THE UNIVERSITY OF NEW SOUTH WALES

The effects of Alcohol on BMI in Australia

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1. Introduction

This term paper examines a contributing cause of obesity at the individual level – alcohol consumption. This will be the first to use Australian data and provide evidence of how Australia's drinking may have detrimental effects to body weight. However, there is ambiguous evidence about the effects of alcohol and there are suggestions it actually contributes to good health and reduction in weight when consumed in small or moderate quantities (Breslow and Smothers [2005]). This term paper will use two different econometric methods.

Obesity is a rising significant problem all over the world. In particular, Australia ranks first amongst the OECD countries in 2008 at 26% overtaking America at 25%[1]. This rate has more than doubled since 1995 when obesity levels were only 11%[2]. It also represents an increasing financial burden on hospitals. Not only is obesity a major problem in Australia, alcohol consumption also represents a significant issue in society. Australia drinks 9.9 litres per capita in 2007 where 40% drank weekly and 8% drank daily[3]. This is high compared to world standards.

Therefore, this term paper will seek to address the relationship of alcohol on BMI and answer the following hypothesis; (1) higher alcohol frequency and intensity consumption will increase BMI, (2) where this effect will be more significant in women than men. (3) It will also be more prevalent amongst older people because they generally have lower metabolisms, (4) fourth, this relationship is non-linear. BMI will decrease for small or moderate consumption and rise for large alcohol intake. Lastly (5), an extension to literature is to determine whether environmental/genetic factors measured by socioeconomic status play a cause.

The results are robust and demonstrate that, (1) the higher number of drinks consumed per session leads to a person's heavier weight. (2) Second, it also shows alcohol frequency displays a small non-linear relationship. Drinking once or twice a week will cause a weight

[1] Melbourne's Baker IDI Heart and Diabetes Institute (http://www.upi.com/Science_News/2008/06/20/Australia-now-fattest-country-study-says/UPI-23231213998709/)

[2] Australian Bureau of Statistics. National Health Survey 2004-05: Summary of results. ABS cat.no. 4364.0. Canberra:ABS

[3] Australian Institute of Health and Welfare (AIHW) 2008, *2007 National Drug Strategy Household Survey: Detailed findings,* Drug Statistics Series No.20, Canberra: AIHW

reduction, where conversely drinking everyday will lead to a weight gain. (3) Third, there is some evidence to suggest the marginal effect of alcohol on BMI is greater for men than women. (4), (5) Finally, there is no strong proof to advocate that age or sociol-economic status has marginally different effects. The differences could be the result of variances in BMI or different alcohol consumption between the groups.

2. Literature Review

There are literature that explores the phenomenon of alcohol consumption and body weight. Firstly, it is well known alcohol is a high calories drink.

Table 1

Alcohol	Serve size (ml)	Calories per serve	Alcohol (grams)
Normal Beer (5%)	375	135	18.8
Light Beer (2.2%)	375	94	8.3
White wine (dry)	200	135	18.3
Red wine	200	133	18.3
Spirits	30	60	12

Table 1 displays the calories involved in typical drinks. It can be seen clearly they contain large amounts of calories. Combined with lifestyle habits such as watching rugby on a Sunday afternoon eating chips, a BBQ, or sitting around in a bar drinking alcohol can potentially have compounded negative effects on health. Further, alcohol stimulates metabolism, which can induce eating. Therefore, higher alcohol consumption should be directly related to higher BMI. French et al (2009) modelled this phenomenon but they did not control for important food and exercise variables in their studies. Literature suggests that food intake is correlated with both alcohol and BMI, therefore an interaction term can be added for robustness.

Secondly, alcohol directly affects people of different genders and age. This is primarily due to dissimilar biological builds. Ramchandani et al (2000) explain that female bodies contain more lipids and lower amounts of water and thus the same amount of alcohol consumed per unit body weight results in higher alcohol level in women compared to men. Also, Wilsnack et al (2000) found that men consume more alcohol and are more likely to engage in risky behaviour. These results were found using medical clinical experiments and my term paper will try to address using economic techniques whether this relationship is observed in the general population. French et al (2009) used economic techniques and they found a quantitatively small but marginally statistically significant effect for men. The effects for women were even quantitatively smaller and statistically insignificant. They used the first-difference approach to control for all fixed effects. Whilst it seems appropriate and a good method, a critical limitation is the model does not address the issue of reverse causality and measurement errors. Therefore, because of biological and economic reasons, this term paper will separate the estimates between men and women.

French et al (2009) also suggested the effects of alcohol consumption on body weight are different at various stages of life. They separated estimates between three groups; 18-25, 26-50 and 50+ and found counter-intuitively the effects of alcohol on BMI were more prominent amongst the young age group. It appears that estimating these groups are very ad-hoc and would represent a crude approximation. It is more likely, the reduction in metabolism is a gradual process that declines with every increasing age. However, for simplicity, this term paper will focus estimating the age groups.

Further, there are extensive literature that suggests alcohol consumption may be in fact non-linear. Low to moderate consumption is associated with good health, regulates body functions and Breslow and Smothers (2005) suggested it even lowers body weight. Their results contrasted with French et al (2009) who found the effects were only slightly non-linear, the effects too small for it to be plausible. Breslow and Smothers (2005) used a simple pooled cross-sectional technique between years 1997-2001. However, this technique is simple and it is very likely their results are biased due to unobserved factors. My term paper will discuss possibilities for an instrumental variable and incorporate a first-difference model to control for time-invariant effects. At higher levels of alcohol consumption, de Castro (2000) found it is more likely more food will be consumed.

An extension to literature is to suggest that lower social-economic status leads to higher BMI with alcohol consumption. Oers et al (1999) suggests that lower socio-economic status leads to lower health outcomes and more health problems. They found there are usually more excessive drinking and alcohol problems amongst the lower education groups. Whilst it is a difficult issue to identify the casual relationship that lower education leads to more alcohol problems and lower health outcomes, medical research suggests genes play a crucial role in determining alcohol consumption, metabolism and tolerance. Therefore, this term paper would hopefully capture certain gene characteristics amongst lower social-economic status.

3. Empirical Methods

This term paper estimates a cross-section OLS model and the first-difference to predict the effects of alcohol on BMI.

3.1 Cross-section

The cross-sectional model is estimated using an OLS function.

$$BMI_{it} = \alpha + \beta Frequency_{it} + \delta Intensity_{it} + \gamma controls + \mu \qquad (1)$$

where BMI is measured as $\frac{weight\ (kg)}{height^2(m^2)}$ for the i^{th} person in wave 7. Frequency is measured as the number of drinking days in a week, Intensity is measured as the number of standard drinks per episode and μ is the error term.

The cross-sectional model is advantages because it is easy to calculate, and interpret. However, there are limitations associated with this model.

3.11 Limitations

The major limitation is that it is very likely the unobserved error term is correlated with alcohol consumption. For example, an alcohol dependency disorder may result in loss of appetite, or specific dieting behaviour may self-restrict certain quantities of alcohol and food consumption. There is large heterogeneity between people's personalities, habits and values that are hard to control for. The direction of this bias is difficult to determine. Alcohol consumption can be correlated with the error both ways. One method of controlling for omitted variables is the use of instrumental variables.

3.12 Instrumental variables

It is often difficult to find reliable measures of instrumental variables. The conditions are it must be correlated with alcohol but not directly affect BMI. One potential instrumental variable that could be validly used is *alcohol consumption of parents*. Kalervo (1968) and Swan et al (1990) found a strong genetic link and this medical theory is now well established. Children often acquire habits from their parents, so therefore parent's alcohol consumption would be a good proxy for the child's genetic and environmental factors. Intuitively, it would seem likely the variables are strongly correlated.

Also, this instrument would not directly affect the BMI. Intuitively, it would not make sense the parent's alcohol consumption would have anything to do with the child's weight. Therefore, this instrument could be considered reliable and valid.

However, due to data limitations, and time constraints, this term paper will not use instrumental variables. Never-the-less, it would be interesting for future studies.

3.2 First-Difference

There is enough data[4] for two waves to be available in HILDA, so it would seem appropriate or an idea to use the first-difference model.

$$\Delta BMI_i = \alpha + \beta\Delta Frequency_i + \delta\Delta Intensity_i + \gamma\Delta controls + \Delta\mu \qquad (2)$$

where Δ indicates the change in waves 6 to 7. ΔBMI_i indicates the change in BMI between the two waves, whilst the frequency and intensity would specify the change in alcohol consumption in the number of days/week. A key advantage in this model is it controls for time-invariant unobserved variables. For example, individual characteristics such as personalities are removed and controlled for. Therefore, $\Delta\mu$ would now only consist for time-variant errors and produce more consistent results. Finally, the limitations of the first-difference model will be discussed in section 5.21.

[4] BMI data only exists for wave 6 and 7

4. Data

This term paper uses data obtained from HILDA[5] waves 6 and 7. It is appropriate to use this data set because it is one of Australia's largest surveys, and it provides very comprehensive information at the individual level on BMI, alcohol, food, exercise and other control variables. Only two waves are appropriate to use because derived BMI data are unavailable in other years. Wave 6 was administered in 2006 and wave 7 was administered in 2007.

4.1 Variable construction

One measure of weight is the BMI. Whilst it is controversial whether this is the best method to determine a person's body fat or general health, it is the most widely used measure and most previous research have relied on the BMI. HILDA only provides BMI data as a measure of weight and health.

4.11 BMI

The BMI is calculated as $\frac{weight\ (kg)}{height^2(m^2)}$ using self-reported height and weight measures in the surveys. An obvious limitation is self-reported data may be biased. In particular, Spencer et al (2002) found that height was overestimated by a mean of 1.23 cm in men and 0.60 cm in women, and weight was underestimated by a mean of 1.85kg in men and 1.40 kg in women. This suggests the data would represent some downward bias.

4.12 Alcohol

There are two measures of alcohol consumption used in this term paper, Intensity and Frequency. Intensity is measured as the number of standard drinks in a session. Frequency is measured as the number of days alcohol is consumed in a week. The HILDA survey is designed so the respondent chooses an answer from a series of multiple choices.

[5] The Household, Income and Labour Dynamics in Australia (HILDA) Survey

Table 2 - Alcohol consumption questionnaire and conversion

	Intensity		Frequency	
Categories	Standard drinks usually per day	Conversion	Do you drink alcohol?	Conversion: Days/Week
1	1 to 2	1.5	I have never drunk alcohol	0
2	3 to 4	3.5	I no longer drink	0
3	5 to 6	5.5	Yes, I drink everyday	7
4	7 to 8	7.5	Yes, I drink alcohol 5 or 6 days per week	5.5
5	9 to 10	9.5	Yes, I drink alcohol 3 or 4 days per week	3.5
6	11 to 12	11.5	Yes, I drink alcohol 1 or 2 days per week	1.5
7	13 or more	13	Yes, I drink alcohol 2 or 3 days per month	0.5
8			Yes, but only rarely	0.25

Table 2 displays the question and multiple choice categories survey respondents had to answer. Intensity had 7 response categories and frequency had 8. A limitation with HILDA's survey design is that 1 or 2 drinks is in the same category. Therefore, this term paper converts the data given by the survey and takes the mid-point in each category. For example, 1 or 2 drinks is converted to 1.5 drinks. Further, *13 or more drinks* is converted to 13. Whilst, this is not entirely accurate, it is very rare that people drink 13 or more and thus would not significantly affect the results. The intuition is the same for the *frequency* category *"yes, but only rarely".* This category was converted to alcohol consumption once a month (thus 0.25 a week).

4.13 Control variables

To test the relationship between alcohol consumption and BMI, a number of control variables are implemented. In particular, the basic social-economic and demographical information are used. Further, other important control variables are used such as food consumption, and exercise. See table 4 for the list of controls.

4.2 Descriptive statistics

Table 3 - Descriptive Statistics

	Men				Women			
	Wave 6 (2006)		Wave 7 (2007)		Wave 6 (2006)		Wave 7 (2007)	
Variables	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
BMI	26.61	4.64	26.81	5.24	25.92	5.63	26.11	6.16
Alcohol Consumption:								
Intensity: Average number of drinks per session	3.86	2.81	3.81	2.76	2.67	2.01	2.66	1.96
Frequency: Number of drinks per week	1.87	1.80	1.93	1.81	1.41	1.66	1.43	1.69

Sample size: 4055 men and 4163 females

Table 3 shows the descriptive statistics for BMI and alcohol consumption variables between men and women, and split between wave 6 (2006) and wave 7 (2007). Consistent with literature and health statistics, men's BMI increased 0.75% from 26.61 to 26.81, and females BMI increased 0.73% from 25.92 to 26.11. Alcohol consumption is also consistent. Men drinks more alcohol per session on average and more frequently.

Appendix table 7 shows that younger people (18-25) generally drink 5.05 alcohol standard drinks per session compared to older people (50+) who on average consume 2.44 drinks per session. Conversely, descriptive statistics suggests that the older population enjoy more drinking frequency per week.

Also, appendix table 8 shows that people of lower social-economic status generally drink more alcohol per session but less frequently per week.

5. Results

This section will firstly present the results for the cross-sectional OLS, and secondly the first difference model to determine the consumption of alcohol on BMI.

5.1 OLS Cross-section

Table 3 displays the results for the cross-sectional OLS. The first column displays the quadratic form to test hypothesis (4), that the relationship of alcohol consumption to BMI is non-linear. It is hypothesised, that a weight reduction exists for small and moderate consumption of alcohol, and an increase for larger consumption.

Table 3: OLS cross-section regression displaying alcohol consumption

Variables [1]	Quadratic		Linear	
	Men	Women	Men	Women
Intensity: Average number of drinks per session	0.1616	0.2200	0.1488***	0.1116**
	(0.1058)	(0.1607)	(0.0390)	(0.0510)
Quadratic Intensity	-0.0008	-0.0047		
	(0.0077)	(0.0142)		
Frequency: Number of drinks per week	-0.1767	-0.7486***	-0.0739**	-0.3386***
	(0.171)	(0.1940)	(0.0418)	(0.0478)
Quadratic Frequency	0.019	0.0845**		
	(0.0313)	(0.0359)		

*Significant at the 10% level. **Significant at the 5%. ***Significant at the 1%
1: Regression include **control variables**; ***Demographic***: Household income, Number of persons in household, SF-36 mental health, Age, Age², socio-economic disadvantage, highest education level achieved, marital status, current employment status, smokes cigarette. ***Food:*** Cake, snack, bread, fish, legumes, pasta, poultry, meat, vegetables (servings per week). ***Exercise***: How often participate in physical activity a week?
2: The standard errors are heteroskedasticity corrected.
3. Results are robust without outliers measuring BMI greater than 50 (more than 4 standard deviations)

The results for men are not statistically significant and demonstrate there is only a small weight loss for consuming alcohol up to 3 days a week (frequency) with weight increasing every additional alcohol consuming day. On the other hand, women experience larger reductions in weight when consuming alcohol few times a week and the results show it is statistically significant. Intensity measured by the average number of drinks per session suggests a positive, linear and statistically significant relationship (linear regression).

The results are economically small. For example, a man drinking 5 times a session 2 days a week increases his BMI by approximately 0.59. For an average male of 175 cm, this translates to 1.80 kg.

The counter-intuitive sign on the frequency coefficient is surprising but consistent with French et al (2009). The results suggest that drinking 1 or 2 times a week in small quantities may not be detrimental to a person's weight.

5.11 Control variables

Most control variables have their a-priori expected signs. However, food variables; cake and snack suggest that higher consumption leads to lower weight. This unintuitive sign may not have a straight forward interpretation and it is likely to suffer from reverse causality. For example, people who eat more cake will get heavier. On the other hand, people who are heavy may try to reduce weight by eating less cake. None-the-less, these food variables are not the focus of this term paper.

5.12 Age groups

Regressions were also run to test the hypothesis that older people (50+) generally have lower metabolism and therefore the same amount of alcohol will increase their BMI more than the younger group (18-25).

Table 5: BMI in different age categories

Variables	Young (18-25)		Middle-age (26-50)		Old(50+)	
	Men	Women	Men	Women	Men	Women
Intensity:	0.4073*	0.2006	0.0934	0.4827**	-0.0567	-0.1745
Average number of drinks per session	(0.2412)	(0.2598)	(0.1536)	(0.2346)	(0.2239)	(0.6515)
Quadratic Intensity	-0.0198	-0.0041	0.0080	-0.0242	0.0255	0.0238
	(0.0160)	(0.0215)	(0.0121)	(0.0222)	(0.0222)	(0.0929)
Frequency:	-0.8291*	0.0960	-0.2434	-0.9594***	-0.0286	-0.7065
Number of drinks per week	(0.4310)	(0.5413)	(0.2225)	(0.2489)	(0.3294)	(0.4443)
Quadratic Frequency	0.1537*	0.0404	0.0454	0.1294***	-0.0248	0.0595
	(0.0845)	(0.1007)	(0.0405)	(0.0445)	(0.0605)	(0.0788)

*Significant at the 10% level. **Significant at the 5%. ***Significant at the 1%
1: Regression includes **control variables**.
2: The standard errors are heteroskedasticity corrected.

The results demonstrate the coefficients are larger for men compared to women. The results also find counter-intuitively that young people have the largest coefficient, and are statistically significant. This finding is similar to French et al (2009). They assert a reason why their coefficient is large may be due to higher consumption amongst younger adults.

For females, the results are particularly significant and the coefficient is larger for the middle-age group. However, they are roughly economically similar across all age groups and genders, and therefore, the results contradict the hypothesis. Age most likely does not play an important role for BMI in alcohol consumption.

5.13 Social-Economic Status

The results for dividing social-economic status between low (1-3), middle (4-6) and high (7-10) yield similar results to age. The hypothesis that lower social-economic status may suffer from greater effects from alcohol contradicts. The results are shown in appendix table 9.

5.14 Robustness

For robustness, the regression was run without outliers. The largest value of BMI in the sample was 165. The category for morbidly obese is greater than 40. Whilst, it may seem remotely possible there is such a person, it is more likely an error. Therefore, for robustness, every person who had a BMI of greater than 50 was removed. This represents more than 4 standard deviations away from the mean, and subsequently 30 people were removed. The results in table 4 show that it is robust. Economically, the effects of alcohol appear to be slightly stronger in men and weaker in women. However, the results do not affect the statistical significance or the coefficient signs.

Table 4: Cross-section OLS without outliers

Variables	Men	Women	Variables	Men	Women
Alcohol consumption:			***Food: (consumption per week)***		
Intensity: Average number of drinks per session	0.2115**	0.1231	Cake	-0.0899***	-0.0750**
	(0.0858)	(0.1351)		(0.0257)	(0.0328)
Quadratic Intensity	-0.0064	0.0025	Snack	-0.0071	-0.0928
	(0.0068)	(0.0129)		(0.0373)	(0.0494)
			bread	-0.0126	0.0262
Frequency: Number of drinks per week	-0.2244	-0.7704***		(0.0189)	(0.0236)
	(0.1415)	(0.1631)	pasta	-0.1621***	-0.1613***
Quadratic Frequency	0.0230	0.0897***		(0.0346)	(0.0427)
	(0.0248)	(0.0295)	poultry	0.1281***	0.1867***
Controls				(0.0461)	(0.0526)
Demographic:			meat	0.1658***	0.1481***
Household income	0.1196	0.0628		(0.0346)	(0.0466)
	(0.2024)	(0.2587)	vegetables	0.0759	-0.0113
Number of persons in household	0.0100	-0.0477		(0.0572)	(0.0653)
	(0.0543)	(0.0712)	***Exercise:***		
SF-36 mental health	0.0034	-0.0065	Physical activity per week?	-0.1842***	-0.3079***
	(0.0048)	(0.0054)		(0.0305)	(0.0374)
Age	0.3353***	0.3507***			
	(0.0250)	(0.0270)	**Constant**	21.2208***	21.9718***
Age(square)	-0.0031***	-0.0033***		(0.9258)	(1.0546)
	(0.0003)	(0.0003)			
Socio-Economic	-0.0749***	-0.2414***			
	(0.0251)	(0.0299)			
Highest education achieved	-0.1205***	-0.0663			
	(0.0412)	(0.0470)			
Marital Status	0.4339**	0.0983			
	(0.1828)	(0.1952)			
Employment Status	0.0975	-0.3678***			
	(0.2075)	(0.2027)			
Cigarettes	-1.2324***	-0.8152***			
	(0.1785)	(0.2267)			

*Significant at the 10% level. **Significant at the 5%. ***Significant at the 1%
1: The standard errors are heteroskedasticity corrected.

5.2 First difference

The model was also estimated using the first-difference technique. French et al (2009) assert this technique is superior (*under certain conditions*) as it controls for time-varying variables.

Table 6 - First difference regression results

Variables	Quadratic		Linear	
	Men	**Women**	**Men**	**Women**
Intensity: Average number of drinks per session	-0.0411	-0.0463	-0.0065	-0.0611*
	(0.0630)	(0.0878)	(0.0232)	(0.0356)
Quadratic Intensity	0.0028	-0.0012		
	(0.0048)	(0.0077)		
Frequency: Number of drinks per week	0.0425	-0.0886	0.0410	-0.0027
	(0.1038)	(0.1243)	(0.0277)	(0.0369)
Quadratic Frequency	-0.0002	0.0157		
	(0.0173)	(0.0217)		

*Significant at the 10% level. **Significant at the 5%. ***Significant at the 1%

1: Regression include **control variables; *Demographic***: Household income, Number of persons in household, SF-36 mental health, Age, Age², socio-economic disadvantage, highest education level achieved, marital status, current employment status, smokes cigarette.

2: The standard errors are heteroskedasticity corrected.

The first difference model was estimated using equation 2. Unfortunately, wave 6 lacks many control variables used for the OLS cross-section and thus food and exercise variables were omitted from this analysis. None-the-less, the results suggest that only age and the constant are statistically significant and quantitatively meaningful. In contradiction to the OLS cross-sectional model, the coefficient of drinking intensity is now negative and drinking frequency displays a positive coefficient for men but negative coefficient for women.

The results suggest the OLS cross-sectional model is superior to the first-difference in this situation and analysis. The first-difference model is not statistically significant and the signs are unintuitive.

5.21 Limitations

The key problem the first-difference model exhibit is that key explanatory variables do not vary much over the two years. The survey was taken in 2006 (wave 6) and subsequently in

2007 (wave 7). Therefore, it is very likely, the model did not capture many changes. In fact, BMI increased less than 1% and it is likely alcohol consuming habits, demographic circumstances remained relatively stable.

Another major problem is it is likely subject to considerable measurement errors. In fact, BMI and alcohol consumption are self-reported. Spencer et al (2002) found a downward biased estimate for self-reported BMI. On the other hand, this bias does not occur in self reported alcohol consumption. Friesema et al (2004) found the reliability and validity to be reasonably high. Therefore, it is safe to use self-reported alcohol consumption. However, HILDA designs a survey that allows respondents to choose an answer from a category rather than a discrete value. This could lead to series measurement errors. For example, the *number of drinks per week* category lists 1 or 2. For the purpose of this term paper, that category was converted to 1.5. However, if the real response for many people was 1, an upward bias would exist.

This could potentially lead to serious sizable biasness and the regression would be less effective than OLS (Woolbridge [2009]). To correct for this error, an instrumental variable is suggested. However, given the problems with credible and reliable instruments and the challenges associated, this term paper does not test the possibility.

Finally, a further limitation is the potential for reverse causality. What is expected is a person increasing their alcohol consumption will lead to a higher BMI. However, it is also plausible that a person with a high BMI will drink more alcohol for good health.

6. Discussion

This term paper found a number of results. Firstly, there is evidence to suggest the higher number of drinks per session, the heavier a person's weight confirming hypothesis (1). Whilst this effect is statistically significant, it is economically small. Conversely, it also shows the more frequent you drink in a week, the less you weigh.

Secondly (2), there is also some evidence to suggest that alcohol frequency displays a non-linear relationship, where if you consume alcohol once a week, the results demonstrate a person gets lighter. However, if a person consume alcohol daily, it is likely a person will instead gain weight. This relationship is only statistically significant in women. This could provide empirical evidence for literature such as Marmot and Brunner (1991) who found benefits in drinking alcohol moderately. However, alcohol stimulates metabolism which can stimulate eating. Therefore, BMI could be affected by higher food consumption as a result of alcohol, or conversely a health conscience person may balance their calorie needs by *reducing* food intake. Therefore, a person who frequently drinks alcohol during a week may be doing so for good health, and thus their healthy lifestyle may reflect this. This could explain the negative alcohol frequency coefficient. However, it is difficult to determine and interpret the regression clearly the reasons for this decline.

Thirdly (3), it appears the marginal effect of alcohol on BMI is greater for men than women. The linear regression in table 5 suggests the coefficients are larger for men, and also women loose more weight with increasing alcohol frequency consumption. This could be the result of biological differences and/or alcoholic beverage preferences. For example, men are more likely to drink beer whilst women may prefer spirits. Table 1 shows that beer contains more calories per serve than spirits. Therefore, this could partially explain why men are heavier drinking the same number of alcoholic beverages (measured by standard drinks).

Fourth (4), it was also hypothesised that older people would gain more weight due to metabolism. However, it was found the results were largely insignificant, and the effect of alcohol was strongest for the young category. Once again, this most likely reflects beverage preferences where the young category is more likely to drink beer. The older population may prefer to drink spirits such as scotch or whisky. Also, descriptive statistics show the younger group drink more alcohol than the others.

The last hypothesis (5) suggests the effects of alcohol should be greater amongst lower social-economic status. The results were generally insignificant, and the effects were strongest amongst the middle class. However, in general the coefficients are economically small, and statistically insignificant suggesting that alcohol has no effect on BMI.

Finally, French et al (2009) found meaningful results using the first-difference method. The results in this term paper present a model that is statistically and quantitatively insignificant. A major problem arises from the lack of variation in the data. However, even if there were enough variation, the results are still likely to suffer from serious biasness as a result of measurement errors. A cross-sectional pooled OLS would seem more appropriate provided unobserved individual heterogeneity is controlled for and this could be very difficult. One way to control for omitted variable bias is by using instrumental variables. The challenges of finding a valid and reliable instrument have been discussed in section 3.12. Therefore, the cross-sectional pooled OLS does not come without challenges.

7. Conclusion

In conclusion, the results show a quantitatively small yet statistically significant relationship between alcohol consumption and BMI. However, the independent variables such as food and exercise suggest they are all quantitatively similar in magnitude. This implies weight gain is explained by multiple life style issues and not a specific single problem. Therefore, research into this area would be fruitful. Also, results could be more reliable if specific data separating the type of alcoholic beverage (beer, spirit, wine) were available. Finally, to address the omitted variable problem, finding reliable and valid instruments would be beneficial.

The results provide evidence that alcohol play a small contributory role in weight gain. The obesity epidemic is still increasing at an alarming rate in Australia, and the government should focus on a variety of policy issues targeting exercise, diet, and healthy living. Governments should also continue to spend resources in educating the dangers of alcohol consumption, such as drink driving, violence and also stipulate that alcohol *does* in a small way contribute to the Australian *beer gut*.

8. Appendix

Appendix Table 7a - Descriptive Statistics for 18-25 years old

	Men		Women	
	Wave 7		Wave 7	
Variables	**Mean**	**SD**	**Mean**	**SD**
BMI	24.68	4.24	24.25	5.60
Alcohol Consumption:				
Intensity: Average number of drinks per session	5.89	3.56	4.21	2.74
Frequency: Number of drinks per week	1.65	1.41	1.11	1.24

Appendix Table 7b - Descriptive Statistics for 26-50 years old

	Men		Women	
	Wave 7		Wave 7	
Variables	**Mean**	**SD**	**Mean**	**SD**
BMI	27.18	4.74	26.32	5.97
Alcohol Consumption:				
Intensity: Average number of drinks per session	3.68	2.52	2.57	1.79
Frequency: Number of drinks per week	2.06	1.82	1.51	1.71

Appendix Table 7c - Descriptive Statistics for 51+ years old

	Men		Women	
	Wave 7		Wave 7	
Variables	**Mean**	**SD**	**Mean**	**SD**
BMI	27.52	5.83	27.1	6.54
Alcohol Consumption:				
Intensity: Average number of drinks per session	2.96	1.98	1.92	0.98
Frequency: Number of drinks per week	2.01	1.96	1.58	1.89

Appendix Table 8a - Descriptive Statistics social-economic status 1-3

	Men		Women	
	Wave 7		Wave 7	
Variables	**Mean**	**SD**	**Mean**	**SD**
BMI	27.27	6.66	27.30	7.37
Alcohol Consumption:				
Intensity: Average number of drinks per session	4	2.92	2.86	2.20
Frequency: Number of drinks per week	1.68	1.76	1.12	1.53

Appendix Table 8b - Descriptive Statistics social-economic status 4-6

	Men		Women	
	Wave 7		Wave 7	
Variables	**Mean**	**SD**	**Mean**	**SD**
BMI	27.00	4.81	26.49	5.88
Alcohol Consumption:				
Intensity: Average number of drinks per session	3.95	2.88	2.65	1.96
Frequency: Number of drinks per week	1.91	1.79	1.36	1.63

Appendix Table 8c - Descriptive Statistics social-economic status 7-10

	Men		Women	
	Wave 7		Wave 7	
Variables	**Mean**	**SD**	**Mean**	**SD**
BMI	26.69	17.02	25.14	5.32
Alcohol Consumption:				
Intensity: Average number of drinks per session	3.58	2.57	2.56	1.82
Frequency: Number of drinks per week	2.1	1.85	1.67	1.79

Appendix Table 9 - Results for Social-Economics status

	Low(1-3)		Middle (4-6)		High (7-10)	
Variables	**Men**	**Women**	**Men**	**Women**	**Men**	**Women**
Intensity: Average number of drinks per session	0.0111	0.3742	0.4117**	0.3812	0.0796	-0.1506
	(0.2577)	(0.3427)	(0.1670)	(0.2657)	(0.1527)	(0.2422)
Quadratic Intensity	0.0116	-0.0229	-0.0172	-0.0210	0.0018	0.0392
	(0.0180)	(0.0267)	(0.0129)	(0.0231)	(0.0107)	(0.0250)
Frequency: Number of drinks per week	-0.1440	-0.8221	-0.2051	-0.9343***	-0.1122	-0.5214**
	(0.4602)	(0.4767)	(0.2896)	(0.3292)	(0.2038)	(0.2445)
Quadratic Frequency	-0.0156	0.0494	0.0084	0.1277**	0.0308	0.0535
	(0.0883)	(0.0947)	(0.0508)	(0.0598)	(0.0381)	(0.0439)

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