Dietary assessment	Method	Beverage preference definition	Adjustments	Main findings	Reference
NL	Cross sectional study from the Dutch National Food Consumption Survey (2007-2010).	2100 men and women 1054 men and 1046 women. Age: >19	To investigate associations between alcoholic beverage preference and dietary intake in the Netherlands.	A general questionnaire assessed alcoholic beverage preference, and two non-consecutive 24-hour dietary recalls assessed overall diet.	Mean nutrient intakes, food group intakes and adherence to the Dutch Healthy Diet Index (DHD-index) scores and its components through personal interviews (24-hour dietary recalls) twice with an interval of 2–6 weeks.	Beer, wine, spirits (including liqueurs and mixed drinks). Preference for a specific beverage was defined when the average number of reported glasses was ≥70% of the total number of glasses.	Age, sex, body mass index (BMI), education, smoking, physical activity, energy intake and frequency and absolute alcohol consumption.	A beer preference was associated with less healthy dietary behaviour, especially compared with wine preference.	(Sluik et al., 2014)
NL	Cross sectional study from The Dutch Longitudinal Nutrition Questionnaires and NQplus Study (2011-2013).	1653 men and women recruited between May 2011 and February 2013. Age: 20–77	To investigate, among others, associations between alcoholic beverage preference and dietary patterns.	A 180-item semi-quantitative validated Food Frequency Questionnaire (FFQ).	Dietary patterns via a principal component analysis (PCA) on 32 energy-adjusted food groups, excluding alcoholic beverages with the use of a 180-item Semi-quantitative validated Food Frequency Questionnaire	Beer, wine and spirits (all liquors and distilled beverages such as gin, whiskey, rum and liqueur). Preference for a specific beverage was defined as the average number of reported glasses being ≥70% of the total number of glasses.	Age, sex, education, birth country, employment status, and prevalent diseases.	Overall, wine consumers have a better health status than beer consumers with few differences in dietary patterns.	(Sluik et al., 2016b)
US	Cross-sectional study as part of the UNC Alumni Heart Study (UNCAHS) (1994).	4,435 of which 2864 men and 1571 women, 99% European Americans. Participants were students at the University of North Carolina in the years 1964-1966.	To evaluate the associations between alcoholic beverage preferences and indicators of a healthy diet and other health habits.	A 153-item food-frequency questionnaire (FFQ).	Food-group indexes, nutrient intakes, with the use of a 153-item food-frequency questionnaire (FFQ).	Beer, red wine, other wine, and liquor or mixed drinks. Preferred beverage defined as that representing >50% of their alcohol intake.	Controlled for education and income. No adjustment, only tested for sex and beverage preference interactions.	Wine drinkers had healthier diets than those who preferred beer or spirits or had no preference.	(Barefoot et al., 2002)
FI	Cross-sectional study of the 1992 Finnmonica cardiovascular risk factor survey.	985 women and 863 men drawn from the population register in four monitoring areas. Mean age: 25±64.	To describe the associations between alcohol beverage drinking and macronutrients, antioxidants, and body mass index.	A 3-day food record and a self-administered questionnaire.	Mean nutrient intakes via a 3-day food record.	Beer, wine and spirits. Preferred beverage defined as that representing >50% of their alcohol intake.	Age, area, smoking, education, energy from food and alcohol intake.	Alcohol consumers were leaner than abstainers, and wine drinkers in particular had more antioxidants in their diet.	(Männistö et al., 1997)
US	Cross sectional analyses from the control group of a series of case-control studies on alcohol use, myocardial infarction, and lung, breast, and prostate cancer between 1996 and 2001.	1846 men and 1910 women. Age: 35–79.	To assess differences in dietary and lifestyle characteristics associated with alcoholic beverage preference.	Alcohol consumption was assessed with a detailed, computer-assisted interview querying intake during the 12 to 24 months prior to interview.	Daily intake of macro- and micronutrients, monthly frequency of selected food intake through a self-administered modified version of the Health Habits and History food frequency questionnaire developed by researchers at the National Cancer Institute.	Beer, wine, liquor, and mixed beverages. Preferred beverage was defined as that consumed on at least 75% of all drinking occasions.	Age and total alcohol intake.	Wine drinkers had higher socioeconomic status and reduced smoking habit, along with higher intakes of nutrients and healthy dietary habits, than consumers of other beverages.	(McCann et al., 2003)
ES	Cross sectional analyses based on a Prospective cohort study (1999-2007).	15,073 free-living Mediterranean cohort of university graduates.	To evaluate the association between predefined dietary patterns with beverage consumption patterns.	A 136-item semi-quantitative FFQ.	Twenty-five predefined food categories were developed from the FFQ. Major dietary patterns were detected through Principal Components Analysis. A 136-food item semi-quantitative FFQ was used.	Spirits, total wine, red wine, beer. Preference for a specific beverage was not defined. Absolute intakes were assessed.	Age, gender, energy intake, BMI, physical activity during leisure time, smoking, marital status and several diseases.	Beer and spirits consumption showed an inverse linear trend with adherence to the MDP. Moderate red wine consumption (around 25 g/d) was found in all quintiles of MDP adherence.	(Sánchez-Villegas et al., 2009)
IT	Cross-sectional analysis based on the control group of a case-control study (1991-1996).	5642 subjects (3261 women and 2381 men). Age: 20±74 (median age:58).	To identify the association between wine drinking and intake of selected indicator foods (in various populations).	A structured and validated questionnaire.	Food indicator considered (fruit, raw vegetables, cooked vegetables, salad and fish) with the use of a 78-item FFQ.	Wine only, mixed, beer and various spirits only. No definition of preference is defined.	Age, centre, education, body mass index and smoking habits, of reporting above the median intake of each food.	No association between wine drinkers or mixed drinkers with indicators of healthy diet, such as fruit, vegetables and fish.	(Chatenoud et al., 2000)
EU	Consortium on Health and Ageing: Cross-sectional analyses from the Network of Cohorts in Europe and the United States (CHANCES study).	29,423 adults >60 years old.	To compare dietary intake and diet quality according to alcoholic beverage preference in European older adults.	FFQ or dietary history.	FFQ or dietary history. Healthy Diet Indicator and dietary intake.	Wine, beer spirits, no preference, non-consumers. Preferred beverage defined as >70% of total alcohol intake.	Age, gender, education, employment status, smoking history, physical activity, history of coronary heart disease and cancer, alcohol consumption and energy intake.	Among alcohol drinkers wine consumers tend to have higher HEI score and the highest fruit and vegetable intake after non-consumers.	(Sluik et al., 2016c)
BE	Cross sectional study of military population.	5,000 men, of which 598 officers, 2103 non-commissioned officers and 2299 soldiers.	To evaluate the association between beer and wine consumption and dietary patterns.	A 150-item semi-quantitative FFQ.	Healthy Eating Index 2010, the Mediterranean Diet Score and a pattern obtained by principal component analysis.	Beer (all types) and wine (red, white and rosé). Total beer and wine consumption was calculated in ml/day. Beer and wine drinkers were defined as participants for whom ≥60% of their total alcohol consumption was beer or wine respectively.	Age, Military rank, BMI, Physical activity level and smoking-stratified analysis and total energy intake.	Wine drinkers characterised by higher dietary scores and overall better lifestyle compared to beer drinkers.	(Mullie and Clarys, 2015)

Country	Study design	Sample	Objective	Dietary assessment	Data collection instrument	Beverage classification	Adjustments	Main findings	Reference
US	Cross-sectional analysis from the National Longitudinal Study of Adolescent Health. (1995 and 2002).	12,958 young adults. Age: 21,8±1,9.	To examine the relationships between wine preference and selected health determinants in a US national sample of young adults.	Questionnaire about 2 dietary habits: fast food consumption and being a vegetarian.	Alcohol specific questionnaire.	Beer, wine, wine coolers and liquor, hard cider, straight liquor and mixed drinks, and whatever was available. Lifetime abstainers, and ex-drinkers. Preference defined using a question about the most often consumed beverage.	Age, gender, race/ethnicity, and marital status.	Wine drinkers were in a larger percentage light-moderate drinker and self-defined vegetarians, and reported lower frequency of fast-food consumption.	(Paschall and Lipton, 2005)
ES	A cross-sectional analysis on the baseline data of the DiSA-UMH study, an ongoing cohort study. (2006-2012)	Spanish health science students (n = 1098, of which 791 women and 307 men). Age: 17-35.	To assess the relationship between beverage consumption and adherence to the Mediterranean diet.	Mediterranean diet adherence assessed through a modified version of the Mediterranean Diet Score.	A validated 84-item FFQ.	Red wine, other wines, beer, medium alcoholic drinks such as sherry, dry wines or vermouth and spirits such as brandy, gin, rum, whisky or vodka. Subjects were grouped into: non-drinkers (alcohol intake = 0 g/day), exclusive beer and/or wine drinkers (only beer or only wine or only beer and wine consumption) and drinkers of all types of alcoholic beverages. Preferred beverage was that whose consumption was $\geq 50\%$ of total alcohol.	Sex, age, BMI, hours of TV viewing per day, smoking status, soft drink intake and total energy intake	Exclusive drinkers of beer and/or wine had a significantly higher Mediterranean Diet adherence than non-drinkers. No association was found for all types of alcoholic beverages' drinkers.	(Scholz et al., 2016)
ES	Cross-sectional analysis with data from the Non-communicable Disease Risk Factor Surveillance System (2000-2005).	12,037 adults. Age: 18-64.	To examine the association between alcohol consumption patterns and adherence to major food consumption guidelines in adults in Spain.	Structured 24-hour recall questionnaire. Adherence to food guidelines.	Alcohol specific structured questionnaire on alcohol consumption in the previous week.	Wine, beer, spirits, and no preference. Preferred beverage defined as > 80 % of total alcohol intake.	Age, gender, education, social class, body mass index, physical activity and tobacco consumption.	Spirit consumers had lower fruit and vegetable consumption, and more frequently skipped a meal. Beer consumers adhered less frequently to guidelines as compared with those with no beverage preference.	(Valencia-Martin et al., 2011)
DK	Cross-sectional analyses from the Diet, Cancer and Health Study. (1995-1997).	48,763 middle-aged adults (50-64) of which 23,284 men and 25,479 women.	To determine the relationship between the intake of different alcoholic beverages and the indicators of a healthy diet	Selected food groups as indicators of a healthy diet. Assessment was made through a 192-item FFQ.	192-item FFQ	Beer, wine, and spirits (schnapps, whiskey, or gin) 5 drinking categories: Wine, beer, spirits, mixed drinkers and abstainers. Preferred beverage defined as the intake of beverage ≥ 50 % of total alcohol intake.	Age, gender, education, smoking habits, total alcohol intake and BMI.	Wine drinkers as compared with other alcoholic drinkers showed a healthier dietary pattern (higher intake of fruit, fish, vegetables, and salad, and a stronger preference for olive oil for cooking).	(Tjønneland et al., 1999)
ES	Cross-sectional analysis of the baseline data of the PREDIMED study.	3825 participants, of which 1675 men aged 55 to 80 and 2150 women aged 60 to 80 - with no documented cardiovascular disease but at high risk of CVD.	To evaluate the association between alcoholic beverage preference and food habits in a Mediterranean population.	Mediterranean Dietary Score (not including scoring from alcohol) and food groups' consumption assessed through 137-item validated FFQ.	137-item validated FFQ.	Wine, beer, spirits, no consumers. Preferred beverage defined as > 50 % of total alcohol intake.	Age, BMI, blood cholesterol, and energy intake.	No significant differences found in adherence to the Mediterranean food between the main types of alcoholic beverage consumed.	(Carmona-Torre et al., 2008)
US	Cross-sectional analyses with data from the continuing Survey of Food Intake by Individuals (1994-96, 1998).	11,898 adults (6,040 men and 5,858 women).	To examine the independent associations between consumption of food categories and beverages and the Healthy Eating Index (HEI).	Health Eating Index (HEI). Two 24-hour dietary recall instruments.	Two 24-hour dietary recall instruments.	Wine, and beer and ales. Preference was not determined.	Gender stratification.	Wine consumption was positively associated with the HEI for both males and females. Consumption of beer was positively associated with the HEI for males, but not for females.	(Forshee and Storey, 2006)
FR	Cross-sectional analysis with data from the STANISLAS study - a 10-year longitudinal study conducted since 1994.	423 fathers aged 30-60 (median age:42).	To describe the association between drinking patterns of preferred alcoholic beverages and dietary patterns.	Daily intake of specific food groups and 2 dietary patterns derived from principal component analysis.	3-day dietary record completed on two weekdays and one weekend day.	Wine, beer, spirits Preferred beverage defined as that which represented pure alcohol intake ≥ 50 % of the total alcohol consumed. Four drinking patterns (consuming 3-112 g/day).	Age, nonalcohol energy intake, alcohol intakes, cigarette smoking, body mass index, education and season.	Dietary patterns were not related to alcohol preference.	(Herbeth et al., 2012)

Country	Study design	Sample	Aim	Method	Assessment / variables	Beverages / drinking patterns	Covariates	Main findings	Reference
FR	Cross-sectional analysis in the context of SU.VI.MAX study - an 8-year randomized, double-blind, placebo-controlled trial (1994-2002).	2126 men enrolled in 1994. Age: 45-60.	To describe associations between drinking patterns in relation with socio-economic and lifestyle characteristics.	Twelve 24-hour dietary recalls (completed on 8 weekdays and 4 weekend days per year).	The % of energy intake consumed at each meal (breakfast, lunch, dinner and snacks)	Beer and cider, table wines (red, rosé or white), local wines (red, rosé or white), high quality wines (red, rosé or white), champagne, low-alcohol aperitifs (fruit punch, sweet wine, sangria, kir/royal kir, amer picon/Americano, picon-beer, cocktails), high-alcohol aperitifs (aniseed aperitifs, Whisky – Bourbon, vodka, gin, tequila, rum, Marie-Brisard), and digestives (brandy, liquor). Drinking patterns: Abstainers, low drinkers, high quality wine drinkers, regular wine drinkers, beer and cider, digestives, local wines, table wines, abstainers. Cluster analysis.	Age.	The intake of high-quality wine had a higher contribution in energy at dinner, while beer and cider intake was associated with a higher contribution in energy when snacking.	(Rouillier *et al.*, 2004)
ES	Cross-sectional study.	1262 men and women. Age: 18-70.	To assess the association between consumption of different types of beverage along with physical activity and MedDiet adherence.	A 24-hour fluid-specific diary over seven consecutive days.	Mediterranean diet adherence assessed through a 14-item validated screener. Physical activity evaluated with a non-validated self-filled questionnaire.	Time, types and volumes of beverages using standard portion sizes were assessed. The alcoholic drinks (beer, alcohol-free beer, lemon beer, wine, wine with soda, alcoholic mixed drinks, other alcoholic drinks) were recorded. Preference was not determined.	Gender, age, population /region, socioeconomic characteristics, educational level.	Individuals with greater adherence to the MedDiet showed a higher intake of water and wine and a lower consumption of sweet regular beverages, and they engaged in more physical activity.	(Ferreira-Pêgo *et al.*, 2017)
ES	Cross-sectional study (April 2012-June 2013)	231 subjects. Age: 55-85.	To evaluate the associations between moderate alcohol intake and the type of beverages consumed and health, behaviour and quality of life in elderly people.	Interviews were conducted by a trained nutritionist with an ad hoc frequency recall questionnaire specific for alcoholic drinks and dealcoholised beer.	A SF-36 questionnaire assessing physical activity, activities of daily living, Mediterranean diet-adherence score, tobacco consumption, quality of sleep, body composition, medication and perception of health.	Wine, beer, champagne, cider, liquors, spirits and all the mixtures. Drinkers were classified in three groups according to their alcohol intake: 1) abstainers and occasional consumers (ABS) (<4 alcohol drinks per month); 2) beer consumers ($\geq 80\%$ of alcohol intake was beer), and 3) mixed beverage consumers.	Age, gender, socioeconomic status and chronic disease prevalence, PA (physical activity), METs (metabolic equivalents) (minutes per week).	Moderate alcohol consumption, and in particular wine consumption, is associated with a more active lifestyle and better perception of own health in the Spanish elderly subjects studied.	(González-Rubio *et al.*, 2016)

FFQ: 'Subjective measure using a predefined, self- or interviewer administered format'(Shim *et al.*, 2014)

24-hour dietary recalls: 'Subjective measure using open-ended questionnaires administered by a trained interviewer' (Shim *et al.*, 2014)

Diet Quality Scores: include variables that represent current nutrition guidelines or recommendations, such as the Diet Quality Index (DQI), the Healthy Eating Index (HEI), the Dietary Guidelines Index (DGI), the Mediterranean Diet Index (MDI) (Waijers *et al.*, 2007)

Cross-sectional study : Observational study with individual-level variables, measuring exposure and disease at the same time to investigate relationships (Cataldo *et al.*, 2019).

Ecological studies : Descriptive studies that examine populations or groups as the unit of observation (Cataldo *et al.*, 2019).

(nineteen out of twenty-six) of studies wine drinkers:

- had higher adherence to healthy dietary patterns (Paschall and Lipton, 2005; Ruidavets *et al.*, 2004; Sánchez-Villegas *et al.*, 2009; Tjønneland *et al.*, 1999);

- exhibited healthier overall behaviours (González-Rubio *et al.*, 2016; McCann *et al.*, 2003; Mullie and Clarys, 2015; Rouillier *et al.*, 2004; Ruidavets *et al.*, 2004; Sluik *et al.*, 2014),

- had better health status (Sluik *et al.*, 2016b);

- had healthier diets/higher quality diet (Barefoot *et al.*, 2002; Ferreira-Pêgo *et al.*, 2017; Forshee and Storey, 2006; Hansel *et al.*, 2015; Johansen *et al.*, 2006; Sluik *et al.*, 2016b);

- had better quality of life and physical activity habits (Ferreira-Pêgo *et al.*, 2017; González-Rubio *et al.*, 2016) with higher antioxidants content (Männistö *et al.*, 1997).

In addition, people who mainly buy wine and consume it at home generally had a healthier food choice (Berger *et al.*, 2020; Gell and Meier, 2012; Johansen *et al.*, 2006).

More specifically, findings from cross-sectional studies showed that, as compared to the consumers/ consumption of other alcoholic beverages, in terms of food groups, wine consumption was associated with a higher consumption of fruit, vegetables, fish, salads, olive oil, juices and grain (Barefoot *et al.*, 2002; McCann *et al.*, 2003; Tjønneland *et al.*, 1999) and in general wine consumers were more likely to be vegetarian and have less unhealthy dietary habits (e.g., consumption of fast food) (Paschall and Lipton, 2005). As regards nutrients, wine consumers had higher intakes of protein, carbohydrates, fiber, potassium, folate, vitamin C and carotenoids (Männistö *et al.*, 1997; McCann *et al.*, 2003).

Regarding adherence to dietary guidelines and overall diet quality, results showed that moderate wine consumers exhibited healthier dietary behaviours (Barefoot *et al.*, 2002; Ferreira-Pêgo *et al.*, 2017; Forshee and Storey, 2006; McCann *et al.*, 2003; Mullie and Clarys, 2015; Ruidavets *et al.*, 2004; Sánchez-Villegas *et al.*, 2009;

Scholz *et al.*, 2016; Sluik *et al.*, 2014; Sluik *et al.*, 2016b; Tjønneland *et al.*, 1999).

Furthermore, wine consumers seem to be more engaged in higher physical activity (Ferreira-Pêgo *et al.*, 2017; Ruidavets *et al.*, 2004), have better health status and perception of health (González-Rubio *et al.*, 2016; Sluik *et al.*, 2016b), smoke less (McCann *et al.*, 2003) and generally have better lifestyle habits (González-Rubio *et al.*, 2016; Mullie and Clarys, 2015).

From the ecological studies conducted in Europe, findings showed statistically significant differences in spending on healthy foods between wine-preference households and those preferring beer/ spirits (7.0 % and 5.5 % respectively), adjusted for income (Gell and Meier, 2012). Similar and even more pronounced trends were observed in a French supermarket cohort of 196,000 subjects (Hansel *et al.*, 2015): the findings revealed that, in terms of healthy versus unhealthy food budget, purchasers of beer constituted the lowest level with a proportion of 48.9 % compared to 58.3 % for Bordeaux wine purchasers (Hansel *et al.*, 2015). Another study showed that compared to wine buyers, beer buyers bought more ready-cooked dishes, sugar, cold cuts, chips, pork, sausages and soft drinks (Johansen *et al.*, 2006).

In a Danish study, results showed that wine buyers preferred healthier foods, such as fruit and vegetables, poultry, oils and low-fat cheese, whereas beer buyers bought more sugar, chips, pork, lamb, sausages and soft drinks (Johansen *et al.*, 2006). Moreover, the most recently conducted study in the U.K. showed that people consuming wine at home have a diet with a lower percentage of energy coming from unhealthy foods, saturated fats and sugar and the highest from protein (Berger *et al.*, 2020).

It is worth mentioning that some studies in Mediterranean countries, including Italy and Spain, did not observe such strong relationships between wine preference and healthy dietary habits, in contrast to observations made in Northern-European and US populations. In particular, small differences or not significant associations between alcohol preference and dietary patterns/diet quality were observed in some studies. It should be noted that these findings were revealed in studies mainly conducted in the Mediterranean basin (Alcácera *et al.*, 2008; Carmona-Torre *et al.*, 2008; Chatenoud *et al.*, 2000; Herbeth *et al.*, 2012; Scholz *et al.*, 2016). Specifically, Alcácera *et al.* (2008) did not observe any relevant differences in adherence

to the Mediterranean diet according to alcoholic beverage preference. Meanwhile, Chatenoud *et al.* (2000) found no relationship between wine drinkers or mixed drinkers and the indicators of a healthy diet, such as fruit, vegetables and fish. Moreover, another study showed that no significant differences were found in adherence to the Mediterranean diet according to the different types of alcoholic beverage consumed (Carmona-Torre *et al.*, 2008), similar to the findings of a French ecological study (Herbeth *et al.*, 2012).

2.2. Beer preference

In general, no regional differences were found between consumers with a preference for beer, who generally had less healthy dietary and lifestyle habits. Research showed that beer drinkers were more likely to be smokers (Barefoot *et al.*, 2002; Männistö *et al.*, 1997; Mullie and Clarys, 2015; Paschall and Lipton, 2005; Ruidavets *et al.*, 2004) and less physically active (Mullie and Clarys, 2015; Paschall and Lipton, 2005; Ruidavets *et al.*, 2004), and they were less likely to be light-to-moderate drinkers (Paschall and Lipton, 2005) compared to wine and/or other drinkers. Ruidavets *et al.* (2004) showed that in beer drinkers, energy intake was about 9 % higher, energy supplied by protein was lower and energy from fat was higher than among wine drinkers. Consumption of vegetables, fruits, bread, soft cheese and eggs was significantly lower and potato consumption significantly higher among beer drinkers than among wine drinkers. Similar trends were displayed in diet quality: authors found lower diet quality among beer drinkers than among wine drinkers (Barefoot *et al.*, 2002; Forshee and Storey, 2006; Mullie and Clarys, 2015; Ruidavets *et al.*, 2004) and an inverse linear trend between beer and spirits consumption and adherence to the Mediterranean Dietary Pattern (Mullie and Clarys, 2015; Sánchez-Villegas *et al.*, 2009). Another study conducted in the Netherlands showed that beer drinkers had a higher absolute intake of meat, soft drinks, margarine and snacks, and they consumed more energy and less vegetables and fruit juices than wine consumers; however, adherence to the Dutch dietary guidelines did not differ between preference categories (Sluik *et al.*, 2014). Similar conclusions were reached in other studies, in which beer drinkers were found to have less healthy diets (Barefoot *et al.*, 2002), significantly lower intake of vitamins C and E (McCann *et al.*, 2003) and lower carotenoid intake of than wine drinkers (McCann *et al.*, 2003) or wine/spirits drinkers (Männistö *et al.*, 1997). Research has showed that

beer drinkers have worse health status than wine drinkers (Sluik *et al.*, 2016b). Beer consumption was associated with higher energy consumption and total and saturated fat intake, but less added sugar consumption (Mullie and Clarys, 2015). Beer drinkers had a higher frequency of fast food consumption (Paschall and Lipton, 2005) and greater odds of being smokers (Männistö *et al.*, 1997).

No difference among exclusive beer or wine consumers was observed in the diet quality index (rMED), suggesting that beer and wine drinkers may have similar patterns of Mediterranean diet adherence (Scholz *et al.*, 2016). Moreover, it is worth noting that the results of the cross-sectional analyses of a consortium of 29,423 elderly participants from 14 European countries showed that beer drinkers had lower intake of vegetables, PUFA and protein, compared to wine and spirits drinkers, even though no big differences were observed in dietary habits and diet quality according to alcoholic beverage preference (Sluik *et al.*, 2016b). Beer consumers adhered less frequently to guidelines to compared to consumers with no beverage preference (Valencia-Martín *et al.*, 2011). Beer and cider drinkers of often ate snacks and watched TV (Rouillier *et al.*, 2004).

Other studies have also found that shopping baskets with beer as the dominant alcoholic beverage contained more fresh pork, beef, pastries and pickled cucumbers and beetroot than baskets containing cider (Uusitalo *et al.*, 2019).

2.3. Spirit Preference

Findings showed that spirit consumers had the lowest diet quality and the highest intake of meat and spirits (Sluik *et al.*, 2016b), which were mainly consumed in the evening (65 %), thus adhering the least to the Dutch guidelines for a healthy diet (Sluik *et al.*, 2014). In Spain, it was shown that spirit preference was associated with smoking habits (Carmona-Torre *et al.*, 2008), and inadequate consumption of fruit and vegetables, as well as with skipping breakfast (Valencia-Martín *et al.*, 2011) ; it was also associated with a higher energy intake from food and lipids compared to the wine- and beer- preference consumers or non-drinkers (Alcácera *et al.*, 2008). Consumption of poultry was significantly higher in the spirit drinkers group (Herbeth *et al.*, 2012). In a US study, authors demonstrated that spirit preference was significantly associated with the highest intake of cholesterol and the lowest intake of fiber, and the highest proportion of smokers

and the lowest proportion of physically active persons were found in the spirit preference group (Barefoot *et al.*, 2002). Spirit preference was significantly associated with the highest intake of energy from fats, saturated fats and protein, especially among women, and spirit consumers displayed the highest physical activity index and the highest proportion of smokers (Männistö *et al.*, 1997). Moreover, research showed that both men and women liquor consumers had lower intakes of fruit and vegetables, but gender differences in other food groups were detected (McCann *et al.*, 2003). A lower adherence to the Mediterranean diet (Ferreira-Pêgo *et al.*, 2017; Sánchez-Villegas *et al.*, 2009), poor adherence to major food consumption guidelines (Valencia-Martín *et al.*, 2011) and the lowest physical activity frequency (Ferreira-Pêgo *et al.*, 2017) were recorded in drinkers with a preference for spirits. The ecological studies showed that the highest expenditure on unhealthy food occurred in the spirit-preferring households (Gell and Meier, 2012).

DISCUSSION

From this review, it seems that alcoholic beverage preference is correlated with specific dietary and lifestyle habits. Individuals with a wine preference generally had healthier dietary and lifestyle habits than individuals with other preferences, which was mainly observed in Northern European and US studies, as well as to a lesser extent in Mediterranean countries; the latter discrepancy could be explained by the fact that the Mediterranean diet is a cultural heritage in South Europe and is not limited to certain consumer groups, and therefore differences between alcoholic beverages can be expected to be less marked. Those who preferred beer and spirits displayed less healthy dietary habits, without any regional discrepancies arising from the country where the studies were carried out.

The observed relationships between wine preference and a healthier dietary and lifestyle profile could be attributed to cultural, personal (beliefs, concerns, perceptions and attitudes), behavioural and socio-demographic determinants, and their latent interrelations.

From historical perspective, in Mediterranean countries the use of wine without social aspects is meaningless. Wine is considered to be the cornerstone of the traditional Mediterranean dietary patterns in social context, always being consumed at mealtimes with a strong "essence of sharing and conviviality" (Fara, 2015).

The worldwide popularity of the Mediterranean diet for its healthiness and sustainability (Fara, 2015) is undeniable, being similar in philosophy to diets in Blue Zones, areas of the world where people live exceptionally long lives (Buettner and Skemp, 2016).

Moreover, the health benefits of wine consumption - in particular regarding red wine and cardiovascular disease prevention - have been extensively studied in literature, mainly due to its high antioxidant content (Das *et al.*, 2011), thus exposing consumers to a vast array of marketing claims for the role of resveratrol in health and wellness (Higgins and Llanos, 2015). Red wine contains polyphenolic compounds that are associated with the reduction of the inflammatory process, oxidative stress (OS), oxidation of LDL-cholesterol and platelet aggregation, and as a consequence it has a protective role against cardiovascular diseases. Resveratrol is among the most interesting polyphenols in red wine since it is believed to aid in a wide range of medical problems by reducing oxidative stress (Koushki *et al.*, 2020). However, it has been suggested that beyond polyphenols newly detected molecules, such as melatonin and hydroxytyrosol (Marhuenda *et al.*, 2016; Marhuenda *et al.*, 2017), produce anti-oxidative effects in synergy. Consumers with few health issues or concerns about their health are more likely to follow a healthy diet, and the knowledge of the beneficial role of wine on health could influence their willingness to consume wine as part of their diet, suggesting that they value the relationship between food/beverage intake and their health status (Higgins and Llanos, 2015). This speculation is also justified by the following findings: a higher proportion of participants who followed a specific diet for hypertension, hypercholesterolemia or diabetes was found among wine drinkers (Ruidavets *et al.*, 2004), wine drinkers were more likely to have dyslipidemia or to be overweight (Carmona-Torre *et al.*, 2008), a higher percentage of wine drinkers considered themselves to be vegetarians (Paschall and Lipton, 2005), and had better health status (Sluik *et al.*, 2016b) and the ratio of budget for healthy food over budget for unhealthy food was higher for wine drinkers, particularly Bordeaux wine (58.3 %) purchasers (Hansel *et al.*, 2015).

In a study carried out by Sluik *et al.* (2014) in the Netherlands, about half of the wine consumed was found to be red (46 %), followed by white wine (32 %), and it was mostly consumed in the evening (56 %), but also often during dinner (27 %),

which is in agreement with the recommended Mediterranean drinking pattern.

As regards the behavioural characteristics of wine drinkers, the literature suggests that healthy diets on their own are not sufficient for improving health, if they are not combined with daily physical exercise (Fara, 2015). Moreover, regular physical activity is considered to be related to stress reduction and better mood, partly explaining the mediating associations between depression, stress and health outcomes (Hamer *et al.*, 2012). Research has shown the co-occurrence of anxiety disorders and alcohol-use disorders (Smith and Randall, 2012). A recently conducted study demonstrated the positive mood modulation of resveratrol (Zhu *et al.*, 2019). Beyond that, epidemiological research showed that adherence to healthy or Mediterranean dietary patterns is associated with a reduced risk of depression (Lassale *et al.*, 2019). In the present review, it was revealed that among wine drinkers the prevalence of physical activity was higher (Ferreira-Pêgo *et al.*, 2017; González-Rubio *et al.*, 2016; Ruidavets *et al.*, 2004), the perception of their own health was better (González-Rubio *et al.*, 2016), the prevalence of depressive symptoms and of alcohol-related problems were lower (Paschall and Lipton, 2005), a healthier drinking pattern was exhibited (Ferreira-Pêgo *et al.*, 2017). Moreover, a recent review demonstrated that binge drinking and binge eating are different sides of the same coin (Escrivá-Martínez *et al.*, 2020) and thus a healthy drinking pattern goes "hand in hand" with a healthy diet. A cross-sectional study conducted on Danish adults concluded that wine drinking was associated with optimal social, intellectual and personality capacities, compared to beer drinking (Mortensen *et al.*, 2001). This is also illustrated by the results of the study by Valencia-Martin *et al.*, which showed that binge drinking is associated with less adherence to dietary guidelines and less physical activity (Valencia-Martín *et al.*, 2011). Other studies also reported that heavy drinking was related to a lower intake of dietary fibre, fruit and vegetables (Ruidavets *et al.*, 2004; Tjønneland *et al.*, 1999; Valencia-Martín *et al.*, 2011). The trend for a healthier lifestyle among wine drinkers is also justified in the present review by a lower prevalence of smoking habits (Carmona-Torre *et al.*, 2008; Rouillier *et al.*, 2004). Another probable underlying explanation of the observed correlations between wine drinking and healthier dietary and lifestyle habits is the socio-demographic factors among wine drinkers, such as the female gender, older age bracket and generally higher-income, which are considered as strong determinants of

health behaviours, although with contradictory effects. For instance, in our review wine preference was observed in higher-income (Barefoot *et al.*, 2002; McCann *et al.*, 2003) and higher education participants (Paschall and Lipton, 2005), whereas another study found no significant difference in education and employment status between the groups with different alcoholic beverage preferences (González-Rubio *et al.*, 2016). Moreover, in the study by Rouillier *et al.* (2004), differences in terms of education and employment status of wine drinkers were observed depending on the type of wine they drank. The literature suggests that there is interplay between age, gender, chemosensory responsiveness and alcohol consumption (Cravero *et al.*, 2020). It seems that regional differences in socio-demographic factors could influence the preference for a specific alcoholic beverage. In countries dominating global wine production and trade, where wine is more accessible in price and linked to gastronomy, a dominant preference for wine can be expected, as is the case in Mediterranean countries. On the other hand, in Northern-European countries and in the US, it seems that income could play a role in the preference for wine. In particular, higher income households purchase healthier foods (French *et al.*, 2019) and can afford to purchase more expensive wine. Hence, it seems that through diverse mechanisms, socio-economic factors may influence dietary behaviour. Indeed, in the cross-sectional Dutch study on 12965 subjects conducted by Hulshof *et al.* (2003), the consumption of wine, especially with meals, was associated with a healthier dietary behaviour. On the other hand, beer was consumed mostly outside meals and formed part of a less healthy dietary pattern. It is worth noting that these findings were correlated with socio-economic factors; in particular, wine consumption was more frequent among subjects with higher educational and economic status, while beer consumption was found among classes with a lower income. Authors speculated that subjects with a higher educational level tended to be more aware of the characteristics of a healthy diet. Conversely, accessibility to healthy foods might be limited by low income. Similar conclusions were previously drawn in studies by Kesse *et al.* (2001) and Marques-Vidal *et al.* (2000), in which a light-to-moderate alcohol drinking pattern (especially for wine) and healthy dietary behaviour were positively correlated to socioeconomic factors in 72904 middle-aged French women and 1367 Irish men.

The aforementioned conclusions are confirmed by the results of the most recently conducted prospective cohort study on 309,123 participants with a median follow-up period of 9 years, and which studied beverage type, consumption with food and consumption frequency as exposures. This study found that the consumption of red wine within the context of a healthy drinking pattern and when consumed at meals was associated with lower risk of mortality and vascular events among regular alcohol drinkers, after adjusting for the effects of average amount consumed (Jani *et al.*, 2021).

The following general conclusions can be drawn from the data collected in this review: i) socio-economic status and demographic characteristics are correlated with alcoholic beverage preferences: wine drinkers are generally middle aged, with higher incomes and level of education than beer or spirit consumers; wine is preferred by women and beer by men in the majority of the studies, ii) wine consumers, especially in Northern European countries and the US, generally adhere to a healthier dietary pattern and lifestyle and follow the national dietary guidelines, iii) beer is the second alcoholic beverage that is consumed, especially among young people, and it is generally associated with a less healthy dietary pattern, a higher energy intake and consumption of food with relatively poor nutritional quality, and iv) spirits are the least preferred alcoholic beverage in all the studies and are associated with less healthy dietary and lifestyle habits (including smoking), low adherence to dietary guidelines and the lowest physical activity status.

LIMITATIONS

Due to the cross-sectional and ecological nature of the included studies no temporal relationship and, hence, causal inferences can be made. However, this limitation does not weaken the importance of the findings, given that the aim of the present review was to evaluate whether alcoholic beverages preference is associated with certain dietary and lifestyle habits, and not to assess causality. Furthermore, recall bias could be an issue among wine drinkers with higher health literacy. According to Grønbaek (2001), reporting bias relevant to the type of alcoholic beverage does not appear to be a problem in the majority of the population studies (GrØnbaek, 2001). Moreover, the lack of a formal definition of "preference", the absence of conducted studies in many regions around the world, the high heterogeneity between the studies, the wide spectrum of possible

outcomes relevant to diet and lifestyle and the lack of quality assessment of the reviewed studies could influence the generalisability of the findings. The risk of bias assessment of cross-sectional studies is heterogeneous with less applicability (Migliavaca *et al.*, 2020) than other observational study designs, for which standard, valid and widely used tools are available.

CONCLUSIONS

This review has demonstrated that alcoholic beverage preference is associated with diet and lifestyle habits, including drinking patterns and absolute alcohol consumption. Age, gender and socio-economic status are shown to be confounding factors in the association between alcoholic beverage consumption and health outcomes. Given that alcoholic beverage preference is linked to specific dietary and lifestyle patterns, it may be arbitrary and risky to attribute the risk of developing chronic diseases to alcoholic beverages without an in-depth investigation of the underlying inter-correlations with statistical adjustment for 'dietary pattern' as a confounding factor. Therefore, from a public health perspective it seems that drinking pattern, dietary pattern and lifestyle should be studied in combination and as such be evaluated in any future epidemiological studies analysing the relationship between alcohol consumption and underlying correlations in terms of health outcomes.

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