# Alcohol consumption and its association with energy and macronutrient intakes in the diet of New Zealand adults

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# Abstract

**Introduction:**

The detrimental effects of alcohol abuse on human health and injury are well known. Less well documented is the relationship between alcohol consumption and the diet. As alcohol is an energy dense macronutrient, it can significantly increase total energy intakes while also influencing food intakes. Many countries have looked at alcohol consumption in relation to energy and macronutrient intakes, however no research has been done in New Zealand.

**Objective:**

To examine the cross-sectional relationship between alcohol consumption in relation to macronutrient, total and food energy intakes in New Zealand adults aged 15 years and over, and to describe the characteristics that are associated with habitual drinking patterns (non-drinkers, former, light to moderate and heavy drinkers).

**Design:**

We analysed data from the 2008/09 Adult Nutrition Survey, a nationally representative, cross-sectional survey of 4,721 New Zealand adults aged 15 years and over. A total of 4,720 participants comprising of 2,065 men and 2,655 women were included in this study. Habitual alcohol consumption was assessed via a semi quantitative questionnaire and categorized into four groups: non-drinkers, former drinkers, light to moderate drinkers (≤10 drinks/week for women and ≤15 drinks/week for men) and heavy drinkers (>10 drinks/week for women and >15 drinks/week for men). Demographic variables associated with drinking habits were examined using multivariate logistic regression. Food and alcohol consumption was collected via a multiple pass 24-hour dietary recall. Alcohol consumption was categorised into three groups (0, 1-2, ≥ 3). Energy and macronutrient intakes (protein, carbohydrate, fat) from the 24-hour recall were compared between the three drinking groups using multiple linear

regressions. Survey commands were used to allow for the complex sampling design and to provide representative estimates of the New Zealand population.

**Results:**

The majority of New Zealand adults were light to moderate drinkers with 82.9% of males and 74.1% of females. Māori males were more likely to be heavy drinkers than New Zealand European and other (NZEO) men (OR 2.51; $p<0.01$). Pacific females were more likely to be non-drinkers than non-pacific females (OR 4.59; $p<0.01$). A large proportion of 15-17 year olds were habitual light to moderate drinkers (69.6% of males and 71.3% of females). Body mass index (BMI) was 4% lower in male light to moderate drinkers and 7% higher in male heavy drinkers compared to all other habitual consumption categories (non-drinkers, former and heavy drinkers). Increasing alcohol consumption during the 24-hour recall was associated with higher total energy intakes (Males: 9,988kJ for 0 drinks to 13,618kJ for ≥3 drinks; females: 7312kJ for 0 drinks to 9845kJ for ≥3 drinks). Men and women who consumed three or more alcoholic drinks during the recall period had higher food derived energy intakes than those who consumed no alcohol, by 1,386 kJ ($p<0.01$) for men and 675kJ ($p<0.01$) for women.

**Conclusion:**

The high prevalence of regular adolescent drinkers may have detrimental short and long term health outcomes. Addressing the alcohol purchasing age is one way to reduce the opportunity for adolescents to purchase large amounts of inexpensive alcoholic drinks for binge-drinking sessions. The increases in energy intakes on single heavy drinking occasions that we found are cause for concern on a population level in relation to weight gain. Targeting drinking days as a public health strategy may help to increase people's awareness of how much alcohol and food they are consuming on any drinking occasion.

# Preface

The New Zealand Ministry of Health funded the 2008/09 New Zealand Adult Nutrition Survey. This data was used for this thesis project. The New Zealand Crown is the owner of the copyright for the survey data. The results presented in this paper are the work of the authors.

As part of this thesis the candidate conducted the literature review, organized the survey data set for analysis, designed and implemented the statistical analysis, designed the table layout, processed and interpreted the statistical output, and wrote the thesis under the supervision of Dr Jody Miller.

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## List of Abbreviations

NZEO – New Zealand European and Other

BMI - Body Mass Index

CHD – Coronary Heart Disease

ALAC – The Alcohol Advisory Council of New Zealand

NZADUS – New Zealand Alcohol and Drug Use Survey

HDD –Harmful or Hazardous Drinking

AUDIT – Alcohol Use Disorders Identification Test

CVD – Cardiovascular Disease

NHANES - National Health and Nutrition Examination Survey (America)

MOH – Ministry of Health (New Zealand)

EPIC - The European Prospective investigation into Cancer and Nutrition study

ADH – Alcohol Dehydrogenase

NZANS – New Zealand Adult Nutrition Survey

NZDep06 – New Zealand Index of Deprivation 2006

TE – Total Energy (food energy and alcohol energy)

FDE – Food Derived Energy (food energy minus alcohol energy)

# 1 Introduction

Alcohol is the most commonly used recreational drug in New Zealand (1). While the majority of people enjoy alcohol in moderation, there are large numbers of New Zealanders misusing alcohol. This places a considerable burden on themselves and society. While the benefits of light to moderate alcohol consumption are well established, there are a multitude of negative health outcomes associated with higher levels of alcohol consumption. Short-term negative outcomes include engaging in violent and risk taking behaviour resulting in injuries. Long-term health outcomes include increased risk of cancer at various locations, hypertension, liver diseases and overall increased mortality (2).

Alcohol is an energy dense macronutrient, providing 29kJ/gram, second to that of fat (39kJ/gram). Because of this, there is concern that regular consumption may increase energy intakes and contribute to weight gain (3). Additionally, alcohol is known to have an appetite stimulating effect, increasing the amount of food eaten per minute, meal duration and delaying satiety which can indirectly lead to weight gain (4). The relationship between alcohol and BMI is interesting because of the undeniable associations between obesity and many chronic diseases (12) but studies examining this relationship have found mixed results (5-11).

Higher levels of alcohol consumption and the drinking status of the person (non-drinker, former, current) have also been associated with different macronutrient, micronutrient and energy intakes as well as overall diet quality (13,14). It is important to examine dietary intakes in relation to alcohol consumption, as populations have varied drinking patterns according to their culture that may affect the diet in different ways. For example, alcohol is generally consumed during mealtimes in many European countries (15), where as New Zealand has more of a binge drinking culture (16).

To date there has been little research carried out on New Zealand adults in the area of alcohol consumption and the diet. Additionally, there is a lack of data on the prevalence of the habitual drinking patterns within New Zealand adults including non-drinkers, former drinkers (have not drunk in the past year, but may have in previous years), light to moderate drinkers and heavy drinkers. Therefore, the current study will examine twenty-four hour recall data to see how energy and macronutrient intakes differ depending on the volume of alcohol consumed on a single occasion. Furthermore, this study will examine the prevalence of habitual drinkers and non-drinkers as well as describing the characteristics that are associated with each drinking pattern.

# 2 Literature Review

This literature review describes the alcohol consumption guidelines in New Zealand and current drinking patterns, as well as the burden this places on society. A concise review of the health effects of alcohol consumption is included, describing the beneficial effects of light to moderate consumption on coronary heart disease (CHD) and adverse health effects of heavy alcohol consumption. A discussion of the effects alcohol consumption can have on the diet follows, with emphasis on macronutrient and energy intakes, as they are relevant to this study. Finally the potential role that alcohol plays in weight gain is examined by reviewing the epidemiological evidence examining light to moderate alcohol consumption as a risk factor for weight gain.

## 2.1 Alcohol consumption in New Zealand

### 2.1.1 Guidelines in New Zealand

The Health Promotion Agency, which performs all functions previously undertaken by the Alcohol Advisory Council of New Zealand (ALAC), has two guidelines regarding low risk alcohol consumption (17). To reduce any long term health risks of alcohol consumption they advise males consume no more three standard drinks per day (no more than 15 standard drinks/week) and females consume no more than two standard drinks per day (no more than 10 standard drinks/week) while including two alcohol free days each week (17). In New Zealand a standard drink is defined as 10 grams of pure alcohol (ethanol), and because beverages vary in strength, the amount of beverage that constitutes a standard drink will also vary. To reduce the risk of incurring an alcohol-related injury on a single occasion, males are advised to consume no more than five standard drinks in a single drinking session and females, no more than four standard drinks. ALAC has two age specific definitions for binge drinking. For an adult (>25 y) binge drinking is consuming seven or more standard drinks

(≥70g of ethanol) and for a young person (18-24 y), consuming five or more standard drinks (≥50g of ethanol) on a single drinking occasion (18).

Alcohol drinking guidelines and definitions differ worldwide. For example, in the United Kingdom (UK) it is recommended that females do not exceed two to three units per day and males do not exceed three to four units per day. However, in the UK one unit of alcohol is defined as 8g of pure alcohol, as opposed to 10g in New Zealand. Furthermore, the UK binge drinking definitions are specific to sex; defined as consuming more than twice the advised daily limit in one drinking session. This is more than 64g of ethanol (>8 units) for males and more than 48g of ethanol (>6 units) for females (19). Contrary to this, the New Zealand binge drinking definitions are specific to age. There is a stronger argument for differentiating binge drinking definitions by age (as opposed to sex) as it is an important determinant of the health risks associated with alcohol consumption. Alcohol related injuries/accidents are experienced disproportionately by younger people, whereas alcohol related harm in the form of disease is more evident among older people (20), irrespective of sex.

### 2.1.2 Patterns of alcohol consumption in New Zealand

The New Zealand government has highlighted alcohol and drug consumption as an area of concern due to the harm it inflicts on all levels of society. Accordingly, the Ministry of Health conducted the 2007/08 New Zealand Alcohol and Drug Use Survey (NZADUS), which measured self reported alcohol and drug use behaviours among over 6,500 New Zealanders aged 16–64 years, to better understand New Zealanders' drinking patterns (1). The survey measured past year use of alcohol and drugs, frequency of use, harms experienced - both personal and due to other peoples' use of alcohol - and help-seeking behaviour. The survey was designed so to produce results that were representative of the New Zealand population and groups of interest, in particular Maori and Pacific people. The findings showed that 85% of New Zealand adults had consumed an alcoholic beverage in the past year,and of those, 12.6% exceeded the 2009 ALAC guidelines at least once a week (of no more than four standard drinks for females and six for males on a single drinking occasion). Underreporting is a common problem with self-reported questionnaires, as participants can intentionally underestimate their intake of alcoholic beverages due to fear of being stigmatized (2). Therefore it is possible the prevalence of high-risk drinking in New Zealand is underestimated. Moreover, the 2007/08 NZADUS did not give a detailed analysis on patterns of drinking, thus leaving a gap in the research for looking into the prevalence of non-drinkers, former, light to moderate and heavy drinkers within New Zealand adults.

The term 'harmful or hazardous drinking' (HDD) is commonly used when looking at alcohol consumption in New Zealand. It is a more specific term than binge drinking and tends to be used in relation to an AUDIT (Alcohol Use Disorders Identification Test) score. The test comprises of ten questions and was developed by WHO to identify hazardous drinking (21). Harmful drinking is defined as a pattern of alcohol consumption that results in physical or psychosocial harm while hazardous drinking is a pattern that places individuals at risk of adverse long-term health outcomes (22). The 2006/07 New Zealand Health Survey found that HDD was present in 17.7% of the New Zealand population and was more common in males and younger age groups, particularly males aged 18-24 years (53.6%). The prevalence of HDD in females was highest in those aged 18-24 years (32.1%) (22).

### 2.1.3 Burden of alcohol on society

Heavy alcohol use may adversely affect the health of an individual (described in section 2.2) but it can also affect society with net social costs whereby society has fewer resources and less welfare than it would in the absence of alcohol misuse (23). The social costs incurred from alcohol misuse place a large burden on society in terms of personal, economic and social impacts. In 2005/06 the total cost of harmful alcohol cost in New Zealand - intangible (morbidity and mortality) and tangible (labour lost, manufacturing alcohol, health care, road crashes and crime) - was estimated to be $4,939 million, of which $1,764 million was purely labour hours lost due to harmful alcohol use (23). In New Zealand it was estimated that in the year 2000 alone, there were 12,000 years of life lost that were attributable to alcohol consumption (24). When both mortality and morbidity were included in the analysis it was estimated that the loss of 26,000 disability adjusted life years (DALYs) were attributable to alcohol. Given the high rates of excessive alcohol consumption (exceeding ALAC's recommendations) reported in the 2007/08 NZADUS and the 2006/07 New Zealand Health Survey, as well as the harm this behaviour is placing on the individual and society, clearly there is a pressing need to address the problem of unhealthy drinking in New Zealand.

### 2.2 Health outcomes associated with alcohol

A large number of observational studies suggest light to moderate intakes of alcohol are associated with lower mortality and reduced risk and severity of coronary heart disease (CHD) (25-28). Sex specific intakes that have been identified, with the major protective effects on mortality and CHD risk being observed at intakes of around 10g/day (1 standard drink) for females and 25g/day (just over 2 standard drinks) for males (26,29). The observational evidence is strengthened by plausible biological mechanisms that help explain the protective effects of alcohol on CHD and mortality. Light to moderate alcohol consumption is associated with favourable lipid profiles, notably an increase in high density lipoproteins, which may account for up to 50% of the documented protective effects on CHD risk (30,31). Furthermore, favourable coagulation profiles are promoted through light to moderate alcohol intake, in particular decreased platelet aggregation and prevention of blood clots (25,32).

While it was once thought that some alcoholic beverages were more beneficial than others, specifically wine over beer or spirits (33-35), current evidence suggests that is the alcohol per se, rather than the type of beverage that is protective of cardiovascular disease (CVD) (28,36). A major confounder in the association between wine consumption and lower

CVD risk are specific lifestyle factors such as the diet and physical activity levels. Wine drinkers have been found to have healthier diets (37), higher levels of physical activity in addition to higher levels of education and lower prevalence's of smoking compared to beer and spirits drinkers (38). This may in part explain the findings from previous studies that have reported the protective effects of wine consumption on CHD over other types of alcoholic beverages (34,35).

A limitation with epidemiological studies examining the relation between alcohol and CVD is the use of current abstainers as the reference group. This group often includes former drinkers who may have stopped drinking for health reasons and may have higher overall CVD risk (39). For example, a methodological study in the US found that 56% of former drinkers (quit due to difficulties controlling their drinking) had liver and heart related conditions (40). Therefore, comparing drinkers with this higher-risk reference group may slightly overestimate any cardioprotective effects that alcohol may have, however, it is thought that this factor alone is not enough to explain the large cardioprotective associations of moderate alcohol consumption that has been observed in epidemiological studies (39). The problem of using inappropriate reference categories highlights the importance of putting former drinkers and lifelong abstainers into two separate categories, as well as the need for information to be collected on reasons subjects stopped drinking.

While there is a general consensus that moderate alcohol consumption is protective of CHD and mortality (28), there are also many adverse effects associated with heavy alcohol intakes. The negative health outcomes of such consumption include increased risk of cancer at various sites e.g. oesophageal and colon, intentional and unintentional injuries, hypertension and liver cirrhosis (29). As such, WHO identified alcohol consumption as one of the top ten risk factors for worldwide burden of disease (41). Furthermore, they have concluded that number of years of life lost due to drinking outweighs the years saved attributable to the protective effects of alcohol on CHD risk reduction (42).

The pattern of alcohol consumption, rather than simply volume of alcohol consumed, is most strongly associated with different health outcomes (29). "Drinking pattern" does not have a universal definition, but is generally considered to encompass alcohol quantity, frequency of consumption and, in some studies, whether the alcohol is consumed with or without food (28). The quantity of alcohol consumed during a single occasion determines the likelihood of suffering immediate harm. Short term implications of consuming large volumes of alcohol, commonly leading to intoxication, include: engaging in risk taking behaviour such as unprotected sexual activity; drink driving; aggressive behaviour; and acute alcohol poisoning (2,42).

Prolonged heavy drinking patterns (>60g/day) are associated with the cumulative effects of alcohol over a lifetime and are associated with negative impacts on family, social and working life as well as chronic diseases such as cancer and cirrhosis of the liver (28,29,42,43). There is strong evidence that alcohol is an independent risk factor for primary liver cancer as well as being causally associated with malignant tumours of the oral cavity, pharynx, larynx, oesophagus, colorectal and female breast (44). Furthermore, while light to moderate intakes of alcohol are associated with lower CHD risk, regular or sporadic heavy intakes of alcohol, even when usual consumption is light or moderate, is associated with increased risk of coronary events (28,45). Chronic heavy alcohol use is also associated with cardiomyopathy, cardiac dysrhythmias, and sudden cardiac death (28), presumably due to increased clotting, risk of thrombosis and reduced threshold for ventricular fibrillation after a heavy drinking occasion (45).

There are also concerns that alcohol consumption during adolescence may impact on brain development (46,47). While it was once thought that the major stages of brain development occurred before birth and in early childhood, adolescence is now recognised as a period of continued neurologic and cognitive development (46,48). Advances in imaging technology have shown that the adolescent brain may be especially vulnerable to the neurotoxic effects of alcohol, which is of great concern given that one in three past year drinkers aged 16-17 years in the 2007/08 NZADUS had consumed a large amount of alcohol at least monthly over the past year, including 12.6% at least weekly (1). Furthermore, alcohol consumption during this time has been directly linked to onset of alcohol addiction as well as higher rates of mental health problems such as anxiety and depression (46,48).

## 2.3 Diet and alcohol

### 2.3.1 Chronic excessive alcohol consumption and nutrient status

In addition to impacting negatively on health and disease outcomes, heavy alcohol intakes may also adversely affect the diet and nutrient status of the individual, increasing the risk of micronutrient deficiencies and malnutrition (49). Heavy alcohol use may cause primary malnutrition whereby alcohol displaces other nutrients, and secondary malnutrition resulting from alcohol interfering with the digestion, absorption, metabolism and utilization of some nutrients (49). Alcoholics also have increased intestinal atrophy, bleeding and disturbed intestinal motility, all of which contribute to impaired nutrient utilization (50,51). Nutritional components that have been shown to be decreased by large intakes of alcohol are folate, vitamins $B_{12,}$ $B_6$, C, A, D, E, K, thiamine, zinc, selenium, magnesium. This occurs both through lower dietary intakes and malabsorption or maldigestion (49).

### 2.3.2 Binge drinking and nutrient status

Unlike chronic alcoholism, there has been little published research on the impact of binge drinking on nutritional status and the diet. Individuals who begin a drinking occasion with the intention of becoming intoxicated are sometimes known to avoid eating beforehand as to become intoxicated sooner, therefore compromising their short term dietary intake (2). Excessive volumes of alcohol can also cause gastrointestinal upset resulting in vomiting and diarrhoea, which may reduce the absorption of nutrients (51). Infrequent binge drinking is unlikely to have any significant long-term impact on nutritional status, however the more frequent the episodes of excessive alcohol consumption, the higher the risk of the diet and nutrient intake being adversely affected (2).

### 2.3.3 Light to moderate consumption and nutrient status

Multiple studies have been undertaken to assess the impact of a range of alcohol consumption levels, including light and moderate intakes, on nutritional status and dietary intake (6,9,13,14). However the definitions and cut offs used to classify individuals into groups based on quantity, frequency and status (drinker/non-drinker/previous drinker) of alcohol intake are inconsistent, making it difficult to compare studies, and the conclusions are contradictory. There is also a lack of studies looking into how different drinking patterns (volume, frequency, with food) are associated with the diet, as most studies simply look at average volume consumed. The following sections will describe the associations between alcohol consumption, macronutrient, micronutrient and energy intakes as well as body weight. A summary table of the cross-sectional studies investigating associations between alcohol, energy and macronutrient intake is in **Appendix C.**

## 2.4 Alcohol, total and food derived energy intakes

Alcohol is the second highest source of energy after fat, providing 27 kilojoules per gram. Because of its high energy density, there is some concern that consumption of moderate amounts of alcohol may contribute to higher energy intakes, leading to weight gain and increased risk of obesity (the possible role of alcohol as a risk factor for weight gain is discussed in detail in section 2.8). Overall the evidence from cross-sectional observational studies suggests that moderate alcohol consumption has an additive effect to the diet, meaning that individuals are unlikely to compensate for the additional energy provided by alcohol by consuming less food (1,2,6,23,43,52). As well as being a significant source of energy, studies show that moderate intakes of alcohol may increase food intake, thereby having an indirect effect on increasing overall energy consumption (3,53). The appetite-enhancing effect of alcohol may be due to enhancement of socialization, increased duration of food intake and delayed satiety (3). Moreover, alcohol works differently to other macronutrients in that the body cannot store the energy from alcohol; therefore it has priority in metabolism and can affect other regulator pathways such as appetite (3).

The appetite stimulating effect of alcohol was tested in an interventional study, where participants were given one mega joule preloads of alcohol, non-alcoholic preloads or no preload before a meal. The results showed total energy intakes increased significantly when the alcohol preload was given, and food eaten per minute was higher, meal duration was longer and satiation occurred at a later time point (4). These results contribute to the body of evidence that alcohol increases total energy intakes when added to the diet and suggest that alcohol consumption may be a factor in weight gain due to more food being consumed and its effect on appetite. However, because of its short time frame, interventional studies such as this cannot be used to predict longer term body weight outcomes (3,4).

As mentioned earlier, due to the high-energy value of alcohol, total energy intakes tend to increase as alcohol consumption increases (6,8,13,54,55). Conversely, the associations of food-derived energy, which excludes energy from alcohol, are less consistent. Cross-sectional studies have found food derived energy to either increase (54), decrease (8,55) or decrease for men but increase for women (9). One of these studies used data from Americas 1971-75 National Health and Nutrition Examination Survey (NHANES), including 10,428 participants aged 18-74 years, found that although total energy increased as alcohol consumption increased (0.03g - >24g/day), food derived energy intakes decreased, therefore alcohol was replacing food derived energy in the diet (8). On the other hand, a study of 72,904 French women from the European Prospective investigation into Cancer and Nutrition study (EPIC) found both total and food-derived energy intakes increase with increasing alcohol consumption (54).

The differences in the results between these studies may simply be due to methodological differences such as fewer consumption categories with a narrow range of 'drinks/day'. This could lead to more participants being classified in the highest consumption category, when in fact they may be light to moderate drinkers according to another studies classification system. In this situation the highest consumption category would appear more diverse and potentially less likely to show significant differences compared to lower consumption categories.

The general exception to increases in food energy intake with increasing alcohol intake is seen in heavy consumers, where alcohol substitutes other energy sources resulting in a lower body weight. This is due to primary (alcohol replacing food) as well as secondary malnutrition (alcohol interfering with nutrient utilization) (8).

## 2.5 Alcohol and macronutrients

Several studies have investigated the relationship between increasing alcohol consumption and fat, carbohydrate and protein intakes (6,8,54,55). A common finding from studies that have reported macronutrient intakes as a percentage of food derived energy (excluding energy from alcohol), is that as alcohol consumption increases, the percentage of food derived energy from carbohydrates decreases (6,54-56). This was demonstrated in a cross-sectional survey of 72,904 French females from the EPIC study, which found the percentage of food derived energy from carbohydrates fell incrementally as alcohol consumption increased (44.3% of food derived energy in the 0-2g of ethanol/day group to 39.7% in the >32g ethanol/day) (54). The reasons for lower carbohydrate intakes among drinkers is unknown (9).

Associations between fat and protein intakes in relation to alcohol consumption are much less consistent. An analysis of data from four cycles of NHANES in the US involving 15,871 individuals aged 20 years and over, found protein intakes (grams) increased as alcohol consumption category increased across the categories of <1 to ≥5 drinks/day (14). Other cross-sectional studies have also found protein in addition to fat increasing with alcohol consumption level, when taken as a percentage of food derived energy (8,54,55,57). However, other studies have found no association or mixed results for fat or protein as a percentage of food derived energy as alcohol consumption increases (6,14,58). These differences in these results could be due to the number of different methods used to assess alcohol and food intakes in the different studies (food frequency questionnaire, twenty-four hour recall, qualitative questionnaire).

## 2.6 Alcohol and micronutrients

The relationship between alcohol and the diet can be investigated one step further to look at specific micronutrient intakes within the diets of drinkers and non-drinkers. Research into the association of alcohol intake on micronutrient intake or status has mainly involved alcoholics with reduced nutrient intakes from substitution of food with alcohol (primary malnutrition) (49,59), whereas few studies have investigated associations between light to moderate alcohol consumption and actual micronutrient intakes. Some studies have found moderate to higher alcohol consumption is associated with increased dietary intakes of iron, calcium, vitamin A, B2, B3 C, D, and E (2,8,14,60-62), whereas other studies have observed lower intakes of calcium, folate, vitamin A and B2, with increasing alcohol consumption (8,49,58,63).

There are several methodological reasons that may explain the variation between studies findings. Alcoholic beverages themselves, mainly beer and wine, contain nutrients and only a few studies have accounted for this (14,61). Notably, the vitamin and mineral contents of alcoholic beverages can vary a great deal depending on the raw ingredients, and the production methods used (2). Furthermore, some studies report nutrients in terms of absolute intake of a nutrient in grams or milligrams (14,58,63) and others report nutrient densities per 1000kcal as a proportion of total or non-alcoholic energy (8,62). When energy from alcohol is included, it can dilute nutrient intakes due to higher energy intakes with increasing alcohol consumption, whereas excluding energy from alcohol allows relative comparisons of nutrient intakes, regardless of the quantity of alcohol consumed.

### 2.6.1 Micronutrient absorption and utilization

Alcohol has been shown to interfere with the absorption and metabolism of some micronutrient, namely folate and vitamin B12, decreasing their availability (49). Therefore, utilisable nutrient levels may be lower than reported dietary intakes (2). The relationship between varying levels of alcohol intake and any one nutrient is hard to disentangle as studies are often done with malnourished alcoholics (64,65). Factors such as habitual nutrient intake, nutrient status, volume of alcohol, time taken to consume and consumption with or without food, can all affect nutrient absorption and utilisation (2). A suggested mechanism for alcohols adverse effects on vitamin B12 is altered binding of intrinsic factor in turn decreasing absorption (2).

## 2.7 Alcohol and body weight

As mentioned earlier, alcohol has a high energy content and often has an additive effect on total energy intakes and food intakes (1,2,6,23,43,52) (with the possible exception of very heavy drinkers who substitute food for alcohol (49,59)). However, associations between alcohol and weight gain are often hard to extricate. This potential relationship between alcohol and weight gain is of particular interest as it is well established that body size, especially distribution of body fat, is strongly associated with increased risk of chronic diseases and mortality (12). Cross-sectional studies have generated mixed conclusions between alcohol intake and body weight. Inverse (5-9) or no associations (10) with increasing alcohol intakes have been reported in females and positive (9-11) or no associations (6-8) reported in males. An analysis of data from the Nurses Health Study and Health Professionals Follow Up study (n=89,538) found no relationship between alcohol and BMI in males but a clear inverse association in females (7) and these associations could not be explained by differences in smoking status or type of alcoholic beverage consumed. Contrary to this finding a study using data from the EPIC study (n=36,034) found a positive relationship in males whereby body weight increased with increasing alcohol consumption (9).

Theoretically, moderate additive alcohol intakes will be accounted for in the energy-balance equation, thus promoting positive energy balance and weight gain, however alcohol energy is not as clear-cut as other substrates. As alcohol cannot be stored by the body, it takes priority in metabolism and is eliminated as quickly as possible (3). In heavy consumers and eventually in daily moderate consumers, a large fraction of alcohol energy may not be an available source of energy due to the induction of a secondary oxidation system (MEOS). This 'energy wastage' has been proposed to explain why heavy and regular moderate alcohol consumption does not influence body weight as expected (3). Moreover, minimal energy wastage is reported when alcohol is processed via the principal route using the alcohol dehydrogenase enzyme (ADH) (66). Hence low alcohol intakes may promote weight gain while higher intakes are associated with weight loss.

It is not surprising that there is no clear pattern regarding the relationship between weight and alcohol consumption. Firstly, the cross sectional nature of many of these studies is an underlying limitation as they are unable to prove causal relationships, only associations. Secondly, there are a multitude of factors that influence the potential role alcohol plays in weight gain such as; volume and frequency of consumption, drinking pattern (consumed with food and meal composition), current body weight (particularly obese), family history of overweight/obesity, sex and genetic differences in ADH enzyme function. The potential for confounding is problematic in observational studies as there are many factors that directly affect weight gain that may differ with drinking status, namely; age, physical activity level, sex and smoking status (3). Although many studies have controlled for these factors, residual confounding may still be an issue. Overall, there does seem to be a great deal of debate as to just how much alcohol affects weight gain. Conclusions from the aforementioned population-based studies may in fact be correct for the population in which the data was collected (3).

# 3 Objective statement

The aims of this study are:

- To describe the characteristics of the New Zealand adult population that are associated with habitual alcohol consumption patterns.
- To examine the cross-sectional associations between alcohol consumption and energy and macronutrient intakes in the New Zealand diet.

# 4 Methods

## 4.1 Survey population

The 2008/09 New Zealand Adult Nutrition Survey (NZANS) was a nationally representative, cross sectional survey of 4,721 New Zealanders aged 15 years and over (67). Participants were selected using an area-based sampling frame based on 32,173 small geographic areas (meshblocks) that represented 98.9% of New Zealand's 1.4 million permanent private dwellings. Participants were recruited using a three-stage selection process, involving the selection of 607 meshblocks using a probability-proportional-to-size design, followed by the random selection of households within each selected meshblock and a single randomly selected eligible participant within the household. Increased sampling of Māori and Pacific people and some age groups (15-18 and 71+ years) occurred in order to achieve adequate numbers for producing robust age and ethnicity data. Before the interview, informed, written consent was obtained from the participant, or from the guardian if the participant was aged 18 years or less. The New Zealand Health and Disability Multi-Region Ethics Committee granted ethical approval for the survey (MEC/08/04/049) (67).

## 4.2 Demographic data collection

Trained interviewers collected the survey data for the 2008/09 NZANS using computer-assisted personal interview software (LINZ® Electronic Dietary Data Acquisition System (LEDDAS©)(67). Participants were interviewed in their home.

Participants' ethnicity was output to New Zealand European and Other (NZEO), Māori and Pacific. The 'Other' ethnic group comprised mainly of Asian, Middle-Eastern, Latin American and African ethnicities and was combined with 'European' to avoid small sample size problems. The small numbers (n=34) who reported 'New Zealander' as their ethnicity or refused to answer the ethnicity question were included in the NZEO ethnic group. Prioritized ethnicity was applied to the 450 participants who selected more than one ethnic group. For example if an individual selected both Māori and NZEO, they would be classified in the Māori ethnic group. This ensures that the total number of responses equals the total population.

Socio-economic status was classified according to the New Zealand Index of Deprivation 2006 (NZDep06). This area-based index of deprivation measures the level of socioeconomic deprivation for each meshblock according to a combination of the following 2006 Census variables: income, access to a car, household crowding, home ownership, employment status, qualifications, support and access to a telephone. The 10 categories on the NZDep06 scale were collapsed into quintiles, where quintile 1 represents the 20% of areas with the lowest deprivation, and quintile 5 represents the 20% of areas with the highest deprivation (67).

### 4.2.1 Nutrition related health questionnaire

Participants were asked whether a doctor had diagnosed any of the following long-term health conditions; heart disease, stroke, diabetes, osteoporosis, high blood pressure or high blood cholesterol. Participants were also asked about age of diagnosis and any treatments for these condition (67). In addition, information was sought on tobacco and alcohol use.

## 4.3 Dietary Data Collection and Analysis

A computer assisted, multiple-pass 24-hour recall method was used to obtain detailed, quantitative information of all foods, drinks and dietary supplements the participant consumed the previous day (67). The interviewer administered the recall using the LINZ24© module of the Abbey software package (LINZ® Health & Activity Research Unit, University of Otago, Dunedin, New Zealand).

The 24-hour recall was conducted in four stages using a standardized protocol as prompted by the computer. In the first stage a ‘quick list’ of all foods and beverages consumed are collected. The second stage collects detailed descriptions of all foods and beverages on the quick list. Computer controlled questions and prompts guide the collection of the cooking methods used, recipes for mixed dishes, additions made ‘on the plate’, brand and product names, time consumed and where the item was sourced from. The third stage estimated the quantity of all foods and beverages consumed using household measures or food photographs, shape dimensions, food portion assessment aids (e.g. dried beans) and packaging information. Lastly in the fourth stage, the foods were reviewed in chronological order to verify the descriptions and amounts consumed.

To account for seasonal variations in food consumption dietary intake data was collected over 12 months. In addition, data was collected across all days of the week to allow for differences between week and weekend days. The survey aimed to achieve an even spread of interviews across all days of the week with a minimum of 10% of interviews on Saturday and Sunday. However as weekends are considered protected family time target fell short at 9.3% for Saturday and 8.2% for Sunday **(Table 1)** (67).

**Table 1** - Percentage of primary 24-hour recall interviews, by day of week

| Day of week | Percent |
|---|---|
| Monday | 16.0 |
| Tuesday | 17.2 |
| Wednesday | 19.1 |
| Thursday | 16.7 |
| Friday | 13.5 |
| Saturday | 9.3 |
| Sunday | 8.2 |

Nutrient analysis involved matching the detailed description of each food item to an appropriate nutrient line. An electronic subset of data from the New Zealand Food Composition Database (NZFCDB) known as FOODfiles 2010, was the main source of food composition data. If a direct match was not found in FOODfiles, the food was matched to nutrient lines using appropriate overseas food composition databases. If no appropriate matches were available in New Zealand or overseas and the food was commonly consumed in the 2008/09 NZANS, the New Zealand Institute of Plant and Food Research Ltd prioritised the food item for nutrient analysis (67).

### 4.4 Categorisation of alcohol consumption

Classification of habitual alcohol consumption was determined from the nutrition related health questionnaire in the 2008/09 ANS. Classification was based on four questions; how often the participant consumed beverages containing alcohol (frequency) over the past 12 months, and on those drinking occasions, how many alcoholic beverages do they consume (quantity).

**Table 2** shows the habitual alcohol consumption category classification criteria. Non-drinkers were classified as those who had never consumed alcohol in their lifetime, not counting small sips/tastes. Former drinkers were classified as those who may have consumed alcohol in their lifetime, but not in the previous 12 months. The classification of light to moderate and heavy drinking categories was based, as much as possible, on ALAC's 'low risk alcohol drinking advice' of no more than 10 and 15 standard drinks per week for men and women, respectively (17).

**Table 2** – Habitual alcohol consumption categories based on ALAC guidelines[1]

| Category | Classification criteria |
|---|---|
| Non-drinker | Those who reported never having consumed alcohol in their lifetime (not including small sips/tastes) |
| Former drinker | Those who reported consuming alcohol in their lifetime but not during the previous 12 months before the survey took place |
| Light to moderate drinker | Women: Those who reported consuming no more than 10 standard drinks per week[1,2]<br>Men: Those who reported consuming no more than 15 standard drinks per week[1,2] |
| Heavy drinker | Women: Those who reported consuming more than 10 standard drinks per week[1]<br>Men: Those who reported consuming more than 15 standard drinks per week |

[1] ALAC's 'Low-risk alcohol drinking advice' (17)
[2] One standard drink is equivalent to 10g of pure alcohol (ethanol)

We were unable to include the recommendation for having two alcohol-free days a week because the questionnaire did not include this information.

The responses to the alcohol questionnaire that the participant could select were given as ranges rather than specific amounts; e.g. drink “Up to 4 times per month” and “One or Two” drinks on a typical day. Participants who reported drinking “Up to 4 times per month” were classified as drinking once or less per week and those who reported drinking “Up to 3 times a week was classified as drinking 2-3 times a week. There were instances where the classification category was not clear-cut (because the beverage range overlapped with the ALAC cut-off) and it was decided to opt for the lower classification category (light to moderate), due to the majority of the beverage range being below the ALAC cut-off and to avoid overestimating the prevalence of heavy drinkers. Full details of habitual drinking category classification are shown in **Appendices A & B.**

Participants were also categorized into three alcohol consumption categories based on alcohol intake from the 24-hour dietary recall. The alcohol consumption groups were; 0 drinks, 1-2 standard drinks, and 3 or more standard drinks consumed within the 24-hour recall time period. A standard drink was based on 10g of pure alcohol (ethanol). One individual was excluded from the analysis because of an implausible alcohol intake (841g).

### 4.5 Anthropometric measurements

Measurements were made on participants who consented, except pregnant females and participants who were not able to stand up. Participants were asked to wear light clothing on the day of the interview and to remove their shoes for the measurements.

Height and weight measurements were taken in duplicate. If the two measurements differed by more than 1%, a third measurement was taken. The mean of the two closest measurements (or three) was used. Height was measured to the nearest 0.1 cm using a stadiometer (Seca 214) and weight was measured using electronic scales to the nearest 0.1 kg

(Tanita HD-351, maximum weight 200kg). BMI was determined as weight (kg) / [height (m)]$^2$.

## 4.6 Statistical analysis

Stata 12.0 (StataCorp, Texas) was used for all statistical analyses. Survey weights were used to account for the complex sampling design, and to produce estimates that are representative of the New Zealand population. Results are presented separately for males and females, due to sex specific alcohol guidelines and energy and macronutrient intakes also differing by sex.

Demographic characteristics (age, ethnicity, NZDep06.) and health related variables (BMI, and self reported high cholesterol, diabetes, hypertension and smoking status) are presented by habitual drinking category, as mean (SEM) for continuous variables and % (SEM) for categorical variables. Differences between males and females for characteristics within each drinking category were tested using survey weighted chi-square tests.

Logistic regression models were used to determine unadjusted odds ratios and associated 95% confidence intervals (CI). The unadjusted odds ratio for age-group, ethnicity and NZDep06 is the relationship between the demographic category of interest and the drinking level compared to all other categories within that demographics category. For example, the odds of being a non-drinker for the 15-17 year age group, compared with all other age-group categories. To examine the independent associations between each demographic characteristic with habitual drinking status, we performed multivariate logistic regression adjusting for all demographic variables (age, ethnicity, NZdep06, BMI and smoking status). The adjusted odds ratio analysis compares each demographic category to a selected reference category adjusted for age-group, ethnicity, NZDep06, BMI and smoking status. BMI was entered into the logistic regression as a continuous variable. The odds ratio for BMI indicates the ratio of BMI of being in that drinking category compared to not being in that drinking category. The odds ratio for health related factors (current smoker, hypertension, high cholesterol and diabetes) indicate the odds of having this health related condition in the drinking category of interest compared with not having the condition.

Mean (SE) intakes of macronutrients (carbohydrate fat, saturated fat and protein) are presented as grams, as a percentage of total energy and as a percentage of food-derived energy (total energy (kJ) minus energy from alcohol (kJ)). Multiple linear regression models with age entered as a continuous, independent variable were used to obtain age-adjusted mean energy and macronutrient intakes. Differences in unadjusted intakes between drinking levels were tested with ANOVA, whereas age-adjusted differences were tested using multiple linear regression models.

# 5 Results

## 5.1 Nutrition related health questionnaire

### 5.1.1 Population characteristics

The characteristics of New Zealand adults by habitual drinking habits, defined from the nutrition related health questionnaire, are presented in **Table 3**. For both men and women, heavy drinkers were younger (34.5 y) than non-drinkers (40.7 y), former drinkers (51.3 y) and light to moderate drinkers (44.7) ($p<0.001$ for all comparisons). In the youngest age group (15-17 years), 69.6% of males and 71.3% of females were classified as light to moderate drinkers and 6.1% of males and 7.1% of females were classified as heavy drinkers. The highest percentage of heavy drinkers was observed in the 18-24 year age group (21.5% of males and 18.6% of females). Overall, the majority of New Zealanders were classified as light to moderate drinkers (82.9% of males and 74.1% of females).

There were some differences in demographic characteristics between males and females within habitual drinking categories (**Table 3**). Male non-drinkers were younger than female non-drinkers (33.1 years vs. 43.3 years, $p<0.001$) and more Pacific females than Pacific males were non-drinkers (25.7% females vs. 9.4% males, $p<0.001$). A higher percentage of Pacific males than Pacific females were light to moderate drinkers (61.5% for males vs. 51.2% for females, $p<0.001$) and heavy drinkers (11.5% for males vs. 3.4% for females, $p<0.01$). Furthermore, more Māori males were heavy drinkers than Māori females (14.6% vs. 8.4%, $p<0.01$). While more NZEO females than NZEO males were non-drinkers (7.1% and 2.3%, respectively, $P<0.001$), the percentage of heavy drinkers did not differ for NZEO males and females.

**Table 3** - Characteristics by habitual alcohol consumption category from the nutrition related health questionnaire[1]

| | Males | | | | Females | | | |
|---|---|---|---|---|---|---|---|---|
| | Non-drinker[2] | Former[3] | Light /moderate[4] | Heavy[5] | Non-drinker[2] | Former[3] | Light/ moderate[4] | Heavy[5] |
| Participants | 2.8 (0.4) | 7.1 (0.7) | 82.9 (1.3) | 7.3 (1.0) | 7.6 (0.7)* | 10.0 (0.9)* | 74.1 (1.3)* | 8.2 (0.9) |
| Mean (SEM) age, years | 33.1 (2.9) | 53.0 (1.6) | 44.7 (0.6) | 32.0 (1.7) | 43.3 (1.7)* | 50.1 (1.4) | 44.8 (0.6) | 36.5 (1.5)* |
| Age group | | | | | | | | |
| 15-17 n=546 | 17.8 (3.8) | 6.6 (1.6) | 69.6 (3.9) | 6.1 (1.7) | 18.1 (2.5) | 3.5 (1.1) | 71.3 (2.9) | 7.1 (1.8) |
| 18-24 n=480 | 3.0 (1.1) | 1.7 (0.7) | 73.9 (4.4) | 21.5 (4.3) | 6.3 (2.5) | 3.5 (1.4) | 71.7 (4.5) | 18.6 (3.6) |
| 25-44 n=1429 | 1.7 (0.6) | 4.8 (1.2) | 84.2 (2.1) | 9.4 (1.8) | 6.2 (1.2) | 11.0 (1.8) | 73.5 (2.4) | 9.4 (1.6) |
| 45-64 n=924 | 1.6 (0.7) | 8.5 (1.5) | 86.9 (1.9) | 3.0 (1.0) | 6.8 (1.5) | 10.1 (1.5) | 76.6 (2.5) | 6.5 (1.5) |
| 65+ n=1341 | 1.8 (0.6) | 13.7 (2.1) | 84.0 (2.1) | 0.5 (0.2) | 9.8 (1.5) | 14.2 (1.9) | 73.7 (2.4) | 2.3 (0.7) |
| Ethnicity | | | | | | | | |
| NZEO n= 2980 | 2.3 (0.4) | 5.7 (0.8) | 85.9 (1.3) | 6.1 (1.1) | 7.1 (0.9)* | 9.0 (1.0)* | 75.4 (1.5)* | 8.5 (1.0) |
| Māori n= 1039 | 3.5 (1.8) | 13.2 (2.0) | 68.7 (3.5) | 14.6 (2.9) | 3.9 (1.5) | 13.1 (1.5) | 74.6 (2.1) | 8.4 (1.2)* |
| Pacific n=701 | 9.4 (2.2) | 17.6 (2.5) | 61.5 (3.4) | 11.5 (3.0) | 25.7 (2.5)* | 19.7 (2.6) | 51.2 (3.1)* | 3.4 (1.0)* |
| NZDep06[6] | | | | | | | | |
| 1 n=664 | 2.4 (0.7) | 4.5 (1.4) | 89.8 (2.0) | 3.3 (1.5) | 4.9 (1.8)* | 9.2 (2.5) | 78.0 (3.2)* | 7.9 (2.1) |
| 2 n=829 | 3.0 (1.2) | 4.4 (1.4) | 85.0 (3.2) | 7.6 (2.3) | 6.8 (1.4)* | 8.4 (1.9) | 78.5 (2.6) | 6.3 (1.6) |
| 3 n=761 | 1.0 (0.4) | 4.5 (1.4) | 87.8 (2.7) | 6.7 (2.3) | 9.1 (1.9)* | 6.4 (1.3) | 75.2 (3.3)* | 9.3 (2.1) |
| 4 n=1072 | 3.2 (0.8) | 9.6 (2.1) | 77.1 (3.4) | 10.0 (2.7) | 7.7 (1.5)* | 13.3 (2.0) | 70.1 (2.9) | 8.8 (1.9) |
| 5 n=1394 | 4.8 (1.3) | 14.0 (1.8) | 71.3 (2.5) | 10.0 (2.1) | 9.2 (1.6)* | 13.3 (1.8) | 68.5 (2.4) | 9.0 (1.7) |

Abbreviations: NZEO, New Zealand European and others; NZDep06, New Zealand deprivation scale; SE, standard error.
[1] All values % (SEM) unless otherwise specified.
[2] Non-drinker was defined as never consuming alcohol, not counting small tastes/sips
[3] Former drinkers defined as someone who has not consumed alcohol in the past 12 months, but reported being a drinker previously.
[4] Light/moderate drinker defined as ≤10 drinks/week for females & ≤15 drinks/week for males.
[5] Heavy drinker defined as consuming >10 drinks/week for females & >15 drinks/week for males.
[6] Area based deprivation score, 1 is least deprived, 5 is most deprived.
* Significantly different to males (P<0.001), using survey chi-square test.

### 5.1.2 Predictors of habitual drinking habits

**Table 4** shows the characteristics associated with being a non-drinker for males and females. After adjustment for ethnicity, NZDep06, BMI and smoking status, males and females aged 15-17 years were more likely to be classified as non-drinkers compared to all other age groups (OR 6.39; $p<0.01$). Pacific males and females were also more likely to be non-drinkers compared to non-pacific males and females in the unadjusted analysis, and the NZEO reference group, once age, NZDep06, BMI and smoking status were adjusted for (OR 4.33; $p<0.01$ for males and OR 4.59; $p<0.01$ for females). NZEO males and females were less likely to be non-drinkers compared to the non-NZEO males and females (unadjusted OR 0.43; $p<0.01$ for males and OR 0.67; $p<0.05$ for females). Males in the most deprived NZDep06 quintile (quintile 5) were significantly more likely to be non-drinkers when compared with all other NZDep06 quintiles (unadjusted OR 2.07; $p<0.05$) as well as when compared with the reference quintile (quintile 3) and adjusted for age, ethnicity, BMI and smoking status (OR 5.13; $p<0.01$). However, females in the least deprived quintile (quintile 1) were less likely to be non-drinkers when compared with the reference quintile 3 and adjusted for age, ethnicity, BMI and smoking status (OR 0.33; $p<0.05$). Male and female current smokers were less likely to be non-drinkers in comparison to non-smokers (OR 0.11 $p<0.01$ for males and OR 0.09 $p<0.01$ for females).

**Table 5** shows the characteristics associated with being a non-drinker for males and females. Males and females aged 65 years and over were significantly more likely to be former drinkers compared with all other age groups (unadjusted OR 2.61; $p<0.01$ for males and unadjusted OR 1.65; $p<0.01$ for females). After adjustment for ethnicity, NZDep06, BMI and smoking status the association remained significant for males (OR 4.47; $p<0.01$) but was no longer statistically significant for females. Māori and Pacific people were more likely to be former drinkers when compared with NZEO, but after adjustment for age NZDep06, BMI and smoking status, only Pacific males remained more likely to be former drinkers when

**Table 4** - Odds ratios for characteristics associated with being a non-drinker[1]

| | Males | | | | | | Females | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Unadjusted[2] | | | Adjusted[3] | | | Unadjusted[2] | | | Adjusted[3] | | |
| | OR | (95%CI) | p-value | OR | (95%CI) | p-value | OR | (95%CI) | p-value | OR | (95%CI) | p-value |
| Age group | | | | | | | | | | | | |
| 15-17 | 11.62 | (6.03, 22.42) | <0.01 | 6.39 | (2.32, 17.62) | <0.01 | 2.93 | (1.98, 4.34) | <0.01 | 2.23 | (1.27, 3.91) | <0.01 |
| 18-24 | 1.08 | (0.49, 2.39) | 0.84 | 1.46 | (0.47, 4.56) | 0.51 | 0.79 | (0.33, 1.86) | 0.59 | 0.78 | (0.29, 2.11) | 0.63 |
| 25-44 | 0.50 | (0.22, 1.13) | 0.09 | 1.00 | | | 0.71 | (0.45, 1.12) | 0.14 | 1.00 | | |
| 45-64 | 0.46 | (0.18, 1.19) | 0.11 | 1.34 | (0.39, 4.60) | 0.64 | 0.85 | (0.50, 1.45) | 0.54 | 1.29 | (0.62, 2.68) | 0.49 |
| 65+ | 0.59 | (0.29, 1.18) | 0.14 | 1.78 | (0.57, 5.53) | 0.32 | 1.40 | (0.93, 2.10) | 0.11 | 1.61 | (0.90, 2.88) | 0.11 |
| Ethnicity | | | | | | | | | | | | |
| NZEO | 0.43 | (0.22, 0.82) | 0.01 | 1.00 | | | 0.67 | (0.45, 0.98) | <0.05 | 1.00 | | |
| Māori | 1.30 | (0.43, 3.96) | 0.65 | 1.09 | (0.31, 3.78) | 0.90 | 0.46 | (0.21, 1.02) | 0.06 | 0.72 | (0.25, 1.99) | 0.52 |
| Pacific | 4.13 | (2.23, 7.60) | <0.01 | 4.33 | (1.59, 11.80) | <0.01 | 4.82 | (3.39, 6.87) | <0.01 | 4.59 | (2.69, 7.85) | <0.01 |
| NZDep06[4] | | | | | | | | | | | | |
| 1 | 0.80 | (0.39, 1.6) | 0.54 | 2.31 | (0.78, 6.86) | 0.13 | 0.58 | (0.27, 1.26) | 0.17 | 0.33 | (0.12, 0.88) | <0.05 |
| 2 | 1.08 | (0.45, 2.63) | 0.86 | 3.58 | (1.15, 11.15) | <0.05 | 0.86 | (0.52, 1.40) | 0.56 | 0.67 | (0.32, 1.37) | 0.27 |
| 3 | 0.31 | (0.13, 0.73) | <0.01 | 1.00 | | | 1.29 | (0.78, 2.14) | 0.32 | 1.00 | | |
| 4 | 1.20 | (0.63, 2.28) | 0.58 | 3.35 | (1.24, 9.10) | <0.05 | 1.01 | (0.63, 1.64) | 0.94 | 0.77 | (0.38, 1.57) | 0.47 |
| 5 | 2.07 | (1.06, 4.06) | <0.05 | 5.13 | (1.54, 17.08 | <0.01 | 1.29 | (0.82, 2.03) | 0.27 | 1.02 | (0.50, 2.13) | 0.94 |
| BMI[5] | 0.92 | (0.88, 0.96) | <0.01 | 0.95 | (0.01, 1.00) | 0.06 | 0.99 | (0.96, 1.03) | 0.75 | 0.98 | (0.94, 1.02) | 0.33 |
| Current smoker[6] | 0.11 | (0.03, 0.34) | <0.01 | 0.11 | (0.03, 0.39) | <0.01 | 0.93 | (0.04, 0.21) | <0.01 | 0.09 | (0.04, 0.22) | <0.01 |
| Hypertension[6] | 2.11 | (1.00, 4.46) | <0.05 | 1.18 | (0.40, 3.45) | 0.76 | 1.29 | (0.86, 1.94) | 0.22 | 1.66 | (0.93, 2.94) | 0.08 |
| High cholesterol[6] | 4.06 | (1.15, 14.3) | <0.05 | 2.58 | (0.58, 11.50) | 0.21 | 1.25 | (0.77, 2.05) | 0.36 | 1.06 | (0.58, 1.92) | 0.85 |
| Diabetes[6] | 0.72 | (0.27, 1.92) | 0.51 | I0.43 | (0.12, 1.50) | 0.19 | 0.53 | (0.28, 1.01) | 0.05 | 0.55 | (0.25, 1.22) | 0.14 |

Abbreviations: NZEO, New Zealand European and others; NZDep06, New Zealand deprivation scale; OR, odds ratio; CI, confidence interval.

[1] Non-drinker defined as someone who has never consumed alcohol in his or her lifetime, not counting small tastes/sips.

[2] The unadjusted odds ratio for age-group, ethnicity, NZDep06, is the relationship between the demographic category of interest and the drinking level compared to all other categories within that demographics category. E.g. the odds of being a non-drinker for the 15 to 17 year age group, compared with all other age-group categories.

[3] The adjusted odds ratio analysis compares each demographic category to a selected reference category adjusted for age-group, ethnicity, NZDep06, BMI and smoking status.

[4] Area based deprivation score, 1 is least deprived, 5 is most deprived.

[5] Indicates the ratio of BMI of being in that drinking category compared to not being in that drinking category.

[6] Indicates the ratio of having the health related condition of interest in the drinking category compared with not having the condition.

compared with NZEO (OR 2.07; $p<0.05$). Males and females in the most deprived quintile (quintile 5) were more likely to be former drinkers when compared with all other quintiles (unadjusted OR 2.74; $p<0.01$ for males and unadjusted OR 1.51; $p<0.05$ for females). However, after adjustment for age, ethnicity, BMI and smoking status, the associations remained only remained significant for males (OR 2.62; $p=0.05$).

**Table 6** shows the characteristics associated with being a light to moderate drinker for both sexes. Males aged 45-64 years were more likely to be light to moderate drinkers in comparison to all other age group categories (unadjusted OR 1.55; $p<0.05$). No statistically significant associations were found for females in relation to age group categories. Pacific males and females were less likely to be light to moderate drinkers compared with NZEO; these associations did not change after adjustment for age, NZDep06, BMI and smoking status (OR 0.53; $p<0.05$ for males and OR 0.43; $p<0.01$ for females). In comparison with all other NZDep06 quintiles, males in the least deprived NZDep06 quintile (quintile 1) were more likely to be light to moderate drinkers and males in the two most deprived quintiles (quintiles 4&5) were less likely to be light to moderate drinkers. After adjustments (age, ethnicity, BMI and smoking status), males in quintiles 4 and 5 were less likely to be light to moderate drinkers compared to males in reference quintile 3 (OR 0.45; $p<0.05$ for quintile 4 and OR 0.44; $p<0.05$ for quintile 5). The only significant association for females was in the most deprived quintile (quintile 5), where females were less likely to be light to moderate drinkers in comparison to all other quintiles (unadjusted OR 0.71; $p<0.05$).

**Table 7** shows the characteristics associated with being a heavy drinker. Males and females aged 18-24 years were more likely to be heavy drinkers compared with all other age groups (unadjusted OR 4.81; $p<0.01$ for males and unadjusted OR 3.09; $p<0.01$ for females) and the reference age group (25-44y) once adjustments were made (ethnicity, NZDep06, BMI, smoking status) (OR 3.86; $p<0.01$ for males and OR 2.24; $p<0.05$ for females). Males and females aged 65 years and over were significantly less likely to be heavy drinkers in

**Table 5 -** Odds ratios for characteristics associated with being a former drinker[1]

| | Males | | | | | | Females | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Unadjusted[2] | | | Adjusted[3] | | | Unadjusted[2] | | | Adjusted[3] | | |
| | OR | (95%CI) | p-value | OR | (95%CI) | p-value | OR | (95%CI) | p-value | OR | (95%CI) | p-value |
| Age group | | | | | | | | | | | | |
| 15-17 | 0.92 | (0.53, 1.62) | 0.78 | 1.97 | (0.79, 4.90) | 0.15 | 0.31 | (0.16, 0.61) | <0.01 | 0.35 | (0.15, 0.81) | <0.05 |
| 18-24 | 0.21 | (0.09, 0.49) | <0.01 | 0.41 | (0.14, 1.19) | 0.10 | 0.30 | (0.13, 0.69) | <0.01 | 0.32 | (0.11, 0.95) | <0.05 |
| 25-44 | 0.54 | (0.31, 0.94) | <0.05 | 1.00 | | | 1.18 | (0.78, 1.81) | 0.43 | 1.00 | | |
| 45-64 | 1.33 | (0.85, 2.11) | 0.22 | 2.28 | (0.98, 5.36) | 0.06 | 1.00 | (0.68, 1.51) | 0.98 | 1.05 | (0.53, 2.11) | 0.88 |
| 65+ | 2.61 | (1.68, 4.05) | <0.01 | 4.47 | (1.80, 11.07) | <0.01 | 1.65 | (1.14, 2.27) | <0.01 | 1.34 | (0.67, 2.68) | 0.40 |
| Ethnicity | | | | | | | | | | | | |
| NZEO | 0.36 | (0.24, 0.52) | 0.36 | 1.00 | | | 0.56 | (0.42, 0.76) | <0.01 | 1.00 | | |
| Māori | 2.23 | (1.45, 3.46) | <0.01 | 1.51 | (0.80, 2.84) | 0.20 | 1.42 | (1.02, 1.96) | <0.05 | 1.36 | (0.73, 2.51) | 0.33 |
| Pacific | 3.04 | (2.03, 4.59) | <0.01 | 2.07 | (1.02, 4.20) | <0.05 | 2.32 | (1.59, 3.39) | <0.01 | 1.75 | (0.87, 3.49) | 0.12 |
| NZDep06[4] | | | | | | | | | | | | |
| 1 | 0.55 | (0.28, 1.07) | 0.08 | 0.52 | (0.13, 2.06) | 0.35 | 0.89 | (0.48, 1.63) | 0.70 | 1.26 | (0.48, 3.03) | 0.64 |
| 2 | 0.55 | (0.28, 1.08) | 0.08 | 0.98 | (0.28, 3.43) | 0.98 | 0.78 | (0.47, 1.32) | 0.36 | 1.02 | (0.44, 2.35) | 0.97 |
| 3 | 0.56 | (0.29, 1.10) | 0.09 | 1.00 | | | 0.55 | (0.34, 0.89) | <0.05 | 1.00 | | |
| 4 | 1.53 | (0.90, 2.61) | 0.12 | 2.68 | (0.91, 7.88) | 0.07 | 1.52 | (1.02, 2.27) | <0.05 | 1.31 | (0.66, 2.60) | 0.44 |
| 5 | 2.74 | (1.81, 4.12) | <0.01 | 2.62 | (0.99, 6.91) | 0.05 | 1.51 | (1.03, 2.21) | <0.05 | 1.24 | (0.64, 2.40) | 0.52 |
| BMI[5] | 1.06 | (1.02, 1.10) | <0.01 | 1.03 | (0.99, 1.09) | 0.17 | 1.06 | (1.02, 1.09) | <0.01 | 1.03 | (0.97, 1.09) | 0.24 |
| Current smoker[6] | 1.23 | (0.68, 2.21) | 0.50 | 1.01 | (0.53, 1.94) | 0.97 | 1.01 | (0.61, 1.68) | 0.97 | 0.84 | (0.48, 1.47) | 0.55 |
| Hypertension[6] | 0.46 | (0.30, 0.70) | <0.01 | 0.91 | (0.51, 1.64) | 0.76 | 0.63 | (0.44, 0.90) | <0.05 | 0.94 | (0.56, 1.62) | 0.84 |
| High cholesterol[6] | 0.78 | (0.51, 1.19) | 0.25 | 1.40 | (0.77, 2.54) | 0.27 | 0.51 | (0.35, 0.75) | <0.01 | 0.58 | (0.34, 0.97) | <0.05 |
| Diabetes[6] | 0.21 | (0.12, 0.37) | <0.01 | 0.44 | (0.17, 1.13) | 0.09 | 0.30 | (0.18, 0.49) | <0.01 | 0.44 | (0.20, 0.90) | <0.05 |

Abbreviations: NZEO, New Zealand European and others; NZDep06, New Zealand deprivation scale; OR, odds ratio; CI, confidence interval.

[1] Former-drinker defined as someone who has consumed alcohol in his or her lifetime, but did not consume alcohol during the previous 12-months.

[2] The unadjusted odds ratio for age-group, ethnicity, NZDep06, is the relationship between the demographic category of interest and the drinking level compared to all other categories within that demographics category. E.g. the odds of being a non-drinker for the 15 to 17 year age group, compared with all other age-group categories.

[3] The adjusted odds ratio analysis compares each demographic category to a selected reference category adjusted for age-group, ethnicity, NZDep06, BMI and smoking status.

[4] Area based deprivation score, 1 is least deprived, 5 is most deprived.

[5] Indicates the ratio of BMI of being in that drinking category compared to not being in that drinking category.

[6] Indicates the ratio of having the health related condition of interest in the drinking category compared with not having the condition.

comparison to all other age groups (unadjusted OR 0.06; $p<0.01$ for males and OR 0.22; $p<0.01$ for females). Māori males were more likely to be heavy drinkers compared to non-Māori males but after adjustments for age, NZDep06, BMI, smoking status this association was no longer significant. After these same adjustments, Māori and Pacific females were less likely to be heavy drinkers compared with NZEO females (OR 0.52; $p<0.05$ for Māori females and OR 0.33; $p<0.01$ for Pacific females). Male smokers were significantly more likely to be heavy drinkers in comparison to male non-smokers after adjustments for age, ethnicity, NZDep06 and BMI (OR 1.94; $p<0.05$).

In addition to demographic variables, **Tables 4 to 7** present odds ratio of having a health condition in each drinking category compared with not having the health condition. Hypertensive males were more likely to be non-drinkers compared to non-hypertensive males, however this association was attenuated to insignificance after adjustments for age, ethnicity, NZDep06, BMI and smoking status. Diabetic males and females were less likely to be former drinkers than non-diabetics. Once adjusted for the aforementioned variables, this association only remained significant in females (OR 0.44; $p<0.05$). Hypertensive males and females were less likely to be former drinkers than non-hypertensive individuals, however after adjustment, these associations were no longer significant. After adjustments, diabetics of both sexes were significantly more likely to be light to moderate drinkers than non-diabetics (OR 2.31; $p<0.05$ for males and OR 2.18; $p<0.05$ for females). Diabetic females were significantly more likely to be heavy drinkers in comparison to non-diabetic females. This relationship remained significant after adjustment (OR 8.34; $p<0.05$).

**Tables 4 to 7** also present the odds ratio for BMI of being in a drinking category compared to not being in that drinking category. The odds ratio for BMI in the light to moderate male drinkers category was 0.96 ($p<0.05$), this indicates BMI was 4% lower in male light to moderate drinkers compared to all other drinking categories (non-drinker, former and heavy drinker). BMI was 7% higher in male heavy drinkers compared to all other categories

**Table 6** - Odds ratios for characteristics associated with being a light to moderate drinker[1]

| | Males | | | | | | Females | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Unadjusted[2] | | | Adjusted[3] | | | Unadjusted[2] | | | Adjusted[3] | | |
| | OR | (95%CI) | p-value | OR | (95%CI) | p-value | OR | (95%CI) | p-value | OR | (95%CI) | p-value |
| Age group | | | | | | | | | | | | |
| 15-17 | 0.45 | (0.30, 0.66) | <0.01 | 0.30 | (0.17, 0.53) | <0.01 | 0.86 | (0.62, 1.18) | 0.34 | 0.88 | (0.59, 1.33) | 0.55 |
| 18-24 | 0.54 | (0.33, 0.88) | <0.05 | 0.40 | (0.21, 0.78) | <0.01 | 0.87 | (0.55, 1.38) | 0.55 | 1.02 | (0.58, 1.78) | 0.95 |
| 25-44 | 1.16 | (0.82, 1.64) | 0.42 | 1.00 | | | 0.95 | (0.70, 1.28) | 0.71 | 1.00 | | |
| 45-64 | 1.55 | (1.08, 2.21) | <0.05 | 1.01 | (0.89, 1.74) | 0.96 | 1.21 | (0.88, 1.67) | 0.25 | 1.02 | (0.64, 1.62) | 0.93 |
| 65+ | 1.10 | (0.76, 1.59) | 0.61 | 0.72 | (0.40, 1.30) | 0.28 | 0.97 | (0.74, 1.28) | 0.85 | 0.93 | (0.62, 1.41) | 0.74 |
| Ethnicity | | | | | | | | | | | | |
| NZEO | 3.06 | (2.27, 4.14) | <0.01 | 1.00 | | | 1.46 | (1.17, 1.82) | <0.01 | 1.00 | | |
| Māori | 0.40 | (0.28, 0.58) | <0.01 | 0.64 | (0.40, 1.04) | 0.07 | 1.03 | (0.80, 1.33) | 0.83 | 1.24 | (0.82, 1.87) | 0.31 |
| Pacific | 0.31 | (0.22, 0.43) | <0.01 | 0.53 | (0.31, 0.91) | <0.05 | 0.34 | (0.26, 0.46) | <0.01 | 0.43 | (0.29, 0.63) | <0.01 |
| NZDep06[4] | | | | | | | | | | | | |
| 1 | 2.10 | (1.33, 3.33) | <0.01 | 1.01 | (0.52, 2.34) | 0.80 | 1.29 | (0.88, 1.89) | 0.19 | 1.28 | (0.68, 2.40) | 0.44 |
| 2 | 1.22 | (0.73, 2.06) | 0.45 | 0.67 | (0.31, 1.32) | 0.29 | 1.36 | (0.97, 1.90) | 0.08 | 1.13 | (0.64, 1.99) | 0.67 |
| 3 | 1.62 | (0.96, 2.72) | 0.07 | 1.00 | | | 1.07 | (0.74, 1.57) | 0.71 | 1.00 | | |
| 4 | 0.64 | (0.42, 0.97) | <0.05 | 0.45 | (0.23, 0.89) | <0.05 | 0.77 | (0.57, 1.06) | 0.11 | 0.88 | (0.52, 1.50) | 0.64 |
| 5 | 0.43 | (0.31, 0.59) | <0.01 | 0.44 | (0.24, 0.83) | <0.05 | 0.71 | (0.54, 0.93) | <0.05 | 0.83 | (0.50, 1.37) | 0.46 |
| BMI[5] | 0.97 | (0.94, 0.99) | <0.05 | 0.96 | (0.93, 1.00) | <0.05 | 0.98 | (0.96, 1.01) | 0.15 | 1.01 | (0.98, 1.04) | 0.69 |
| Current smoker[6] | 0.80 | (0.55, 1.18) | 0.26 | 0.89 | (0.58, 1.35) | 0.58 | 0.11 | (0.03, 0.34) | <0.01 | 0.11 | (0.03, 0.39) | <0.01 |
| Hypertension[6] | 1.06 | (0.75, 1.49) | 0.76 | 1.04 | (0.62, 1.74) | 0.89 | 1.07 | (0.82, 1.39) | 0.63 | 0.89 | (0.59, 1.33) | 0.56 |
| High cholesterol[6] | 0.77 | (0.52, 1.14) | 0.19 | 0.85 | (0.50, 1.47) | 0.57 | 1.06 | (0.78, 1.44) | 0.71 | 1.17 | (0.79, 1.72) | 0.43 |
| Diabetes[6] | 2.21 | (1.31, 3.72) | <0.01 | 2.31 | (1.06, 5.03) | <0.05 | 1.91 | (1.22, 3.00) | <0.01 | 2.18 | (1.15, 4.11) | <0.05 |

Abbreviations: NZEO, New Zealand European and others; NZDep06, New Zealand deprivation scale; OR, odds ratio; CI, confidence interval.

[1] Light to moderate drinker defined as consuming no more than 10 drinks/week for females or no more than 15 drinks/week for males.

[2] The unadjusted odds ratio for age-group, ethnicity, NZDep06, is the relationship between the demographic category of interest and the drinking level compared to all other categories within that demographics category. E.g. the odds of being a non-drinker for the 15 to 17 year age group, compared with all other age-group categories.

[3] The adjusted odds ratio analysis compares each demographic category to a selected reference category adjusted for age-group, ethnicity, NZDep06, BMI and smoking status.

[4] Area based deprivation score, 1 is least deprived, 5 is most deprived.

[5] Indicates the ratio of BMI of being in that drinking category compared to not being in that drinking category.

[6] Indicates the ratio of having the health related condition of interest in the drinking category compared with not having the condition.

(OR 1.07; p<0.01). BMI was 6% higher both male and female former drinkers compared to all other drinking categories but after adjustment for age, ethnicity, NZDep06 and smoking status the results were no longer statistically significant. BMI was 8% lower in male non-drinkers compared to all other drinking categories, but was no longer significant after adjustment for possible confounders.

## 5.2 Twenty-four hour recall

### 5.2.1 Macronutrients

**Tables 8 and 9** show the mean macronutrient and energy intakes by alcohol intake category from the 24-hour recall. After adjusting for age, males and females who consumed three or more alcoholic drinks during the recall had higher total energy intakes (from both food and alcohol) compared to those who consumed no alcohol during the recall (13, 618kJ vs. 9,988kJ; p<0.01 for males and 9,845kJ vs. 7,312kJ; p<0.01 for females) as well as those who consumed one to two drinks during the recall (13,618kJ vs. 10,1789kJ; p<0.01 for males and 9,845kJ vs. 8077kJ; p<0.01 for females). Females who consumed one to two drinks also had higher total energy intakes than females who consumed no alcohol during the recall (8,077kJ vs. 7,312kJ; p<0.01). There were no differences in total energy intakes between males who consumed one to two drinks and males who consumed no alcohol during the recall.

Adjusting for age, males and females who consumed three or more drinks also had higher food derived energy intakes (excluding energy from alcohol) than those who consumed no alcohol during the recall (11,334kJ vs. 9,948kJ; p<0.01 for males and 7,950kJ vs. 7,275kJ; p<0.01 for females). Males who consumed three or more drinks also had higher food derived energy intakes than males who consumed one to two drinks (11,334kJ vs. 9634.2 p<0.01). There were no statistical differences in food derived energy intakes between females who consumed three or more drinks and females who consumed one to two drinks. For both males

**Table 7** - Odds ratios for characteristics associated with being a heavy drinker[1]

| | Males | | | | | | Females | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Unadjusted[2] | | | Adjusted[3] | | | Unadjusted[2] | | | Adjusted[3] | | |
| | OR | (95%CI) | p-value | OR | (95%CI) | p-value | OR | (95%CI) | p-value | OR | (95%CI) | p-value |
| Age group | | | | | | | | | | | | |
| 15-17 | 0.79 | (0.42, 1.49) | 0.47 | 1.12 | (0.47, 2.66) | 0.79 | 0.84 | (0.48, 1.50) | 0.56 | 0.94 | (0.48, 1.84) | 0.85 |
| 18-24 | 4.81 | (2.60, 8.88) | <0.01 | 3.86 | (1.70, 8.77) | <0.01 | 3.09 | (1.81, 5.27) | <0.01 | 2.24 | (1.09, 4.59) | <0.05 |
| 25-44 | 1.59 | (0.95, 2.67) | 0.08 | 1.00 | | | 1.27 | (0.78, 2.03) | 0.33 | 1.00 | | |
| 45-64 | 0.31 | (0.16, 0.63) | <0.01 | 0.38 | (0.15, 0.96) | <0.05 | 0.71 | (0.40, 1.23) | 0.22 | 0.67 | (0.31, 1.45) | <0.05 |
| 65+ | 0.06 | (0.02, 0.14) | <0.01 | 0.07 | (0.02, 0.23) | <0.01 | 0.22 | (0.11, 0.44) | <0.01 | 0.28 | (0.10, 0.81) | <0.05 |
| Ethnicity | | | | | | | | | | | | |
| NZEO | 0.41 | (0.25, 0.68) | <0.01 | 1.00 | | | 1.24 | (0.85, 1.82) | 0.27 | 1.00 | | |
| Māori | 2.51 | (1.44, 4.39) | <0.01 | 1.58 | (0.78, 3.20) | 0.20 | 1.02 | (0.68, 1.55) | 0.91 | 0.52 | (0.28, 0.94) | <0.05 |
| Pacific | 1.70 | (0.89, 3.27) | 0.11 | 0.83 | (0.28, 2.44) | 0.73 | 0.39 | (0.21, 0.72) | <0.01 | 0.33 | (0.14, 0.74) | 0.01 |
| NZDep06[4] | | | | | | | | | | | | |
| 1 | 0.37 | (0.15, 0.95) | <0.05 | 0.92 | (0.29, 2.93) | 0.89 | 0.95 | (0.51, 1.77) | 0.86 | 1.49 | (0.52, 4.30) | 0.46 |
| 2 | 1.06 | (0.52, 2.16) | 0.87 | 1.32 | (0.51, 3.44) | 0.57 | 0.70 | (0.38, 1.27) | 0.24 | 1.32 | (0.50, 3.47) | 0.58 |
| 3 | 0.90 | (0.42, 1.94) | 0.79 | 1.00 | | | 1.18 | (0.69, 2.03) | 0.54 | 1.00 | | |
| 4 | 1.56 | (0.79, 3.05) | 0.20 | 1.41 | (0.55, 3.65) | 0.47 | 1.11 | (0.66, 1.86) | 0.70 | 1.47 | (0.60, 3.61) | 0.40 |
| 5 | 1.54 | (0.87, 2.73) | 0.14 | 1.28 | (0.51, 3.25) | 0.60 | 1.13 | (0.70, 1.81) | 0.62 | 1.43 | (0.60, 3.65) | 0.44 |
| BMI[5] | 1.05 | (1.00, 1.09) | <0.05 | 1.07 | (1.02, 1.13) | <0.01 | 0.98 | (0.94, 1.02) | 0.27 | 0.97 | (0.93, 1.00) | 0.10 |
| Current smoker[6] | 2.24 | (1.30, 3.87) | <0.01 | 1.94 | (1.10, 3.40) | <0.05 | 1.23 | (0.68, 2.21) | 0.50 | 1.01 | (0.53, 1.94) | 0.97 |
| Hypertension[6] | 1.82 | (0.95, 3.50) | 0.07 | 0.96 | (0.40, 2.32) | 0.93 | 1.25 | (0.71, 2.22) | 0.44 | 0.86 | (0.38, 1.95) | 0.71 |
| High cholesterol[6] | 1.59 | (0.75, 3.37) | 0.23 | 0.69 | (0.29, 1.61) | 0.38 | 1.98 | (1.00, 3.91) | <0.05 | 1.55 | (0.65, 3.71) | 0.32 |
| Diabetes[6] | 2.54 | (0.34, 18.8) | 0.36 | 0.74 | (0.07, 7.73) | 0.80 | 14.7 | (3.54, 60.62) | <0.01 | 8.34 | (1.06, 65.40) | <0.05 |

Abbreviations: NZEO, New Zealand European and others; NZDep06, New Zealand deprivation scale; OR, odds ratio; CI, confidence interval.

1 Heavy-drinker defined as consuming more than 10 drinks/week for females and more than 15 drinks/week for males.

2 The unadjusted odds ratio for age-group, ethnicity, NZDep06, is the relationship between the demographic category of interest and the drinking level compared to all other categories within that demographics category. E.g. the odds of being a non-drinker for the 15 to 17 year age group, compared with all other age-group categories.

3 The adjusted odds ratio analysis compares each demographic category to a selected reference category adjusted for age-group, ethnicity, NZDep06, BMI and smoking status

4 Area based deprivation score, 1 is least deprived, 5 is most deprived.

5 Indicates the ratio of BMI of being in that drinking category compared to not being in that drinking category.

6 Indicates the ratio of having the health related condition of interest in the drinking category compared with not having the condition.

and females, there were no differences in food derived energy between those who consumed one to two drinks and those who consumed no alcohol.

Males that consumed three or more drinks during the recall had higher intakes (grams) of fat, saturated fat, protein and carbohydrates, after adjusting for age, compared to those who consumed one to two drinks and those who consumed no alcohol during the recall. Females who consumed three or more drinks only had higher intakes of carbohydrates (grams) than females who consumed no alcohol during the recall (233.5g vs. 210.9g; $p<0.05$), but there were no differences in fat or protein intakes between drinking levels.

After adjusting for age, the percentage that each macronutrient (fat, saturated fat, carbohydrate, protein) contributed to total energy intake was lower in those who consumed three or more drinks than those who consumed one to two drinks and no drinks during the recall. This was true for both sexes. Therefore as drinking level increased, alcohol took up a larger percentage of total energy intakes (from 6.1% in 1-2 drinks to 17.4% in ≥3 for males and from 7.2% in 1-2 drinks to 19.54% in ≥3 for females). There were no statistical differences in the percentage that each macronutrient contributed to food derived energy intakes across the three alcohol intake categories. Therefore all alcohol consumption categories had similar proportions of food-derived energy coming from each macronutrient.

**Table 8** - Weighted mean 24-hour nutrient and energy intakes by alcohol intake category for males

| | Alcohol intake category (number of drinks) | | | | | |
|---|---|---|---|---|---|---|
| | Unadjusted | | | Age adjusted | | |
| | 0 | 1-2 | ≥3 | 0 | 1-2 | ≥3 |
| Total energy (kJ) | 10062.8 (161.7) | 10017.4 (343.6) | 13596.6 (490.0)[2,3] | 9987.7 (156.0) | 10178.5 (333.8) | 13618.4 (483.8)[2,3] |
| Food derived energy (kJ) | 10021.0 (161.2) | 9478.2 (340.5) | 11313.2 (439.0)[2,3] | 9948.3 (154.8) | 9634.2 (330.6) | 11334.2 (435.3)[2,3] |
| Fat (g) | 95.8 (1.9) | 89.0 (4.1) | 109.7 (5.1)[3,4] | 95.1 (1.9) | 90.9 (4.1) | 109.9 (5.2)[2,3] |
| % of TE | 34.5 (0.4) | 31.9 (0.8)[2] | 29.2 (0.6)[2,3] | 34.5 (0.4) | 32.0 (0.8)[2] | 29.2 (0.7)[2,3] |
| % of FDE | 34.6 (0.4) | 33.9 (0.8) | 35.2 (0.7) | 34.6 (0.4) | 34.0 (0.8) | 35.2 (0.7) |
| Saturated fat (g) | 37.9 (0.9) | 35.0 (1.8) | 41.9 (2.0)[3] | 37.6 (0.9) | 35.6 (1.8) | 42.0 (2.1)[4,5] |
| % of TE | 13.5 (0.2) | 12.4 (0.4)[2] | 11.1 (0.3)[2,3] | 13.5 (0.2) | 12.4 (0.4)[3] | 11.1 (0.3)[2,3] |
| % of FDE | 13.5 (0.2) | 13.2 (0.4) | 13.4 (0.3) | 13.5 (0.2) | 13.2 (0.4) | 13.4 (0.3) |
| Carbohydrate (g) | 285.1 (4.6) | 274.4 (11.1) | 315.5 (13.3)[4,5] | 283.1 (4.4) | 278.7 (10.7) | 316.1 (12.9)[4,5] |
| % of TE | 48.9 (0.4) | 46.7 (0.9)[2] | 39.6 (0.8)[2,1] | 48.9 (0.4) | 46.6 (0.9)[4] | 39.6 (0.8)[2,3] |
| % of FDE | 49.0 (0.4) | 49.7 (0.9) | 47.9 (0.9) | 49.1 (0.4) | 49.7 (0.9) | 47.9 (0.9) |
| Protein (g) | 102.6 (2.3) | 95.0 (3.3) | 117.5 (5.2)[2,3] | 101.9 (2.2) | 96.4 (3.4) | 117.7 (5.3)[2,3] |
| % of TE | 17.4 (0.2) | 16.4 (0.4)[4] | 14.6 (0.3)[2,3] | 17.5 (0.2) | 16.4 (0.4)[2] | 14.6 (0.3)[2,3] |
| % of FDE | 17.5 (0.2) | 17.5 (0.5) | 17.8 (0.4) | 17.5 (0.2) | 17.5 (0.5) | 17.8 (0.4) |
| Alcohol (g) | 1.4 | 18.6[2] | 78.7[2,3] | 1.4 | 18.8[2] | 78.8[2,3] |
| % of TE | 0.3 | 6.1[2] | 17.4[2,3] | 0.4 | 6.1[2] | 17.4[2,3] |

Abbreviations: TE, total energy (food & alcohol); FDE, food derived energy (total energy minus energy from alcohol).
[1] Adjusted for age from survey linear regression models.
[2] Significantly different to 0 drinks category p<0.01.
[3] Significantly different to 1-2 drinks category p<0.01.
[4] Significantly different to 0 drinks category p<0.05.
[5] Significantly different to 1-2 drinks category p<0.05.

**Table 9** - Weighted mean 24-hour nutrient and energy intakes by alcohol intake category for females

| | Alcohol intake category (number of drinks) | | | | | |
|---|---|---|---|---|---|---|
| | Unadjusted | | | Age adjusted | | |
| | 0 | 1-2 | ≥3 | 0 | 1-2 | ≥3 |
| Total energy (kJ) | 7327.3 (89.5) | 7866.5 (272.0) | 9904.2 (290.6)[2,3] | 7312.4 (86.7) | 8077.2 (274.6)[2] | 9845.1 (271.1)[2,3] |
| Food derived energy (kJ) | 7288.9 (86.8) | 7374.5 (274.3) | 8006.2 (248.3)[2] | 7274.7 (83.93) | 7575.5 (277.1) | 7949.8 (235.4)[2] |
| Fat (g) | 68.7 (1.2) | 71.1 (3.4) | 75.9 (3.4)[4] | 68.5 (1.1) | 73.0 (3.5) | 75.4 (3.5) |
| % of TE | 33.9 (0.3) | 32.4 (0.7)[4] | 28.5 (1.0)[2,3] | 33.9 (0.3) | 32.5 (0.7)[4] | 28.5 (1.0)[2,3] |
| % of FDE | 34.0 (0.3) | 34.9 (0.7) | 35.0 (1.1) | 34.0 (0.3) | 34.9 (0.7) | 35.0 (1.1) |
| Saturated fat (g) | 27.0 (0.5) | 26.8 (1.4) | 29.4 (1.9) | 26.9 (0.5) | 27.7 (1.5) | 29.2 (1.9) |
| % of TE | 13.2 (0.2) | 12.1 (0.4)[2] | 10.9 (0.5)[2] | 13.2 (0.2) | 12.1 (0.4)[4] | 10.9 (0.5)[2,5] |
| % of FDE | 13.27 (0.16) | 13.02 (0.40) | 13.35 (0.56) | 13.3 (0.2) | 13.1 (0.4) | 13.3 (0.6) |
| Carbohydrate (g) | 211.3 (2.6) | 209.1 (8.4) | 235.3 (12.1)[4] | 210.9 (2.5) | 215.7 (8.4) | 233.5 (11.3)[4] |
| % of TE | 49.6 (0.3) | 45.0 (0.8)[2] | 39.5 (1.1)[2,3] | 49.6 (0.3) | 45.1 (0.8)[2] | 39.7 (1.1)[2,3] |
| % of FDE | 49.8 (0.3) | 48.5 (0.8) | 49.3 (1.3) | 49.8 (0.3) | 48.5 (0.8) | 49.3 (1.3) |
| Protein (g) | 72.9 (1.0) | 74.6 (2.6) | 74.8 (2.9) | 72.8 (1.0) | 75.8 (2.6) | 74.4 (3.0) |
| % of TE | 17.3 (0.2) | 16.4 (0.4)[4] | 13.3 (0.5)[2,3] | 17.3 (0.2) | 16.3 (0.4)[2] | 13.3 (0.4)[2,3] |
| % of FDE | 17.3 (0.2) | 17.78 (0.4) | 16.5 (0.6) | 17.4 (0.2) | 17.6 (0.4) | 16.6 (0.6) |
| Alcohol (g) | 1.3 | 17.0[2] | 65.4[2,3] | 1.3 | 17.3[2] | 65.4[2,3] |
| % of TE | 0.4 | 7.2[2] | 19.5[2,3] | 0.4 | 7.2[2] | 19.5[2,3] |

Abbreviations: TE, total energy (food & alcohol); FDE, food derived energy (total energy minus energy from alcohol)
[1] Adjusted for age from survey linear regression models.
[2] Significantly different to 0 drinks category p<0.01.
[3] Significantly different to 1-2 drinks category p<0.01.
[4] Significantly different to 0 drinks category p<0.05.
[5] Significantly different to 1-2 drinks category p<0.05.

# 6 Discussion and Conclusion

The results of our study showed that the majority of New Zealand adults aged 15 years and over had consumed alcohol in the past year. Māori males were more likely to be heavy drinkers and pacific females were more likely to be non-drinkers than non-Māori males and non-Pacific females, respectively. We also found that a large proportion of 15-17 year olds consumed light to moderate amounts of alcohol on a regular basis, and approximately one in five 18-24 year olds were heavy drinkers. Results from the 24-hour recall showed that increasing alcohol consumption was associated with higher total energy intakes, and males and females who consumed three or more alcoholic drinks during the recall period also had higher food derived energy intakes than those who did not consume alcohol. Additionally, male light to moderate drinkers had lower BMI's whereas male heavy drinkers had higher BMI's, compared with all other habitual drinking categories.

In the current study, 86.9% of New Zealand had consumed alcohol in the past year with a further 7.3% of females and 8.2% of males consuming large amounts on a regular basis (classified as 'heavy drinkers' using ALAC's low-risk alcohol drinking advice). These results are similar to the 2007/08 NZDAUS, which found that 85.2% of New Zealanders were past year drinkers, although the prevalence of weekly heavy drinking was slightly higher (12.6%) (1). The results from the present study also showed that Māori males were significantly more likely to be heavy drinkers compared to non-Māori males (OR 2.51; $p<0.01$). This again, is in line with findings from the 2007/08 NZDAUS, where a higher proportion of Māori consumed a large amount of alcohol on a drinking occasion than non-Māori males (79.7% vs. 64.8%) (1). The 2007/08 NZDAUS also found that Māori women experienced nearly four times more physical and/or sexual assaults, due to another persons alcohol/drug use, compared to non-Māori women (1). Accordingly the National Drug Policy 2007-2012 identified Māori people as a key policy priority group as they suffer disproportionate harms from the effects of drugs and alcohol (68). It has been recognized that a whānau (family) based approach, developed by and for Māori, is the most effective way to go about addressing these disparities (68).

A large proportion of New Zealanders engage in harmful or hazardous drinking (HDD) patterns. The 2006/07 New Zealand Health Survey showed that HDD is present in even younger age groups, with HDD identified in 20.9% of males and 17.3% of females aged 15-17 years, and a high proportion of 18-24 year olds, according to AUDIT test scores (53.6% of males and 31.2% of females) (22). In the present study, we found that 6% of 15-17 year olds, and 19% of 18-24 year olds had a heavy habitual drinking pattern, most likely putting them as an at risk group for HDD. The lower prevalence of potentially harmful drinking in the 2008/09 NZANS is most likely due to NZANS containing four broad alcohol consumption questions, whereas the 2006/07 New Zealand Health Survey used ten more specific alcohol consumption questions from the WHO developed AUDIT questionnaire (21). New Zealand is not alone in having a high prevalence of risky alcohol consumption. According to the Australian 2010 National Drug Strategy Household Survey, 19.4% of Australians aged 16-17 years and 25.7% aged 18-19 years were putting themselves at risk of an alcohol related injury at least monthly and 10% and 28.7% doing so at least weekly (69).

It is of particular concern that 70% of 15-17 year olds in the present study reported consuming light to moderate amounts of alcohol on a regular basis, and 6% reported regular heavy drinking. Emerging research indicates the adolescent brain is especially sensitive to the effects of excessive or prolonged alcohol exposure. In particular, the frontal and temporal lobes which are undergoing final critical periods of development during adolescence (70). These areas of the brain play a crucial role in memory, complex decision making, inhibition of impulse/child like behaviour as well as normal responses to fear (48). Alcohols' toxic effect is known to manifest in these rapidly developing lobes. Consequently, exposure to significant levels of alcohol during early and mid-adolescence is associated with higher rates of common mental health problems such as anxiety and depression later on in life as well as being more likely to develop an alcohol addiction (71,72). Furthermore, teenagers tend to have an altered sleep-wake cycle (delayed sleep onset and rising), which results in increased alertness in the evening and offsets the usually sedating effect of alcohol. It is thought that this may result in a higher likelihood of adolescents engaging in risk taking behaviour, potentially resulting in serious injury (46). This information is particularly relevant to policy makers when setting a minimum age for alcohol purchase (which was dropped from 20 to 18 years in 1999 (1)) and consumption, the latter of which New Zealand does not currently have.

To our knowledge, this is the first study to examine the association between alcohol consumption, macronutrient and energy intakes in New Zealanders diets. We found that New Zealand males and females who drank three or more alcoholic drinks during the 24-hour recall had higher total and food derived energy intakes than those who did not consume any alcohol during this period. The increase in total energy intakes over and above the increase in food energy shows that alcohol had an additive effect on the diet during a drinking occasion, whereas the higher food energy intakes shows that individuals did not compensate for the increased energy from alcohol by consuming less energy from food. The additive effect of alcohol on energy intakes observed in this study is consistent with findings from cross-sectional studies carried out in other countries (1,2,6,8,9,23,43,52).

In the present study, females who drank three or more drinks on any single occasion had higher gram intakes of carbohydrates compared to those who drank no alcohol, and males had higher gram intakes of fat, saturated fat carbohydrates and protein compared to those who drank one-two drinks and no alcohol. However, when each macronutrient was analysed as a percentage of food derived energy, there were no differences across the three alcohol intake categories. Therefore, while the higher food energy intakes could have been due to either increased consumption of energy dense foods (high fat or high sugar) or larger quantities of food being consumed, or both, our results suggest that individuals who drank three or more drinks were eating larger quantities of food, rather than specifically increasing intakes of high fat or high sugar foods. Nevertheless, an analysis of the types and amounts of foods consumed by drinkers and non-drinkers was beyond the scope of this study, and warrants further investigation.

A possible explanation for the higher food energy intakes seen in those who drank three or more drinks on a single drinking occasion could be the appetite-enhancing effect of alcohol. This effect was well demonstrated in a controlled experimental study in which alcoholic preloads of one mega joule were given before a meal and compared to iso-caloric preloads of other macronutrients (4). The alcoholic preload increased energy intakes by around 20% and also led to more grams of food eaten per minute, prolonged meal duration as well as satiation occurring at a later time point (4).

The differences in food derived energy intakes for men between those who consumed three or more drinks on a single drinking occasion versus those who consumed no alcohol was approximately 1390kJ (325cal) which is equivalent to five slices of white bread (medium thickness) or 10 bananas (73). The difference for women in these same categories was approximately 675kJ (162cal) which is equivalent to two and a half slices white bread or just over five bananas (73), half the energy difference seen in men. If an individual were to increase their energy intake by the aforementioned values on a regular basis, without compensatory decreases on non-drinking days (energy imbalance), it would almost certainly lead to weight gain (74). The 2008/09 NZADUS found that 22% of past year drinkers consume alcohol three-six times weekly and 12.6% of these past year drinkers consume a large amount of alcohol on a drinking occasion at least weekly, indicating a large proportion of the population could be affected by the higher food energy intakes. However, it is important to note that we only examined the diets of individuals on a single drinking day compared to other individuals who did not consume alcohol during their 24-hour recall, and we did not examine habitual dietary patterns. Prospective studies with repeated dietary intake data, conducted over longer periods of time are needed to determine if the higher energy intakes associated with drinking alcohol are similar on non-drinking days.

Despite the high energy content of alcohol, and its influence on increasing energy intakes, it is still controversial as to how much of a role alcohol intake plays in weight gain and obesity (3). Epidemiological studies investigating alcohol intake and BMI have shown either a positive (9-11) or null association (6-8) for men and an inverse (5-9) or null association for women (10).

In the current study, BMI according to habitual drinking status was 7% higher for male heavy drinkers and 4% lower for male light to moderate drinkers, compared to all other drinking categories. While this suggests higher alcohol intake may lead to weight gain in men, a major limitation of this analysis was the potential for confounding; for example, male light to moderate drinkers may be generally healthier (more physically active, healthier food choices) than heavy drinkers. A further limitation is the cross sectional study design, which does not allow any conclusions to be drawn about a causal association between alcohol intake and BMI. Misclassification may have occurred due to intentional or unintentional misreporting of alcohol intake (75). We did not find any associations between alcohol intake and BMI for women and it has been suggested that this may due to women indulging less in excessive alcohol consumption (9). Contrary to this, we found similar proportions of men and women were classified as heavy drinkers (**Table 3)**. Clearly more research is needed to determine the extent to which alcohol may influence body weight.

### Strengths and Limitations

Several aspects of our study lend weight to our findings. The 2008/09 NZANS was a nationally representative, cross-sectional survey with a large sample size (n=4,721) and good representation of all age and ethnic groups (67). The overall weighted response rate for this study was 61%, a similar response rate to other population surveys such as Australia the

United Kingdom (76,77) An automated, multiple-pass 24-hour recall was used to collect high quality dietary intake data. There are several advantages of this method of dietary data collection, such as: literacy not required as recall is administered by an interviewer thus can be used on a wide socioeconomic range of the population, relatively quick to administer with a low respondent burden and it is inexpensive (67,78,79). Furthermore, the 24-hour recall is the dietary assessment method of choice for most national nutrition surveys worldwide (e.g. United States; NHANES, United Kingdom; NDNS, Australia; NNS) (67).

Another strength of our study was that a comparison of our prevalence of current drinkers from the habitual questionnaire was nearly identical to the 2007/08 NZADUS (86.1% vs. 85.2%, respectively) (1). This suggests that although the nutrition related health questionnaire in the 2008/09 ANS has not been validated, it appears to have been reliable in determining the correct proportion of New Zealand adult drinkers and non-drinkers. Lastly, we separated abstainers into two separate groups; non-drinkers and former drinkers. Many studies combine these groups into a single non-drinker category, however the characteristics within these categories may differ. For example, we found that Pacific males and females were more likely to be non-drinkers, whereas Māori men and women were more likely to be former drinkers, when compared to the NZEO ethnic group. According to the sick quitter hypothesis, some former drinkers may have stopped consuming alcohol due to an illness and the reaction between alcohol and their prescription drugs (80). Therefore combining former and non-drinkers into one category may not be appropriate due to their different characteristics.

There are also several limitations of our study that must be taken into account when interpreting our results. The 24-hour dietary recall method has some limitations in itself. These include inaccurate reporting of food consumption due to reliance on memory, difficulty estimating portion sizes and social desirability bias (79). In social drinking situations where people are drinking over a long period of time, potentially until intoxicated, recalling how many drinks they consumed and what they ate may be especially problematic. Additionally, unlike Americas national nutrition survey (NHANES), the 2008/09 NZANS did not use the 'forgotten foods lists' of the multiple pass 24-hour recall, which has been shown to pick up additional foods participants may have eaten (81). It has been estimated that this step collects foods that account for approximately 7% of an individuals daily energy intake (82), therefore not including this step may underestimate dietary intakes.

Another limitation was that the 2008/09 NZANS fell short of its target of conducting 10% of interviews on a Saturday and Sunday, corresponding with 24-hour dietary recall data from Friday and Saturday (67). Friday through to Sunday have been identified as days when alcohol is more likely to be consumed as well as increased fat and total energy intakes (83), possibly due to more social occasions/celebrations. The reduced recall rates on these particular days may have lead to less drinkers, and potentially fewer higher-level drinkers, therefore influencing the relationship between macronutrient intakes and volume of alcohol consumed on a single drinking occasion. Another weakness of our study was the potential for habitual alcohol consumption misclassification due to the classification questions not being precisely matched with the current ALAC low risk drinking advice. Future surveys looking at the diet in relation to alcohol consumption in New Zealand would benefit from taking the ALAC guidelines into account as well as including a question on alcohol free days per week to determine how many New Zealand adults follow ALAC's recommendation of two alcohol free days per week (17). Furthermore, incorporating questions from the Alcohol Use Disorders Identification Test (AUDIT) on heavy alcohol consumption would allow better classification of survey participants, particularly regarding binge drinkers.

Lastly, it is important to remember that it is impossible to distinguish habitual drinkers from non-drinkers using a single 24-hour recall, and our results can only be used to interpret cross-sectional associations between dietary intakes on drinking days versus non-drinking days within the New Zealand population. Furthermore, this was a cross sectional study between alcohol and dietary intake which cannot be interpreted as cause and effect.

**Implications for future research**

In light of our finding of increased food energy intakes in drinkers consuming three or more drinks on a single occasion, future research could look into the associations between alcohol consumption and BMI. A long-term cohort study would provide information on how much of an effect alcohol is having on body size, an area that has not been looked at in New Zealand. Future research in the area of alcohol and dietary intake could also investigate associations between alcohol consumption and diet quality in the form of a 'healthy eating index.' This method has been used in the 1999-2000 NHANES data sets (13,14) and may be more advantageous than examining macronutrient intakes alone. Considering that people eat foods as opposed to individual nutrients, recommendations from these scoring systems tend to be more relevant and meaningful. Further research into the timing of increased food intake on drinking days would also be interesting to see if the results align with experimental evidence showing alcohol to increase appetite and amount of food consumed (4).

**Conclusion**

The high prevalence of regular adolescent drinkers may have detrimental short and long-term health effects. This issue was bought to attention last year when New Zealand parliament members debated over splitting the purchasing age of alcohol from bars and restaurants (18y) and alcohol shops and supermarkets (20y), in order to reduce the opportunity for adolescents to purchase large amounts of inexpensive alcoholic drinks for binge-drinking sessions. Although the bill was not passed, the evidence of the detrimental effects of alcohol on the teenage brain cannot be ignored and will eventually need addressing. European countries such as Norway have acknowledged this by having differential purchasing ages for alcohol over a certain ethanol concentration. However, this would not solve the problem of unhealthy drinking in the large number of 18-24 year olds that we observed in our study. Rather, there needs to be an overall change in New Zealand risky drinking culture.

The increases in energy intakes on single drinking occasion that we observed are cause for concern on a population level when considering the growing waistlines of New Zealanders. Targeting drinking days as a public health strategy may help increase people's awareness of how much they are drinking and eating during these occasions. On an individual level, lack of compensation for this additional energy on non-drinking days would place alcohol as another risk factor in the already complex weight gain equation. As well as identifying volumes and frequency of risky drinking behaviour, health practitioners need to be aware that drinking occasions can result in larger quantities of food being consumed, particularly in overweight individuals.

## Application to Dietetic Practice

Dietitians, play an important role in addressing nutritional issues in both a public health and clinical setting. From a public health perspective, dietitians can use our results to encourage the public to cut down their drinking by informing them of the propensity for eating more with heavy drinking, whereas light to moderate drinking does not appear to have the same affect. Television advertisements that elicit an emotional response from the viewer, such as ALAC's "It's not what we are drinking, it's how we are drinking' as well as "Don't bring your mates" are all good examples of how advertising is used to reach a large portion of New Zealanders. Public health campaigns could target the negatives of heavy alcohol consumption combined with a weight gain aspect, as this double hit may have more impact than targeting each aspect alone.

In a clinical setting, dietitians encourage healthy, active lifestyles, which includes appropriate drinking advice. Identification of heavy drinkers is imperative. The 2006/07 New Zealand Health Survey found that less than 10% of people with harmful or hazardous drinking had talked to their primary care provider about their alcohol use, suggesting that the problem is going largely undetected (22). Considering the majority of New Zealanders consume alcohol regularly and may consume large amounts, dietitians should have easy access to alcohol screening tools, such as AUDIT, to help identify patients who are drinking in harmful or hazardous ways and offer them the appropriate support.

In patients identified as heavy drinkers, dietitians should primarily encourage the patient to moderate their alcohol intake. This may involve education on what a standard drink is, as many common drink sizes contain more than 10g of ethanol (for example, a standard restaurant serving of wine is 150ml, which is 1.4 standard drinks of white wine). This will help people to become more aware of how much they are drinking.

ALAC recommend eating whist drinking, however this comes secondary to their primary advice of drinking in moderation. If people are not receptive in cutting down their alcohol intake, dietitians could recommend consuming foods of lower energy densities (E.g. sandwiches, toast, oven chips, pasta or rice dishes and crackers) and drinking water whilst drinking to minimise any increases in food energy intakes during a drinking session, like we found in our study.

The 2008/09 ANS identified 37% of New Zealanders aged 15 years and over as overweight and 29% as obese. Coincidentally, a common reason for vising a dietitian is for weight loss advice. In light of our study showing heavy drinking occurring in certain subpopulations (e.g. 18-24y, Māori males), it appears that weight issues and heavy alcohol use may be encountered simultaneously. Our results also show that these regular heavy drinkers may be at risk of consuming more food energy. If these increased energy intakes are not balanced out on non-drinking days it is a risk factor for weight gain (74). Therefore in weight loss patients who are not willing to lower their alcohol, intake dietitians could focus on the frequency and volumes of alcohol being consumed, as well as eating habits (types and quantities of food) on drinking days compared to non-drinking days. This will allow the dietitian to identify just how counteractive these drinking occasions are to the patients weight loss goals and hopefully encourage the patient to cut down.

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# Appendices

**Appendix A: Habitual alcohol consumption classification of non-drinkers and former drinkers, based on questions 14 & 15 from the nutrition related health questionnaire.**

**SC2_Q14** In your entire life, have you had at least one alcoholic drink, not counting small tastes or sips?

1 Yes
2 No

-1 Did not answer
-2 Not applicable

**SC2_Q15** Have you had a drink containing alcohol in the last 12 months?

1 Yes
2 No

-1 Did not answer
-2 Not applicable

Questions 14 and 15 from the nutrition related health questionnaire in the 2008/08 ANS were used to identify ‘non-drinkers’ and ‘former drinkers’ for habitual alcohol consumption category classification. Non-drinkers were classified as never consuming alcohol in their lifetime (not counting small tastes or sips) where as former drinkers may have consumed alcohol in their lifetime, but they have not consumed alcohol in the 12 months prior to the 2008/09 NZANS.

**Appendix B: Habitual alcohol consumption classification of light/moderate and heavy drinkers, based on questions 16 & 17 from the nutrition related health questionnaire.**

**SC2_Q16** Using Showcard C2.16: How often do you have a drink containing alcohol?

[Interviewer: Don't prompt answer. Wait and code.]

SHOWCARD C2.16

1 Monthly or less
2 Up to 4 times per month
3 Up to 3 times a week
4 4 or more times per week

-1 Did not answer
-2 Not applicable

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**SC2_Q17** Using Showcard C2.17: How many drinks containing alcohol do you have on a typical day when you are drinking?

[Interviewer: Take average and round to nearest whole number if necessary e.g. if respondent says 4 or 5, average is 4.5, round to nearest whole number = 5.]

SHOWCARD C2.17

1 One or two
2 Three or Four
3 Five or Six
4 Seven to Nine
5 Ten or more

-1 Did not answer
-2 Not applicable

| | Question 16 (frequency of drinking) | | | |
|---|---|---|---|---|
| **Question 17 (number of drinks)** | | | | |
| **Women** | **1** | **2** | **3** | **4** |
| **1** | 0.25-0.5 | 1-2 (max) | 2-4 or 3-6 | 4-8+* |
| **2** | 0.75-1 | 3-4 (max) | 6-8 or 9-12* | 12-16+ |
| **3** | 1.25-1.5 | 5-6 (max) | 10-12 or 15-18 | 20-24+ |
| **4** | 1.75-2.25 | 7-9 (max) | 14-18 or 21-27 | 28-36+ |
| **5** | 2.5+ | 10 or more (max) | 20+ or 30+ | 40+ |
| **Men** | | | | |
| **1** | 0.25-0.5 | 1-2 (max) | 2-4 or 3-6 | 4-8+ |
| **2** | 0.75-1 | 3-4 (max) | 6-8 or 9-12 | 12-16+* |
| **3** | 1.25-1.5 | 5-6 (max) | 10-12 or 15-18* | 20-24+ |
| **4** | 1.75-2.25 | 7-9 (max) | 14-18 or 21-27 | 28-36+ |
| **5** | 2.5+ | 10 or more (max) | 20+ or 30+ | 40+ |

Light grey: light/moderate drinkers (≤10 drinks/week for women & ≤15 drinks/week for men)
Dark grey: heavy drinkers (>10 drinks/week for women & >15 drinks/week for men)
*Drinks range per week crossed over ALAC cut off

Questions 16 and 17 from the nutrition related health questionnaire in the 2008/09 ANS were used to identify ‘light to moderate and ‘heavy drinkers’ for habitual alcohol consumption category classification. A ‘range of drinks per week’ was worked out based on combinations of answers to questions 16 and 17. Classification into habitual drinking category was based on ALAC’s ‘low risk drinking advice’, which advises that females consume no more than 10 and males no more than 15 standard drinks per week. Therefore 10 or more standard drinks per week became the cut-off for female light to moderate drinkers and 15 or more standard drinks became the cut-off for male light to moderate drinkers.

Participants who reported drinking “Up to 4 times per month” (Q16) were classified as drinking once or less per week and those who reported drinking “Up to 3 times a week were classified as drinking 2-3 times a week. There were four instances where the classification category was not clear-cut (shown by the asterisks). This was due to the beverage range including the ALAC cut-off. It was decided to opt for the lower classification category (light to moderate) due to the majority of beverage range being below the ALAC cut-off and to avoid overestimating the prevalence of heavy drinkers.

**Appendix C: Cross-sectional studies investigating associations between alcohol, energy and macronutrient intake.**

**Table 10** – Cross-sectional surveys investigating associations between alcohol, energy and macronutrient intakes

| Survey year (ref) | *n (% M)* | Age | Alcohol intake measured by: | Alcohol intake categories | | | | | | | | Associations with increasing alcohol intakes: | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | Energy intake | Macronutrient intake |
| NHANES 1996-2006 (14) | 15871 (52) | 20+ y | QQ | Current drinker: men | <1 drink/d | 1 drink/d | 2 drinks/d | 3 drinks/d | 4 drinks/d | ≥5 drinks/d | | TE intakes increased. | Prot intakes (g) increased for men and women; no associations with fat and CHO. |
| | | | | Current drinker: women | <1 drink/d | 1 drink/d | 2 drinks/d | 3+ drinks/d | | | | | |
| EPIC (France) 1993-95 (54) | 72904 (0) | 40-60 y | FFQ | All women | 0 | >0 - 2 g EtOH/d | >2 - 4 g EtOH/d | >4 - 8 g EtOH/d | >8 - 16 g EtOH/d | >16-32 g EtOH/d | >32 g EtOH/d | TE and FDE intakes increased. | Prot and fat intakes (%FDE) increased; CHO intake (%FDE) decreased. |
| EPIC (Germany) (6) | 24894 (47) | 35-65 y | FFQ | Men and women | 0 | >0 - 4.9 g EtOH/d | 5.0 - 9.9 g EtOH/d | 10 - 19.9 g EtOH/d | 20 - 39.9 g EtOH/d | > 39.9 g EtOH/d | | TE increased for men and women; FDE decreased for women but ns (P=0.07) for men | CHO intakes decreased (g and %FDE); Prot (g) decreased men, no association women; Prot (%FDE) increased men, decreased women; fat (g) no association men, increased women; fat (%FDE) decreased men, increased women. |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MONICA (France) 1995-97 (55) | 1100 (100) | 45-64 y | QQ | All men | 0 | 1-19 g EtOH/d | 20-39 g EtOH/d | 40-59 g EtOH/d | > 59 g EtOH/d | | TE increased, FDE decreased (p<0.001) | CHO intake decreased (g and %FDE); fat (%FDE) increased. No associations with Prot |
| EPIC (10 European countries) 1992-2000 (9) | 36034 (36) | 35-74 y | 24-hr recall | Men | 0 | 1-12g EtOH/d | 12.1-24g EtOH/d | >24g EtOH/d | | | FDE decreased | Fat, prot and CHO (starch) intakes (%FDE) increased |
| | | | | Women | 0 | 1-12g EtOH/d | >12g EtOH/d | | | | FDE increased | Fat and Prot intakes (%FDE) increased, CHO (starch) (%FDE) decreased |
| Centre of Preventative Medicine of Dijon (France) (58) | 157 (100) | 20-60 y | QQ | All men | 0 | 0.1-39g EtOH/d | 40-79g EtOH/d | > 79g EtOH/d | | | No change in TE intakes or FDE | CHO intake (% total energy) decreased but ns as %FDE, no associations fat or prot |
| HANES I (1971-1974) (8) | 10428 (41) | 18-74 y | QQ | Men and women | <0.03g EtOH/day | 0.03-5.9g EtOH/d | 6g-24g/day | >24g EtOH/day | | | TE increased and FDE intakes decreased | CHO intakes (g) decreased, prot intakes (g) higher for men and women, prot intakes higher for men (g) |

Abbreviations: QQ, quantitative questionnaire; FFQ, food frequency questionnaire; CHO, carbohydrate; Prot, protein; EtOH, ethanol (pure alcohol)
Drink/day refers to alcoholic beverage per day, EtOH/d refers to ethanol per day; TE, total energy is energy from food and alcohol, FDE, food derived energy is food energy minus energy from alcohol.