

## EPIDEMIOLOGY

### The Effect of Alcohol Consumption on Later Obesity in Early Adulthood — A Population-based Longitudinal Study

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**Abstract** — **Aims:** The study aimed to determine whether alcohol use during late adolescence contributes to the weight gain from adolescence to young adulthood or risk of obesity or waist circumference at young adulthood. **Methods:** A population-based, longitudinal study of 5563 Finnish twins born in 1975–1979 and surveyed at ages 16 (T1), 17 (T2), 18 (T3) and 23–27 (T4) years. Drinking habits, height and weight were self-reported at T1, T2, T3 and T4; waist circumference was self-measured at T4. As potential confounders, we used smoking, diet, physical activity, place of residence, socio-economic status and parents' body mass index (BMI). **Results:** Compared to the reference group (drinking once to twice per month), the BMI increase from T3 to T4 was less among abstaining men ( $-0.62 \text{ kg/m}^2$ , (95% CI  $-1.04, -0.20$ )) and among women in those drinking less than monthly ( $-0.38 \text{ kg/m}^2$ , ( $-0.71, -0.04$ )). In women, at least weekly drinking was associated with larger waist circumference (Beta 1.55 cm, (0.48, 2.61)), but this became statistically non-significant after adjusting for potential confounders. In a multilevel model for change, drinking frequency was not associated with weight change in women; in men, a negative association was seen, but it was statistically non-significant after adjusting for potential confounders. **Conclusions:** These results from a population-based study with a large set of confounding variables suggest that alcohol use during adolescence has at most a minor effect on weight gain or development of abdominal obesity from adolescence to young adulthood.

## INTRODUCTION

A steep rise in obesity prevalence is seen in the transition from late adolescence to early adulthood (Pietiläinen et al., 2008). However, the factors contributing to this alarming phenomenon are not well characterized, though physical inactivity (Pietiläinen et al., 2008) and smoking (Saarni et al., 2009) are shown to predict future obesity, in particular abdominal obesity by early adulthood. Alcohol is one such potential factor that may account for the increase in obesity in young adults. It is also an important source of energy, and it is known to affect food intake (Westerterp-Plantenga and Verwegen, 1999) and reduce lipid oxidation thus favoring the fat accumulation in adipose tissue, especially in visceral fat deposits (Lukasiewicz et al., 2005; Suter, 2005). However, its effect on body weight remains controversial in several cross-sectional and longitudinal studies reviewed by Suter (2005). The existing literature about the effect of alcohol consumption on body weight is inconsistent and does not permit definitive conclusions about alcohol–weight relationship. The subjects of these studies are mostly middle-aged or older, and accordingly, the results cannot be generalized to adolescents and young adults. Alcohol drinking habits, as well as other health habits, are established typically during adolescence, and drinking habits overall are quite stable over time to early adulthood (Pape and Hammer, 1996).

Knowledge of the possible effects of alcohol drinking during adolescence on later body weight is currently sparse. Two of the existing longitudinal studies suggest an association between adolescent heavy drinking and later overweight, obesity and cardiovascular morbidity (Fan et al., 2008; Oesterle et al., 2004). However, a third longitudinal study reported an association between adolescent regular

drinking and adult abdominal obesity only among girls, and this association became statistically non-significant after adjusting for current body mass index (BMI) (Laitinen et al., 2004). In an Australian study, a positive cross-sectional association between drinking and body weight at age 18 was found in boys but not in girls (Burke et al., 2001). On the other hand, among Greek adolescents such an association was seen between current alcohol intake and overweight but not abdominal obesity, only among girls but not boys (Tzotzas et al., 2008).

In this longitudinal study, we used a population-based sample to examine the effect of four repeated measures of alcohol intake at late adolescence (ages 16–18 years) on BMI and waist circumference in young adulthood. We also included a large set of possible confounding factors known to be associated with alcohol use, weight gain or both.

## MATERIALS AND METHODS

### Subjects

The data used are from FinnTwin16, a population-based, longitudinal study of five consecutive and complete birth cohorts of Finnish twins born in 1975–1979 and their parents. The twins were surveyed at the ages of 16 (T1), 17 (T2), 18 (T3) and 23–27 (T4) years. The baseline data were collected through mailed questionnaires within 60 days of the twins' 16th birthday and consists of 5563 responses, 2881 girls and 2682 boys. The response rates were high on all occasions (83–97%). A total of 2161 (80%) of the males and 2595 (90%) of females who responded to the baseline survey responded also to the last survey at age 23–27 during 2000–2002 (Kaprio, 2006).

Subjects with known illnesses (diabetes mellitus, SLE, inflammatory bowel diseases, celiac disease, hyper- or hypothyroidism, malignancies, mental disability and mobility disorders) or ongoing medication affecting weight ( $n = 192$ ) (insulin, thyroxin, antipsychotic medication, per oral corticosteroids, anticonvulsants having weight gain as a common side effect) were excluded from the analyses. Our final data included 2648 females and 2613 males.

## MEASURES

### *Alcohol use*

*Drinking frequency.* In the T1–T4 questionnaires, the subjects were asked to report their frequency of alcohol usage in nine possible categories (never, once per year or less, three to four times per year, about once per couple of months, about once per month, twice per month, once per week, twice per week and daily). Because there were very few subjects in the most frequent categories, their responses were re-categorized into four groups: never, less than monthly, once or twice per month and weekly/daily. In the multilevel model, we used the same nine drinking frequency classes that were used in the questionnaire forms.

*Binge drinking.* The surveys at T1 to T3 also included a question on the frequency of binge drinking, i.e. being really drunk, with four possible response categories (never, less than monthly, about one to two times a month and weekly or more often). The binge drinking response categories were used unchanged in our analyses.

### *Anthropometric measures*

Height and weight were self-reported at T1, T2, T3 and T4 years and used to compute BMI ( $\text{kg}/\text{m}^2$ ). The waist circumference was self-measured using the tape measure supplied with the questionnaire. Waist circumference was assessed only in the T4 survey. The comparability of self-reported and measured data was ascertained in 566 twins participating in another study including height, weight and waist circumference measurements. The measurements took place on average 663 days after the completion of the T4 questionnaire. The intraclass correlation for height was 0.99, for BMI was 0.94 and for waist circumference was 0.73 (Saarni *et al.*, 2009).

The parents' heights and weights at age 20 were recalled during T1 for calculation of their BMI in young adulthood to enhance correspondence to the BMIs of their children as young adults. The subjects were categorized as normal weight, overweight or obese at T1–T2 based on age-specific criteria using the zanthro function for Stata (Cole *et al.*, 2000; Vidmar *et al.*, 2004) based on exact age for under 18-year-old subjects. The cut-points defined based on UK data were used (Cole *et al.*, 2000). For over 18-year-old subjects, the BMI cut offs  $<25 \text{ kg}/\text{m}^2$  were used for normal weight,  $25\text{--}29.99 \text{ kg}/\text{m}^2$  for overweight and  $\geq 30 \text{ kg}/\text{m}^2$  for obesity (WHO, 2000).

### *Confounding factors*

*Smoking.* Smoking is known to be associated with alcohol use (Fisher *et al.*, 2007) and later overweight and abdominal obesity (Saarni *et al.*, 2009). Subjects were divided into four groups based on questions at T1–T3. Those who reported be-

ing never smokers at all waves were considered never smokers. Those who reported having quit smoking in each survey to which they responded were classified as quitters. Those who reported daily smoking every time they responded were considered daily smokers. All others were categorized as changers.

*Diet.* Breakfast skipping has been found to be associated with other potentially unhealthy dietary habits (Keski-Rahkonen *et al.*, 2003). Types of milk and spread on bread have been shown to be good indicators of saturated fat intake (Cole *et al.*, 2000). The use of sugar sweetened and possibly even artificially sweetened soft drinks has been shown to be associated with weight gain and obesity (Allison and Mattes, 2009; Malik *et al.*, 2006; Swithers and Davidson, 2008). To adjust for dietary habits, data on the frequency of breakfast eating, type of milk used (never, skimmed, 1% fat, low-fat or whole milk), table spread (nothing, margarine, butter, butter-vegetable fat mixture or light butter) and cola soft drinks (one-third-liter bottles per day) from the T1 survey were used. Breakfast eating was assessed at T1 in three possible response categories: every morning, about three to four mornings per week and once per week or less often.

*Physical activity.* Leisure time physical activity was assessed in the T1–T3 surveys. The subjects were asked to report their frequency of leisure time physical activity excluding school physical education in seven categories: never, less than monthly, one to two times per month, once per week, two to three times per week, four to five times per week and daily. Those who reported exercising four to five times per week or more in all three questionnaires formed the 'exerciser' group, those exercising one to two times a month or less were categorized as 'passive', and the remainder comprised the 'intermediate' group as described in detail and validated earlier (Aarnio *et al.*, 2002).

*Socio-economic status.* Parental socio-economic status was determined based on questions concerning occupation, employment and education. If both parents participated, paternal SES was used in the analysis, while for single parent families, the SES of the respondent parent (generally mother) was used. Socio-economic status was classified into six categories (upper and lower white-collar work, skilled and unskilled workers, farmers and other) following the criteria of the Finnish Classification of Socio-economic Groups of Statistics Finland (1989).

*Place of residence.* Place of residence was determined as urban or rural based on information obtained from the Association of Finnish local and regional authorities. Residence urbanization is shown to have effect on adolescent alcohol use (Lintonen *et al.*, 2000b).

### *Statistical analyses*

We hypothesized adolescent alcohol intake to increase body weight and risk of overweight and possibly also affect waist circumference in adulthood. To examine our study question as fully as possible, we used several outcome variables (mean BMI, change in BMI, waist circumference and becoming overweight or obese) and also two different measures of alcohol use: drinking frequency and binge drinking.

In regression models, drinking frequency and binge drinking at T3 were used as baseline because alcohol use is illegal under the age of 18 in Finland, and therefore, we found the

Table 1. Descriptive statistics at T3 and follow-up (T4 — young adults) characteristics according to drinking frequency at T3 (age 18.5 years)

Characteristics	Drinking frequency at T3			
	Never	Less than once/month	1–2 times a month	At least once/week
<i>Men</i>				
Subjects (number)	208	363	895	904
Mean BMI at T3 (95% CI)	21.6 (21.3–22.0)	21.8 (21.5–22.1)	21.9 (21.7–22.0)	21.9 (21.7–22.1)
Percent obese at T3	2	2.2	0.4	0.8
Percent overweight at T3	9.4	11	9.5	6.3
Mean BMI at T4	23.3 (22.8–23.8)	23.9 (23.5–24.3)	23.9 (23.7–24.1)	23.9 (23.7–24.2)
Percent obese at T4	3.6	5.7	3.6	4.1
Percent overweight at T4	22	29	29	29
Mean $\Delta$ BMI from T3 to T4	1.5 (1.2–1.9)	2.2 (1.9–2.4)	2.0 (1.9–2.1)	2.1 (1.9–2.2)
Mean waist circumference at T4	83.8 (82.3–85.2)	85.2 (84.0–86.3)	85.3 (84.6–85.9)	85.4 (84.7–86.1)
<i>Women</i>				
Subjects (number)	208	462	1148	739
Mean BMI at T3	20.8 (20.5–21.2)	20.9 (20.7–21.2)	20.8 (20.6–21.0)	21.0 (20.80–21.2)
Percent obese at T3	0	1.5	1.3	1.1
Percent overweight at T3	7.2	7.7	6.3	6.5
Mean BMI at T4	22.0 (21.5–22.5)	22.0 (21.7–22.3)	22.2 (22.0–22.4)	22.6 (22.3–22.9)
Percent obese at T4	2.7	2.7	3.8	5.1
Percent overweight at T4	13	13	15	18
Mean $\Delta$ BMI from T3 to T4	1.1 (0.8–1.4)	1.1 (0.9–1.3)	1.4 (1.3–1.6)	1.5 (1.3–1.6)
Mean waist circumference at T4	74.1 (72.6–75.7)	75.1 (74.1–76.0)	74.5 (73.9–75.1)	76.1 (75.3–76.8)

reported alcohol use at T3 to be more reliable. When analyzing the effects of drinking frequency, the largest group (those drinking one to two times a month) was used as reference because the never-drinking group was very small compared to the other groups and because adolescent abstainers are known to differ from alcohol users in the population (Leifman et al., 1995; Winter et al., 2002).

Firstly, we analyzed the effect of drinking frequency at T3 on change in BMI from T3 to T4 and on waist circumference at T4. Their analyses were carried out using linear regression firstly in a robust model, secondly adjusted for dietary habits at T1 (breakfast eating, spread on bread, cola soft drinking), age at T3 and T4, parent's BMI at age 20, smoking at T3, physical activity at T1–T3 and father's socio-economic status, and finally, the model examining waist circumference was adjusted also for the BMI at T4 to explore the body shape. If the effect of alcohol use on waist circumference was seen in the model adjusted for BMI, it would indicate that alcohol might have an effect on abdominal obesity independently of body weight.

Logistic regression models were used to analyze the dichotomised outcomes: risk of becoming overweight or obese from T3 to T4 in respect to drinking frequency at T3. In these models, we included only subjects not previously overweight or obese. These regressions were run in three sets: robust model, model adjusted for BMI at T3 and the fully adjusted model (see Table 2).

The effect of binge drinking was analyzed for waist circumference and risk of becoming overweight or obese, with linear and logistic regression models, respectively.

To further exploit the longitudinal structure of our data, we carried out multilevel models for change (Twisk, 2006) including information on BMI and drinking frequency from four time points (T1, T2, T3 and T4). In this model, drinking frequency was included as a continuous variable using the nine classes from the questionnaires. There was no need to combine the classes into larger ones because treating the

drinking frequency as a continuous variable allows smaller class sizes to be used.

Since gender differences in alcohol consumption and body composition were seen in our sample and are well documented also in literature (Wilsnack et al., 2009), we conducted all statistical analyses for men and women separately. The analyses were corrected for the clustered sampling using the family as primary sampling unit. All statistical calculations were performed using the Stata 9.0 statistics software.

## RESULTS

### *Descriptive statistics*

There were no statistically significant differences in the mean BMI and prevalence of overweight or obesity between different drinking groups in men and women at T3 (Table 1). Smoking was strongly associated with drinking frequency in both women and men; the proportion of current smokers was substantially lower among never drinkers compared to frequent drinkers (17 vs 62% in men, 12 vs 63% in women at T3) (data not shown).

Men who were never drinkers at T3 were leaner than all other men at T4 (Table 1). In women, mean BMI at T4 rose progressively with increasing drinking frequency at T3.

### *Weight gain*

From T3 to T4, the BMI increase was smaller among never-drinking men compared to those drinking once per month (Table 2). Adjusting for potential confounders further strengthened this finding ( $-0.62 \text{ kg/m}^2$  (CI  $-1.04, -0.20$ )). The non-abstinent groups did not differ from the reference category for BMI increase. In women, those drinking less than monthly had smaller BMI increases between T3 and

Table 2. Regression coefficients (95% CI) of  $\Delta$ BMI from T3 to T4 according to drinking frequency at T3

Drinking frequency	Men				Women			
	<i>n</i>	Crude	Adjusted for BMI at T3	Full model <sup>a</sup>	<i>n</i>	Crude	Adjusted for BMI at T3	Full model <sup>a</sup>
Never	208	-0.46 (-0.84, -0.07)	-0.47 (-0.86, -0.08)	-0.62 (-1.04, -0.20)	208	-0.32 (-0.69, 0.06)	-0.31 (-0.69, 0.06)	-0.15 (-0.70, 0.40)
Less than once per month	363	0.16 (-0.14, 0.47)	0.15 (-0.16, 0.46)	0.29 (-0.22, 0.81)	462	-0.35 (-0.60, -0.10)	-0.35 (-0.59, -0.10)	-0.38 (-0.71, -0.04)
1–2 times a month	895	0 (reference)	0 (reference)	0 (reference)	1148	0 (reference)	0 (reference)	0 (reference)
At least once per week	904	0.07 (-0.14, 0.29)	0.07 (-0.14, 0.28)	-0.12 (-0.43, 0.19)	739	0.04 (-0.18, 0.26)	0.05 (-0.17, 0.27)	-0.03 (-0.32, 0.25)

<sup>a</sup>Adjusted for BMI at T3, breakfast eating, table spread usage and cola soft drink drinking at T1, age at T3 and T4, parents' BMIs at age 20, smoking at T3, physical activity at T3, education at T3 and father's socio-economic status.

Table 3. Regression coefficients (95% CI) of waist circumference at T4 according to drinking frequency at T3

Drinking frequency	Men				Women			
	<i>n</i>	Crude	Adjusted for BMI at T4 <sup>a</sup>	Full model <sup>a</sup>	<i>n</i>	Crude	Adjusted for BMI at T4	Full model <sup>a</sup>
Never	208	-1.50 (-3.14, 0.14)	-0.46 (-1.68, 0.76)	-0.42 (-1.71, 0.87)	208	-0.38 (-2.25, 1.49)	0.29 (-0.77, 1.36)	0.12 (-1.59, 1.83)
Less than once per month	363	-0.12 (-1.67, 1.43)	-0.10 (-0.91, 0.70)	-0.39 (-1.50, 0.72)	462	0.57 (-0.55, 1.68)	0.95 (0.22, 1.68)	0.37 (-0.68, 1.42)
1–2 times a month	895	0 (reference)	0 (reference)	0 (reference)	1148	0 (reference)	0 (reference)	0 (reference)
At least once per week	904	0.14 (-0.83, 1.10)	0.01 (-0.59, 0.62)	-0.20 (-1.14, 0.74)	739	1.55 (0.48, 2.61)	0.66 (0.11, 1.22)	0.26 (-0.53, 1.04)

<sup>a</sup>Adjusted for BMI at T3 and T4, breakfast eating, table spread usage and cola soft drink drinking at T1, age at T3 and T4, parents' BMIs at age 20, smoking at T3, physical activity at T1–T3, education at T3 and father's socio-economic status at T3.

T4 compared to those drinking once or twice a month. This difference persisted when potential confounders were added to the model ( $-0.38 \text{ kg/m}^2$ , (CI  $-0.71, -0.04$ )). Binge drinking frequency at T3 was not associated with weight gain between T3 and T4.

In men, there were no interactions between drinking frequency and smoking status on the BMI change between T3 and T4. Among women, an interaction was seen between drinking frequency and smoking status for the BMI change between T3 and T4. Daily smokers had  $1.92 \text{ kg/m}^2$  (CI  $-3.29, -0.56$ ) smaller BMI increase between T3 and T4 than non-smokers in the female never-drinking group. This difference became statistically non-significant after potential confounders were added to the model (data not shown).

There were no interactions between rural or urban residence and drinking frequency on the BMI change between T3 and T4 in men. In rural-living women, the never drinkers had  $0.69 \text{ kg/m}^2$  (CI  $0.23, 1.16$ ) smaller BMI increase than those drinking once to twice per month. The difference became marginally non-significant ( $0.69 \text{ kg/m}^2$ , (CI  $-0.01, 1.38$ )) when potential confounders were added to the model. In urban residents, no differences in BMI change were observed by drinking groups (data not shown).

We also fitted a multilevel model for change that included BMI, drinking frequency as a nine-class variable and age at all time points (T1, T2, T3 and T4). In this model, heavier drinking at T1 was seen to be associated with higher BMI at T1 among men (a rise of one class in drinking frequency was associated with an increase in BMI ( $0.26 \text{ kg/m}^2$ , (CI  $0.16, 0.36$ ))) but not among women. A rise of one class in drinking frequency was also associated with  $0.011 \text{ kg/m}^2$  ( $P < 0.001$ , CI  $-0.017, -0.005$ ) smaller increase in BMI per year among both sexes. In other words, the more often one drank, the less the BMI seemed to rise. However, after adjusting for potential confounders, these associations were no longer statistically significant.

#### *Waist circumference*

In women, waist circumference at T4 correlated positively with drinking frequency before adjusting for BMI at T4 or other confounding factors. Those drinking at least weekly at T3 had  $1.55 \text{ cm}$  (CI  $0.48, 2.61$ ) larger waist circumference at T4 than those drinking once to twice per month, but this difference became statistically non-significant when adjusted for potential confounders. In men, no clear trend was observed (Table 3).

Binge drinking at T3 was not associated with waist circumference at T4 in men or women (data not shown).

#### *Risk for overweight or obesity*

For girls drinking less than monthly at T3, the risk of becoming overweight to T4 was decreased (OR = 0.53,  $P = 0.01$ ) compared to girls drinking once to twice per month in the model adjusted for BMI at T3. Although the finding was statistically marginally significant, it persisted when adjusting for other potential confounders. Among men, no statistically significant differences in the risk of becoming overweight were seen. There was no significant association between drinking frequency and becoming obese (BMI  $\geq 30$ ) during the follow-up period in men or women (data not shown).

Binge drinking frequency at T3 was not associated with risk of becoming obese (BMI  $\geq 30$ ) or overweight (BMI  $\geq 25$ ) in either men or women (data not shown).

## DISCUSSION

In this longitudinal population-based study, adolescent drinking habits were only weakly associated with later body weight and weight gain from adolescence to adulthood. Women drinking less than monthly and abstinent men had a smaller weight gain during the follow-up and also smaller mean BMI at young adulthood (T4) than subjects drinking more often. Among women, weekly alcohol use was associated with greater adult waist circumference. The effect on waist became statistically non-significant after adjusting for confounding factors and was not at all seen among men. Also, the effect sizes were relatively small, approximating for example to a difference of  $2.1 \text{ kg}$  in body weight on a subject of  $1.85 \text{ m}$  in height between abstinent and monthly drinking men. Further, in our more detailed analyses using longitudinal data analyses, the results were ambiguous and mostly statistically insignificant after adjusting for confounding factors.

Our results differ somewhat from the previous studies. The cross-sectional association between BMI or overweight and alcohol drinking reported among Australian (Burke et al., 2001) and Greek (Tzotzas et al., 2008) adolescents was not seen in this study. However, in the Australian study, alcohol drinking data were gathered for only 2 days in the middle of the week, so the assessment ignored weekend drinking, and no detailed information on alcohol measures were given by Tzotzas et al. (2008).

We are aware of only three previous longitudinal studies concerning the association of adolescents' alcohol drinking and weight. The positive association between alcohol use and later obesity reported in the two studies using US samples (Fan et al., 2008; Oesterle et al., 2004) was not seen in our data which can be due to cultural differences. In the study by Fan et al. (2008), the lifetime alcohol use was retrospectively reported in middle-age or later, which is an effective way to gather information throughout the life-span but is subject to recall bias. Further, the subjects used were born before year 1961 and therefore, present different cohorts than in the current study. The other US study population used by Oesterle et al. (2004) was born in the 70s like ours' but was ethnically more diverse and included a substantial proportion of low-income families (Oesterle et al., 2004). As childhood social circumstances are known to predispose to later obesity and overweight (Power et al., 2003), this may have affected their results. Alcohol consumption was measured as self-reported heavy episodic drinking, meaning minimum of five or more alcoholic drinks in a row (Oesterle et al., 2004). Laitinen et al. (2004) found self-reported alcohol use often at age 14 to be associated with later abdominal obesity only before adjusting for BMI and other confounding factors in the model. Our results are in line with this even if our subjects were born  $\sim 10$  years later. Alcohol use among Finnish adolescents increased from late 70s to 90s (Lintonen et al., 2000a). Since then, it has been relatively stable, and therefore, it can be assumed that these results are ap-

plicable to the present situation. Alcohol consumption among Finnish adolescents is currently slightly below the European average (Hibell et al., 2004; Lintonen, 2005), and it is possible that the effect of alcohol on body weight differs according to heavier consumption in other European countries.

The never-drinking males and less than weekly drinking females had a smaller weight gain than the others, but the lack of dose-dependence would suggest that the larger weight gain is not necessarily caused by the energy addition due to alcohol in their diet. It is possible that some of the differences seen in weight gain of groups having different drinking habits are caused by differences in other factors such as eating behavior or physical activity associated with alcohol drinking. The results of the multi-level models and regression models examining the relation of drinking frequencies or binge drinking to weight gain or waist circumference also suggest that the overall association between drinking and body weight is quite weak, or it could be due to instability of the drinking habits in adolescence.

The strengths of this study include the longitudinal design, large sample size, repeated assessments of drinking habits, long follow-up time and large number of possible confounding factors, including parental BMI, taken into account. A possibility to assess dietary habits and amount and type of alcohol beverage more in detail would have further strengthened the study. Using only self-reported data is a certain weakness of our study, but taking into account the large sample size and multiple measures, it would be beyond realistic resources to get all data measured. In future studies, attention should be paid on more careful measurement of these issues (e.g. food frequency questionnaire or food and drinking diaries), though even these suffer from underreporting of total intake, especially among the overweight and obese (Heitmann and Lissner, 1995) or heavy drinkers (Midanik, 1988).

## CONCLUSIONS

These results suggest that alcohol use during adolescence has at most a minor effect on weight gain or development of abdominal obesity from adolescence to young adulthood. Possible effect of alcohol on weight development might be mediated by other habits, such as smoking, eating and physical activity.

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