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Hazardous alcohol users during pregnancy: Psychiatric health and personality traits

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Abstract

Background: We examined alcohol use disorders, psychiatric symptoms and personality traits in women reporting alcohol use during pregnancy.
Methods: In a pilot cohort ($n = 139$), subjects were screened for alcohol use disorders, and assessed for psychopathology, personality traits, and alcohol use during the first trimester. Those reporting consumption exceeding a conservative threshold for harmful use were offered a diagnostic psychiatric interview. The main findings of the pilot study were replicated using a large sample of women in the third trimester ($n = 715$), who were screened for alcohol use disorders, had their consumption during pregnancy assessed, and were assessed for personality traits.
Results: In the pilot cohort, only a minority of women who consumed significant amounts of alcohol during pregnancy fulfilled alcohol dependence criteria, or had scores on the Alcohol Use Disorder Identification Test typically associated with such a diagnosis. Psychiatric morbidity was also unremarkable as assessed by self-reported symptom intensity. The distinguishing feature was high novelty seeking. The results were robustly confirmed in the replication study.
Conclusions: Most women with significant alcohol consumption during pregnancy do not seem to be alcohol dependent. Instead, use during pregnancy may reflect impulsive personality traits, and be correlated with additional risk behaviors.

Keywords: Preganancy; Alcohol; Hazardous use; Fetal alcohol spectrum disorders; Personality; Impulsivity; Novelty seeking

1. Introduction

Substance use during pregnancy is a major preventable risk factor for the offspring. The Swedish antenatal care system is charged with identifying such use, and initiating measures that can prevent undesirable outcomes for both the mother and the child (Larsson et al., 1988). Recent Swedish data cause concern, since they indicate that alcohol consumption during pregnancy is more prevalent than previously recognized (Magnusson et al., 2005; Göransson et al., 2003). The full Fetal Alcohol Syndrome (FAS) is a well recognized, serious, but relatively infrequent outcome of high consumption. It is less well recognized that lower levels of alcohol consumption also increase the risk of adverse pregnancy outcomes. Consumption at or above 1 standard drink (10–12 g) of alcohol/day in early pregnancy is associated with increased risk of spontaneous abortion and still-birth, decreased birth weight, and impairments of postnatal growth and intellectual development (Kesmodel et al., 2002a,b; Little et al., 1986; Mills et al., 1984; Streissguth et al., 1994; Windham et al., 1992). In addition, binge-like consumption has been related to adverse outcomes independent of total average intake (Maier and West, 2001).

Against this background, the more comprehensive term "Fetal Alcohol Spectrum Disorder" (FASD) has recently been suggested to include the various degrees and types of alcohol related injury (Sokol et al., 2003), and has reinforced the need to better understand and address mechanisms that lead to alcohol use during pregnancy. Early detection would presumably allow prevention of fetal alcohol effects, since several studies show that many pregnant women reduce or terminate their alcohol use if they receive adequate information about the harmful effects of alcohol for the child (Chang et al., 1999). It has been repeatedly shown that alcohol use during pregnancy can be identified using self-report screening instruments (Chang, 2001; Bradley et al., 1998). Accordingly, we have recently published

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results of using the Alcohol Use Disorder Identification Test, AUDIT (Saunders et al., 1993) and/or the Time-Line Follow-Back, TLFB (Sobell and Sobell, 1992) at the first visit to the antenatal care clinics (ACC:s). During the first trimester, 15% of pregnant women in Stockholm County consumed alcohol in amounts that have been documented to increase the risk for adverse pregnancy outcomes, and therefore even by the most conservative assessment can be labeled significant (Göransson et al., 2003; Magnusson et al., 2005). Perhaps not surprisingly, alcohol use prior to pregnancy and age were predictors of continued significant use during this period. This likely reflects that alcohol use patterns which in themselves do not have harmful health effects outside the period of pregnancy, over time may become habits that are not easily changed during pregnancy. In this group, detection followed by brief interventions given within the framework of the ACC is likely to be a sufficient intervention.

However, our work also seemed to identify a group of women with a more complex presentation. In this group, significant alcohol use during pregnancy was commonly accompanied by past or present illicit drug use and/or a history of psychiatric complaints. This group is unlikely to be successfully managed within the ACC. An understanding of its characteristics may aid efforts aimed at developing and implementing strategies for appropriate referral and intervention. Female alcohol dependent subjects with co-morbid illicit substance use disorders have been described as having increased frequency of depression, post-traumatic stress disorder (PTSD) and eating disorders. They are also more frequently diagnosed with cluster B personality disorders (Landheim et al., 2003) and a personality pattern characterized by higher impulsivity, non-conformity and anxiety related traits (Hallman et al., 2001).

This study was carried out to address two important questions that remain in need of answers. First, it is commonly assumed that women who consume significant amounts of alcohol during pregnancy have alcohol use disorders. This has recently been questioned by Kesmodel and colleagues, who highlighted the need for data to address this issue (Kesmodel, 2003). Our hypothesis was that this is in fact not the case. Our second hypothesis was that, rather than alcohol use disorders, there would be an over-representation of psychiatric morbidity in the consumer group. Because of the association between alcohol dependence and specific personality traits in women reviewed above, we also assessed measures of personality.

2. Method

2.1. Subjects

The project was carried out in accordance with the Declaration of Helsinki, and approved by the Stockholm South Human Subjects Ethics Committee (288/00; 25/02). All subjects participating in the study gave their informed consent.

The pilot cohort was obtained from a previously described general screening project within the antenatal care system of Stockholm County (Göransson et al., 2006). Briefly, during February–July 2002, women admitted to an ACC in central Stockholm were asked to participate by the regular antenatal care midwife, who also carried out the evaluation. Admission was typically in pregnancy week 10 (range 7–23). In total, of 162 pregnant women offered participation, 139 accepted and were assessed.

For the replication, we looked for opportunities to capture data late in pregnancy, to obtain measures of clinically relevant consumption. Furthermore, we wanted to minimize the possibility that actual consumption and/or its reporting was influenced by the assessment procedures. The replication cohort was therefore obtained by targeting all women in the third trimester (pregnancy week 30 or later) admitted during 6 months (January–June 2006) who signed up for the four session parental education routinely offered at an antenatal clinic in central Stockholm, and attended by the vast majority of pregnant women. During the recruitment period, 950 subjects were offered parental education and 735 signed up. The last session was used for data collection. During the first half of the session, the midwife giving the parental education class gave oral information as approved by the ethics committee, and handed out the questionnaires. These were filled out during the break, and returned at the end of the session. Subjects gave their consent by anonymously returning the forms.

2.2. Pilot cohort

Subject characteristics (age, marital status, number of children, education level and occupation) were obtained using a simple descriptive form previously described (Magnusson et al., 2005). Education level was coded as: 0 = not completed primary school (grade 1–9); 2 = completed primary school; 3 = completed secondary (high-) school, not college-preparatory program; 4 = completed secondary school, college preparatory program; 5: = completed college education. Detailed assessment of actual alcohol consumption during pregnancy, until admission into antenatal care, was obtained using face-to-face TLFB interviews, an extensively validated method that not only provides information on total consumption levels, but also on variation of consumption over time (Savage et al., 2003; Sobell and Sobell, 1992). This method has been successfully field tested in the specific population assessed here in our previous studies (Göransson et al., 2006; Magnusson et al., 2005). TLFB was obtained by asking about daily intake of alcohol, and tracking consumption back day by day through the calendar. The length of the period in TLFB varied depending on the pregnancy week in which the subject came for her first visit. Daily amounts consumed were reported in standard glasses and categories of alcohol (beer, wine, fortified wine and liquor). TLFB simply yields estimates of alcohol consumption in gram EtOH. Based on the data reviewed in Section 1, we set a conservative threshold for significant consumption at 70 g alcohol/week during any two or more weeks or/and consumption of 60 g alcohol on the same occasion (binge), twice or more. These subjects were categorized as "consumption positive". The time-point of confirming pregnancy was a TLFB anchor, and following inspection of TLFB data, we excluded those subjects who only reported consumption prior to that anchor time-point from the consumption positive category.

To screen for alcohol use disorders, AUDIT scores (Saunders et al., 1993) for the year preceding pregnancy were obtained from all subjects as previously described (Göransson et al., 2006). Briefly, scores were obtained as self-report by the regular ACC midwife in conjunction with admission into antenatal care. AUDIT is made up of 10 items in three domains: alcohol consumption, alcohol dependence, and alcohol related problems. Consumption is reported in standard drinks (Babor, 1989), originally defined as containing 12 g ± 10% of absolute alcohol. Definition of a standard drink in the Swedish version has been adjusted to local consumption patterns, and is described on the form as 1 bottle (33 cl) beer in tax class II (3.5% v/v, sold outside of the state monopoly), 1 small (25 cl) beer in tax class III (approximately 5% v/v, sales restricted to monopoly stores), 1 glass of wine or 4 cl of hard liquor. AUDIT does not establish a formal diagnosis of alcohol use disorders, but has been shown to detect these with a good trade off between sensitivity and specificity (Bush et al., 1998; Gache et al., 2005), with scores of 13 or higher being strongly associated with dependence, in particular in women (Gache et al., 2005).

In addition to AUDIT, an attempt was made to formally establish substance use and other psychiatric diagnoses in women with significant alcohol consumption during pregnancy as defined above, using the structured clinical interview for diagnosis (SCID) according to the Diagnostic and Statistical, Manual of Mental Disorders, 4th version (DSM IV) (First et al., 1997).

In order to assess present and recent psychiatric symptoms, the Hopkins Symptom Checklist, revised version, SCL-90R was used (Derogatis, 1992). This is a self-report symptom inventory with 90 questions and nine subscales, designed to estimate recently experienced physical and psychiatric distress.

Table 1
Background data on the study populations

	Pilot cohort			Replication cohort		
	Consumption positive ($n = 24$)	Consumption negative ($n = 114$)	p	Consumption positive ($n = 26$)	Consumption negative ($n = 689$)	p
Age	31.4 ± 0.85	31.2 ± 0.41	0.92	32.9 ± 0.80	31.5 ± 0.14	0.062
Education level	4.65 ± 0.12	4.54 ± 0.09	0.57	4.96 ± 0.12	4.66 ± 0.03	0.054
Married/cohabiting	23/24	104/114	0.45	25/26	669/689	0.78
Unemployed	0/24	1/114	0.64	0/26	6/689	0.63

For age and level of education, data are mean ± S.E.M., and p-values that are given were generated by one-way ANOVA. For marital status and unemployment, data are frequencies, and p-values given were generated by χ^2 test. Codes for educational levels are given in Section 2.

SCL-90 does not establish a formal psychiatric diagnosis, but gives both global and domain specific measures of current psychopathology for which normative population data are available in Sweden, allowing generation of *T*-scores (Fridell et al., 2002).

Personality traits were investigated using Swedish Universities Scales of Personality, SSP, a self-report inventory with extensive normative data in the Swedish population. SSP is a refinement of the Karolinska Scale of Personality. It has 13 subscales with a total number of 91 items. SSP has been evaluated and has been found to be easy to understand and administer, regardless of the patient's age, gender or diagnosis (Gustavsson et al., 2000).

2.3. Replication cohort

Subject characteristics were obtained as for the pilot cohort. Presence of alcohol use disorders was assessed using AUDIT for the year preceding pregnancy as described above.

For a sample of this size, face-to-face TLFB interviews were not feasible. Instead, alcohol use during pregnancy was assessed separately using the quantity/frequency items (Item 1–3, or AUDIT-C) from AUDIT, a subscale that has a reasonable validation to detect significant alcohol use (Bush et al., 1998). Significant alcohol use during pregnancy was conservatively defined as score 2 or higher on item 1 (reported use on 2–4 occasions/month), and/or score 1 or higher on item 2 (3–4 standard drinks per drinking episode), and/or score 1 or higher on item 3 (six standard drinks or more on any occasion). Subjects fulfilling these criteria were categorized as "consumption positive".

Personality traits in the replication sample were assessed using SSP as described above.

2.4. Statistical analysis

Within the pilot cohort, possible differences between consumption positive and negative subjects on SCL-90 *T*-scores were evaluated using one-way ANOVA.

Within each of the cohorts, SSP subscale scores were subjected to factor extraction using the principal components method. In each case, following normalized Varimax rotation, this yielded three factors with eigenvalues >1.0, similar to what has been published previously (see Section 3 for factor structure).

Differences between consumption positive and negative subjects on SSP factor scores were analyzed using one-way ANOVA. In the replication cohort, since there were trend level differences for age and education between the consumption positive and negative groups, these two variables were entered into the analysis as co-variates to assess the independent contribution of consumption status.

3. Results

Descriptive data on the two cohorts, broken down by consumption status are given in Table 1.

3.1. Pilot cohort

Among 162 subjects offered assessment, 139 accepted, yielding a drop-out rate of 14%. Of the 139 subjects assessed, 132 (95%) had continued some alcohol use until admission, but for a majority use was marginal and did not exceed the thresholds defined above, and these were classified as "consumption negative". However, 24/139 subjects (17%) reported significant consumption as defined above ("consumption positive").

Recently experienced physical and psychiatric distress, as measured by the SCL-90R, did not differ between consumption positive and negative subjects. *T*-Scores on the nine SCL-90R subscales and the global severity index, GSI, are shown in Table 2.

Table 2
Normalized *T*-scores for level of distress within categories of psychiatric symptoms, and for the global severity index on the SCL-90R, in subjects with and without significant alcohol consumption during the first trimester of pregnancy, as assessed using face-to-face TLFB interviews (see Section 2)

	Consumption negative ($n = 91$)	Consumption positive ($n = 22$)	p
Somatisation	52.4 ± 1.3	49.4 ± 1.1	0.22
Obsessive–compulsive	48.2 ± 1.0	48.0 ± 1.7	0.87
Interpersonal sensitivity	45.6 ± 0.6	44.6 ± 0.6	0.56
Depression	48.8 ± 0.7	47.0 ± 0.8	0.14
Anxiety	45.2 ± 0.7	43.6 ± 0.8	0.36
Hostility	48.0 ± 0.7	47.1 ± 1.1	0.97
Phobic anxiety	47.7 ± 0.4	47.7 ± 0.7	0.82
Paranoid ideation	45.0 ± 0.5	43.4 ± 0.8	0.60
Psychoticism	46.1 ± 0.4	44.9 ± 0–5	0.06
Global severity index	47.8 ± 0.8	46.4 ± 0.8	0.34

Data are mean ± S.E.M. The p-values given were generated using one-way ANOVA for each of the subscale, and the global severity index, respectively. No differences in current or recent symptoms were detected.

Table 3
Factor analysis of SSP subscale scores with the pilot cohort, yielding a previously described three-factor structure (Neuroticism, Aggressiveness and Extraversion, here termed novelty seeking)

	Factor 1: Neuroticism	Factor 2: Extraversion (Novelty seeking)	Factor 3: Aggressiveness
Somatic trait anxiety	*0.66*	−0.12	0.25
Psychological trait anxiety	*0.83*	0.05	0.30
Stress susceptibility	*0.72*	0.01	0.34
Lack of assertiveness	*0.78*	0.12	−0.12
Impulsiveness	0.13	*0.84*	0.07
Adventure seeking	−0.14	*0.79*	0.07
Detachment	0.36	0.31	0.48
Social desirability	−0.15	0.09	*−0.69*
Embitterment	*0.60*	−0.17	*0.48*
Trait irritability	0.23	−0.33	*0.68*
Mistrust	0.43	0.13	*0.56*
Verbal trait aggressiveness	0.04	−0.18	*0.84*
Physical trait aggressiveness	0.18	0.11	*0.69*

Factor loadings of the 13 SSP subscales on the respective factor are shown. Significant loadings onto the respective factor of are shown in italic. Factor 1, "Neuroticism" is mainly comprised of anxiety subscales. Factor 2, novelty-seeking, receives significant loadings from two subscales, "Impulsivity" and "Adventure seeking". Factor 3, "Aggressiveness", receives loadings from verbal and physical aggressiveness subscales, as well as irritability and mistrust.

Among consumption positive subjects, 5/24 had AUDIT scores for the year preceding pregnancy of 9 or higher, indicative of present abuse or dependence. Among these, only 2 subjects had scores of 13 or higher, i.e. strongly associated with a diagnosis of dependence. SCID interviews were carried out in the 16/24 (67%) consumption positive subjects who accepted to undergo an interview. Among those who did not accept, two did not sign up for antenatal care at all, two had miscarriage and four did not want to participate. In good agreement with the AUDIT data, among subjects in whom a SCID interview was carried out, 6 fulfilled criteria for past or present alcohol abuse (among whom one also fulfilled criteria for central stimulant abuse); and only 2 fulfilled criteria for alcohol dependence.

We next compared personality traits, as assessed by the SSP, between consumption positive and negative subjects. Complete SSP and TLFB data to allow this comparison were available from 21 consumption positive and 92 consumption negative subjects. Subscale scores were subjected to a factor analysis using principal component extraction. Similar to what has been previously reported (Gustavsson et al., 2000), three factors with eigenvalues exceeding 1 were identified. Following standard normalized Varimax rotation, these accounted for 23.6, 12.8 and 24.5% of the variance, respectively. Factor loadings of the 13 subscales on the respective factor are shown in Table 3. Inspection of the factor loadings shows that Factor 1 is mainly comprised of anxiety subscales, and can appropriately be labeled "Neuroticism" in agreement with the previously published analysis of SSP (Gustavsson et al., 2000). Factor 2 receives significant loadings exclusively from two subscales, "Impulsivity" and "Adventure seeking", and corresponds to what has previously been labeled "Extraversion", although a label such as "Novelty seeking" might seem more appropriate, and is used use here. Factor 3 is clearly "Aggressiveness" as previously described.

A one-way ANOVA was carried out for factor scores on the respective factor with group categorization – consumption positive vs. consumption negative – as independent variable. There was no difference between the groups with regard to Neuroticism or Aggressiveness scores (0.15 ± 0.24 versus 0.04 ± 0.10, mean ± S.E.M.; $F[1, 111] = 0.63$, $p = 0.43$; and 0.08 ± 0.20 versus 0.01 ± 0.10, $F[1, 111] = 0.075$, $p = 0.78$, respectively). In contrast, there was a significant difference on the novelty seeking factor, 0.43 ± 0.18 versus 0.07 ± 0.10, $F[1, 111] = 4.4$, $p = 0.01$, with the "consumption positive" group scoring significantly higher on this factor.

3.2. Replication cohort

Out of 735 subjects who received questionnaires, complete data were returned by 715, yielding a drop-out rate of 3%. Among the 715 subjects assessed with SSP, 26 were classified as consumption positive as described in Section 2. Only one of the consumption positive subjects had an AUDIT score of 13 or higher indicating likely alcohol dependence.

SSP subscale *T*-scores for consumption positive and negative subjects, respectively, are shown in Fig. 1 as descriptive profiles. SSP scores were subjected to a factor analysis as described for the initial sample, resulting in a very similar 3-factor solution. Factor scores for the three factors are shown in Fig. 2.

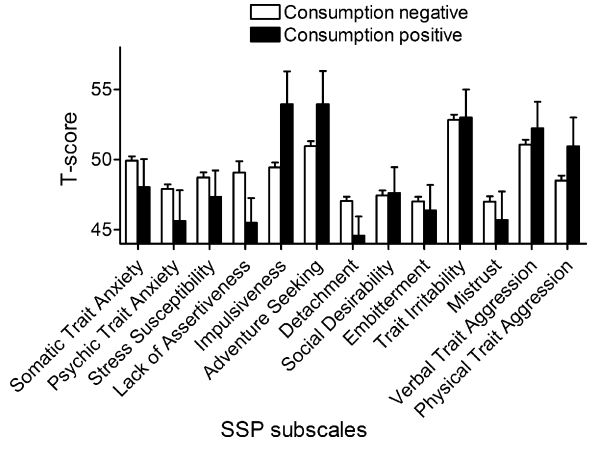

Fig. 1. Descriptive profiles of normalized SSP subscale *T*-scores (mean ± S.E.M.) for subjects in the large replications sample, categorized as consumption positive ($n = 26$) and negative ($n = 689$) in the third trimester of pregnancy.

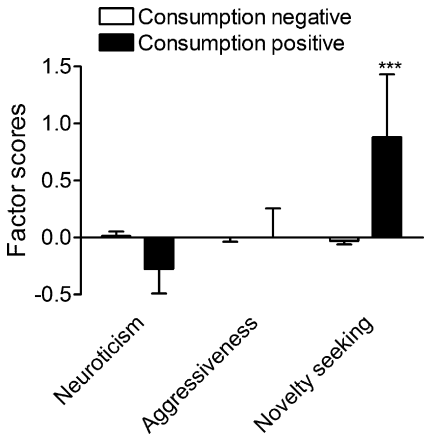

Fig. 2. Factor analysis of the SSP scores shown in Fig. 1 yielded a three factor solution very similar to what has previously been published for this scale, and which was also found for the pilot cohort in this study. Similar to the results in the pilot study (see Section 3), no significant differences were found for Neuroticism or Aggressiveness scores. In contrast, again replicating the finding from the pilot cohort, consumption positive subjects were significantly higher on novelty seeking. Data are mean ± S.E.M.; ***$p < 0.001$. For detailed statistical analysis, see Section 3.

ANOVA on factor scores, with age and education level analyzed as co-variates because of nominally near-significant differences between the groups on these variables, replicated the findings of the initial sample. Thus, no significant differences were found for Neuroticism or Aggressiveness scores ($F[1, 714] = 2.11$, $p = 0.15$, and $F[1, 714] = 0.0$, $p = 1.00$). In contrast, higher Novelty Seeking scores were found in the consumption positive group ($F[1, 714] = 25.9$, $p = 0.0000005$), robustly replicating the finding of the initial sample. Neither age ($p = 0.95$) nor education level ($p = 0.93$) contributed as co-variates.

4. Discussion

We analyzed alcohol use disorders, co-morbid psychiatric symptoms and personality traits in women with self-reported alcohol use during pregnancy at levels which have been shown to increase adverse pregnancy outcomes in epidemiological studies, and therefore even by the most conservative standards must be regarded as significant. It is important to point out that this categorization by no means reflects a position that consumption during pregnancy below these levels can be viewed as acceptable. However, since the relevance of lower consumption levels has been questioned (Armstrong and Abel, 2000; Abel, 1996), we restrict the present analysis to subjects whose consumption should be beyond debate. The pilot study suggested that few women with significant alcohol use during pregnancy had AUDIT scores typically associated with, or fulfilled formal criteria for alcohol dependence. Furthermore, consumption positive subjects did not have psychiatric symptoms at the time of assessment exceeding those of subjects who did not consume significant amounts of alcohol. Instead, the most salient difference between the consumption positive and negative subjects appeared to be at the level of personality traits, where higher novelty seeking was found in the positive group. A low prevalence of alcohol dependence among consumption positive subjects was also found using AUDIT in a larger, independent replication cohort. Most importantly, the main finding of high novelty seeking was confirmed with a high degree of statistical significance in the replication cohort.

The internal validity of these results appears to be good. Two different methods of identifying subjects with significant consumption during pregnancy, TLFB in the pilot study and AUDIT-C in the replication, yielded virtually identical results, both with regard to the low frequency of subjects with alcohol use disorders during the year preceding pregnancy, and with regard to personality traits indicative of increased novelty seeking. Furthermore, potential confounding influence of other subject characteristics seems effectively excluded by the more detailed analysis of the large replication sample. Thus, age and education level, although trend-level different between the groups, did not contribute as co-variates in the analysis, while marital and employment status did not differ between the consumption groups. In the pilot study, consumption data were obtained for the first trimester alcohol consumption, and the issue of "pregnancy awareness" is therefore key to determining the clinical significance of the findings. If the alcohol consumption noted by study participants occurred only very early in the first trimester, before they knew they were pregnant, then implications for FASD would be unclear, and intervention in the prenatal care setting not possible. It is therefore worthwhile to note that in the pilot study, we obtained detailed TLFB assessment of drinking. Confirmation of pregnancy was an anchor point in the TLFB, and this allowed us to exclude the possibility that the alcohol use, which was reported, only referred to consumption before the subjects were aware of being pregnant. Furthermore, the replication study was carried out much later in pregnancy. As expected, the proportion of those consuming significant amounts was lower at that time, indicating that, in many cases, engaging in antenatal care or other processes that evolve after pregnancy is confirmed led to reduction or cessation of consumption. However, the core group who continued significant consumption up to this late stage shared characteristics with those reporting this in early pregnancy, i.e. little if any alcohol use disorders, but (moderately) elevated impulsivity. Finally, in assessing the internal validity of our data, we note that the specificity of elevated novelty seeking in consumption positive subjects is reinforced by the observation that none of the other main personality traits, neuroticism or aggressiveness, contributed significantly to classification of consumption status. Thus, the finding of elevated novelty seeking in consumption positive subjects seems robust.

In considering the external validity of these findings, we note that the principal results were replicated in two different cohorts, independently recruited during two different periods, at different antenatal care clinics within the Stockholm region. Although women in Sweden are allowed free choice of antenatal care clinic, the recruitment site for the pilot cohort mainly has a tradition of serving a defined geographic area, while the site for the replication study serves women from across the entire Stockholm region. It would therefore appear that, at a minimum, our findings can be generalized to women in a metropolitan region such as the greater Stockholm area. Whether generalization beyond this is justified is unclear, since women in other

countries, or outside metropolitan areas, may well have different alcohol use habits both prior to and during pregnancy. Interestingly, Sweden is likely to represent a relatively affluent and well educated population, and the position that alcohol should not be consumed during pregnancy is endorsed here to a higher degree than most other countries. Our data give an indication about the characteristics of women who continue significant but not excessive alcohol use despite this. As has been pointed out (Armstrong and Abel, 2000), in areas when poverty, malnutrition and lack of education are prevalent, the consumption patterns and characteristics may well be very different.

Whether a majority of women who continue to use alcohol during pregnancy are alcohol dependent is an important issue for developing adequate interventions, and has been discussed recently (Kesmodel, 2003). Our data seem to support the notion that in an affluent, well educated population like the one studied here, this is not the case. The implication is that under these conditions, referral to regular addiction medicine providers may typically not be the optimal intervention. A limitation is that in the pilot study, we were unable to carry out structured diagnostic interviews in approximately 30% of our consumption positive subjects. This attrition may well be systematic, such that subjects with more severe alcohol problems were more likely to decline participation. The true prevalence of alcohol dependence may therefore have been somewhat higher than observed. However, this is made less likely by the low number of subjects with AUDIT scores typically associated with alcohol dependence, an observation replicated in the larger, anonymous replication cohort.

In assessing the replication cohort, evaluation of alcohol consumption during pregnancy was simplified, using the quantity/frequency questions from AUDIT (AUDIT-C). It is possible that this method was less sensitive than the face-to-face TLFB interviews used in the smaller pilot study, since a lower proportion of the replication cohort fell in the consumption positive category. However, the numbers are not directly comparable, since the replication cohort was assessed at a later time-point during pregnancy. A more likely interpretation is that many women who report significant alcohol use on admission into antenatal care subsequently reduce their consumption. The consumption positive group detected in the replication study is therefore likely to be a subset of that identified in the pilot. The size of the "late-pregnancy" consumption positive group may appear small, but in fact it constitutes 3.6% of an unselected population of pregnant women in an urban area. Their continued alcohol use at these levels late in pregnancy clearly constitutes a particularly pronounced risk behavior. The public health relevance of identifying and characterizing this group in order to initiate appropriate preventive measures therefore appears indisputable.

The finding of little if any psychiatric morbidity but elevated novelty seeking in this population may provide a valuable insight for the development of interventions. The elevation in measures of this personality trait is moderate and thus, not likely to reflect true psychopathology, fully in agreement with the psychiatric assessment. Instead, it is likely reflective of behavioral patterns within the normal range of variation. This in turn implies the clinically important possibility that simple methods for behavioral modification, if properly tailored, might be sufficient in most of these cases. Being cross-sectional, our study does not address a possible causal link between high novelty seeking and alcohol use. Other data are, however, available in considering the nature of the relationship. Thus, similar personality traits have been reported in women with a fully developed diagnosis of alcohol dependence, in particular those with co-morbid use of illicit drugs (Hallman et al., 2001). Here, in the majority of cases we found increased novelty seeking in the pregnant risk users in the absence of dependence. High novelty seeking is thus, likely to predate the development of alcohol use disorders, and a diagnosis of alcoholism may ultimately only occur in a minority of risk users with these traits. Instead, our results point to the possibility that women who continue to use alcohol during pregnancy may be more prone to engaging in other risk behaviors. In drug using women, personality traits indicative of high novelty seeking have recently been shown to increase the risk for engaging in unprotected sex (Gonzalez et al., 2005), and personality traits have also been discussed as a contributing factor for establishing and staying in destructive relationships (Bergman et al., 1987). It remains to be established whether the increased novelty seeking observed in the socially more highly functioning antenatal population studied here is a marker of other risk behaviors. Determining if that is the case appears clearly worthwhile, as it would allow developing targeted interventions that could reduce risk both for the women involved and their offspring.

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