

T-ACE and predictors of self-reported alcohol use during pregnancy in a large, population-based urban cohort

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Abstract

Aims: To determine 1) the relationship between T-ACE score and maternal self-reported alcohol use prior to and during pregnancy, and 2) the relationship between T-ACE score and maternal demographics, mental health and life circumstances.

Design: Prospective, population-based cohort study.

Setting: Three urban maternity clinics in Calgary, Canada.

Participants: 1,929 pregnant women attended by family physicians at low-risk maternity clinics.

Measures: Women completed three standardized questionnaires over the telephone in the first and third trimesters and eight weeks post-delivery, including the T-ACE and questions about drug and alcohol use, demographics, mental health and life circumstances.

Findings: 43.6% of subjects had a positive T-ACE score at intake (score 2 or greater). A positive T-ACE score was predictive of alcohol use throughout pregnancy, although most women reported no alcohol after the first trimester (93.1%). Multivariate analysis indicated that a positive T-ACE score was significantly associated with being less than 30 years of age; being Caucasian; smoking during pregnancy; having an income of less than \$80,000 per annum; having a history of depression; having a history of alcohol use and binge drinking during a previous pregnancy; lower social support; and poor network orientation.

Conclusions: There was a positive association between the T-ACE score and maternal self-report of alcohol use, poor mental health and poor social support. Routine use of the T-ACE to assess for risk of an alcohol-exposed pregnancy may also help identify women with complex needs who could benefit from additional prenatal support.

Current medical guidelines advise that women who are pregnant or trying to conceive should abstain from alcohol (Butt, Beirness, Gliksman, Paradis, & Stockwell, 2011; Carson et al., 2010; Center of Disease Control and Prevention [CDC], 2005; Stratton, Howe, & Battaglia, 1996). Because the relationship between alcohol and fetal outcomes is not fully understood, no safe level of consumption has been identified (Butt et al., 2011; Carson et al., 2010). The evidence of adverse outcomes due to alcohol-exposed pregnancies ranges from the neurodevelopmental and behavioral problems of fetal alcohol spectrum disorders (FASD) to the more severe problems associated with fetal alcohol syndrome (FAS) (Floyd, O'Connor, Sokol, Bertrand, & Cordero, 2005; Sokol, Delaney-Black, & Nordstrom, 2003). Alcohol use

often co-occurs with other sociodemographic and psychosocial characteristics—such as housing insecurity, child apprehension, and abuse—that have been associated with poor birth and child outcomes (Flynn, Walton, Chermack, Cunningham, & Marcus, 2007; Gavin, Nurius, & Logan-Greene, 2012; Harrison & Sidebottom, 2008; Vettore, Gama, Lamarca, Schilithz, & Leal, 2010). Consequently, there is an opportunity for alcohol screening to identify pregnancies that would benefit from effective interventions and supports.

The prevalence of alcohol use is believed to exceed that identified through self-report or targeted screening. Self-report may identify only 25% of women who drink during

pregnancy, partly because women may be influenced by fears of child apprehension and judgment (Chasnoff, 1989; Chasnoff, Landress, & Barrett, 1990; Chasnoff, Neuman, Thornton, & Callaghan, 2001; Ostrea, 1999). Screening for alcohol use during prenatal visits has been recommended as a key method of identifying women at risk for alcohol-exposed pregnancies, but limited time and lack of referral resources are barriers to screening (Carson et al., 2010; Tough, Clarke, Hicks, & Cook, 2006a).

Screening questionnaires have been developed to aid in the identification of individuals at risk of alcohol dependence or addiction, including the T-ACE, AUDIT, AUDIT-C, CAGE, SMAST, NET and TWEAK (Bradley, Boyd-Wickizer, Powell, & Burman, 1998; Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998; Chang, 2001; Chang et al., 1998; Russell et al., 1994; Sokol, Martier, & Ager, 1989). Many of these screening tools are brief and ask about alcohol use indirectly, to avoid under-reporting due to stigmatization (Russell, 1994). These scales vary in terms of sensitivity and specificity; however, the T-ACE and TWEAK have consistently performed at similar levels and are often recommended together as key screening tools for periconceptional populations (Burns, Gray, & Smith, 2010; Chang, 2001, Russell, 1994, Russell et al., 1994; Sarkar, Einarson, & Koren, 2010). The Society of Obstetricians and Gynaecologists of Canada, as well as the American College of Obstetrics and Gynaecology, recommend both the T-ACE and the TWEAK, and the National Institute of Alcohol Abuse and Alcoholism also recommends use of the T-ACE for the prenatal population (American College of Obstetricians and Gynecologists [ACOG], 2008; Carson et al., 2010; National Institute on Alcohol Abuse and Alcoholism [NIAAA] & National Association of State Alcohol and Drug Abuse Directors, 2006). Recently, the AUDIT-C has demonstrated sensitivity and specificity similar to those of the T-ACE and TWEAK (Burns et al., 2010). The T-ACE was selected for this study because of its well-established reliability, brevity, and simple scoring. It continues to be refined to improve sensitivity and specificity and thus remains a relevant and current tool to consider (Jones, Bailey, & Sokol, 2013).

Although it has been well established that the T-ACE identifies women at risk of harmful drinking patterns during pregnancy, it is unknown to what extent the four-question T-ACE screen would also identify women at elevated risk of poor pregnancy outcomes as a consequence of abuse, food and housing insecurity, poverty, poor mental health and poor social support. The purpose of this analysis was to determine how, or whether, T-ACE score and maternal self-reported alcohol use is associated with some maternal and neonatal characteristics among medically low-risk pregnant Canadian women.

Materials and Methods

This prospective population-based study was conducted between April 2001 and July 2004. It was embedded in a prospective randomized controlled trial of pregnancy

support that enrolled approximately 2,000 women through three low-risk maternity practices in the Calgary Health Region, a large Canadian urban center with approximately 14,000 births per year (Tough, Johnston et al., 2006). Pregnant women who sought care from family physicians at participating clinics were contacted by telephone after booking their first prenatal appointment, invited to participate in a prenatal support intervention study, and mailed consent forms to sign and return if they agreed to participate (Tough, Johnston et al., 2006). Women were informed that participation in this study was independent from receipt of medical care, and information shared with the research team would not be available to their health care provider. Women were excluded from the study if they were under 18, had already attended their first appointment with the prenatal clinic prior to completing the baseline study questionnaire, did not plan to attend the clinic, or could not communicate with study interviewers in one of seven languages (English, French, Cantonese, Mandarin, Punjabi, Urdu, or Arabic dialects). Women who gave informed consent and completed the baseline questionnaire were randomized into three groups with (1) standard prenatal care, (2) additional support and consultation from nurses, or (3) additional support and consultation from nurses and home visitors (Tough, Johnston et al., 2006). Women received newsletters about the study and congratulatory phone calls when their babies arrived, thanking them for their contribution to the study.

All participants completed three standardized questionnaires administered by telephone over the study period, in the first and third trimesters and eight weeks post-delivery. The content was based on input from focus groups, consultations with physicians, nurses, epidemiologists, program developers, and psychologists, and published literature (Tough, Johnston et al., 2006). The questionnaires each took 30 to 40 minutes to complete and included questions about drug and alcohol use, resource utilization, demographics, lifestyle, psychosocial health, network orientation, and history of abuse and neglect. The following standardized, validated tools were included: Kellner Symptom Questionnaire, T-ACE, Rosenberg Self Esteem, McCubbin Social Support Index, Woman Abuse Screening Tool, Edinburgh Postnatal Depression Scale, and Vaux Network Orientation Scale (Brown, Lent, Brett, Sas, & Pederson, 1996; Cox, Holden, & Sagovsky, 1987; Kellner, 1987; McCubbin, Patterson, & Glynn, 2000; Rosenberg, 1989; Vaux, Burda, & Stewart, 1986). Questions were also taken from the Canada National Population Health Survey, Hawaii Healthy Start Program, and Pregnancy Risk Assessment Monitoring System from the U.S. Centers for Disease Control and Prevention. The questionnaires were pilot tested, revised and coded for a Computer Assisted Telephone Interviewing system. Having the questionnaires administered by trained telephone interviewers who were not involved in participants' health care provided confidentiality for participants (Golding & Jones, 2009). This approach reduces potential bias from judgmental interviewer body language (Golding & Jones, 2009), particularly for sensitive questions such as those related to alcohol.

The T-ACE is a four-question screening tool (Table 1). Women who reported no previous alcohol use were assigned a T-ACE tolerance score of 0. Subjects who did not have a valid T-ACE due to missing answers on one or more of the four questions were excluded from this analysis. Women with a score of 2 or more were classified as at risk, and women with a score less than 2 were classified as low risk, according to the established scoring standards at the time of data collection (Sokol et al., 1989). Corresponding values for sensitivity (proportion of women who drink during pregnancy who have a positive screen) of 70 to 88%, and specificity (proportion of women who do not drink during pregnancy who have a negative test) of 79 to 85%, have been reported (Chang, 2001; Chang et al., 1998).

Statistical analyses were conducted in Stata, version 9.0 (StataCorp, 2005). Bivariate analysis was used to determine maternal alcohol and drug use by T-ACE score. Differences between perinatal and maternal characteristics across T-ACE groups were analyzed with Fisher's Exact 2-sided test for categorical variables. Multivariate logistic regression models were developed, with the dependent variable being a T-ACE score of 2 or greater. Independent variables examined were in the domains of maternal characteristics, mental health, lifestyle, psychosocial factors, and drug and alcohol use. Variables were included in the models if they were significantly associated with the outcome at $p < 0.2$ in preliminary regression analysis, and were then removed, in a backwards stepwise fashion, to create a parsimonious model. Adjusted odds ratios and 95% confidence intervals were calculated. In all analyses, $p < .05$ was considered statistically significant.

The study received ethical approval from the Conjoint Medical Bioethics Committee of the University of Calgary and Calgary Health Region.

Results

Recruitment and Completion Rates

Of 2,556 eligible women, 1,929 completed the first two questionnaires and had a valid T-ACE (75.5 % participation rate); follow-up rate was 82.7 % ($n = 1,595$) at eight weeks postpartum. Women who participated but were not retained for follow-up were more likely to be non-Caucasian (24.2% vs. 12.2%, $p = 0.014$), and to have a past history of being unemployed when wanting to work (21.2% vs. 5.9%, $p < 0.001$) and/or of suicidal thoughts or attempts (19.7% vs. 9.8%, $p = 0.027$).

Participant Characteristics

Women had an average age of 29.1 years, were married (91.5%), Caucasian (74.6), had incomes above \$40,000 (74.2%), some post-secondary education (71.6%), and had previously been pregnant (60.7%). Over 37% of women with a positive T-ACE reported income over \$80,000, compared to 30.0% of women with a negative T-ACE score ($p < 0.05$). Those with a positive T-ACE were significantly more likely to be younger, Caucasian, and have a history of

previous abortion (all $p < 0.01$). Women with a negative T-ACE were significantly more likely to own their home and to report previous pregnancy, previous live birth and previous low birth-weight child (all $p < 0.04$) (Table 2).

History of Life Events and Psychosocial Characteristics

The T-ACE identified women with a history of adverse life events and poor psychosocial characteristics, which included abuse, suicidal thoughts or attempts, and parental separation or divorce. Overall, 11% of women reported a history of suicidal thoughts or attempts, and 34.6% of all women in the study reported a history of any abuse, including physical, emotional, sexual, or financial abuse, or abuse by neglect (Table 3). A positive T-ACE score was significantly associated with higher reports of emotional, physical, sexual and other abuse ($p < 0.001$), personal and family history of suicidal thoughts or attempts ($p \leq 0.01$), and family history of violent disagreement ($p = 0.03$). Women with a positive T-ACE were also significantly more likely to report a personal and family history of drug and alcohol abuse, and to report smoking in the current pregnancy (all $p < 0.001$) (Table 3).

Alcohol Use

Overall, 22.3% of women reported that they had consumed some alcohol in their pregnancy, including prior to pregnancy recognition. Using a cut-off of 2 on the T-ACE, 43.6% of subjects had a positive T-ACE score, indicating risk for alcohol misuse. Women with a positive T-ACE were significantly more likely to report alcohol use in a previous pregnancy, binge episodes prior to pregnancy, and higher frequency and volumes of alcohol use in the 12 months before their pregnancy (all $p < 0.001$). However, 93.1% of women with a positive T-ACE report no alcohol consumption by mid-pregnancy, and the majority of consumption was in early pregnancy. Although there were overall low rates of alcohol consumption by mid-pregnancy, a small number of women did continue to use alcohol throughout pregnancy. Women with a positive T-ACE score were more likely to continue consuming alcohol (6.9% at mid-pregnancy and 11.3% in the third trimester) and to report at least one binge-drinking experience in mid-pregnancy (7.1%) and/or in the first 10 weeks postpartum (10.0%) (all $p \leq 0.001$) (Table 4). Women were more likely to report any alcohol consumption in the third trimester than in mid-pregnancy for both the T-ACE positive (11.3% vs. 6.9%) and negative groups (5.7% vs. 2.9%).

Perinatal Events

Women with a positive T-ACE were significantly more likely to report preterm premature rupture of membrane, gestational hypertension, vaginal bleeding, swelling, and feeling blue or depressed (all $p < 0.05$) (Table 5). As well, women with a positive T-ACE were significantly more likely to use an epidural, opiates, or "laughing gas" during labor and delivery (all $p < 0.01$) (Table 5).

Table 1*T-ACE questions*

Item	Question	Scoring
T-tolerance	How many drinks does it take to make you feel high?	A response of greater than 2 drinks = 2 points, with 2 drinks or less = 0
A-annoyed	Have people annoyed you by criticizing your drinking?	Yes = 1 point
C-cut down	Have you felt that you ought to cut down on your drinking?	Yes = 1 point
E-eye opener	Have you ever had a drink first thing in the morning to steady your nerves or get rid of a hangover?	Yes = 1 point

Table 2*Characteristics of women in the study by T-ACE score*

Characteristic	All Subjects	T-ACE*		<i>p</i> value exact
	<i>N</i> = 1929 <i>n</i> (%)	+ve <i>N</i> = 843 <i>n</i> (%)	-ve <i>N</i> = 1086 <i>n</i> (%)	
Maternal age	29.1 <i>sd</i> (4.9)	28.4 <i>sd</i> (5.0)	29.6 <i>sd</i> (4.9)	< 0.001
Maternal age				
18–20	118 (6.1)	72 (8.5)	46 (4.2)	
21–34	1,545 (82.2)	693 (82.2)	892 (82.1)	
35 and over	226 (11.7)	78 (9.3)	148 (13.6)	< 0.001
Previously pregnant				
Yes	1,172 (60.7)	470 (55.9)	702 (64.5)	< 0.001
Previous abortion				
Yes	298 (25.6)	155 (33.3)	143 (20.5)	< 0.001
Previous live birth				
Yes	901 (46.5)	329 (38.9)	572 (52.4)	< 0.001
Previous low birth weight birth				
Yes	59 (6.6)	14 (4.3)	45 (7.9)	0.036
Marital Status				
Single (never married)	138 (7.1)	90 (10.1)	48 (4.4)	< 0.001
Married/Common-law	1,772 (91.5)	743 (87.9)	1,029 (94.3)	
Divorced/Separated	26 (1.3)	12 (1.4)	14 (1.3)	
Caucasian				
Yes	1,445 (74.6)	748 (88.5)	697 (63.8)	< 0.001
Education				
< High school	187 (9.7)	84 (9.9)	103 (9.5)	0.853
High school	362 (18.7)	154 (18.3)	208 (19.1)	
Post-secondary	1,383 (71.6)	606 (71.8)	777 (71.4)	
Homemaker				
Yes	466 (24.1)	134 (15.9)	332 (30.4)	< 0.001
Working > 40 hrs/week during pregnancy				
Yes	212 (16.7)	124 (20.3)	88 (13.3)	0.001
Household income				
< \$40,000	454 (25.8)	169 (21.3)	285 (29.4)	< 0.001
\$40,000–80,000	719 (40.8)	326 (41.1)	393 (40.6)	
> \$80,000	589 (33.4)	298 (37.6)	291 (30.0)	
Smoking not allowed in home				
Yes	1,610 (83.3)	942 (86.5)	668 (79.1)	< 0.001

Characteristic	All Subjects	T-ACE*		p value exact
	N = 1929 n (%)	+ve N = 843 n (%)	-ve N = 1086 n (%)	
T-ACE				
0	1035 (53.4)			
1	57 (2.9)			
2	687 (35.5)			
3	118 (6.1)			
4	38 (2.0)			
5	3 (0.2)			

Table 3

Life events, alcohol use in previous pregnancies, personal and family history of alcohol use and drug and cigarette use of women by T-ACE group

Characteristic	All Subjects	T-ACE*		p value exact
	N = 1929 n (%)	+ve N = 843 n (%)	-ve N = 1,086 n (%)	
History of Abuse and Depression				
Ever emotionally abused				
Yes	505 (26.2)	268 (68.2)	237 (21.8)	< 0.001
Ever physically abused				
Yes	327 (16.9)	179 (21.3)	148 (13.6)	< 0.001
Sexual abuse				
Yes	281 (14.6)	152 (18.1)	129 (11.9)	< 0.001
Ever abused (any type)				
Yes	668 (34.6)	345 (41.0)	323 (29.7)	< 0.001
History of suicidal thoughts or attempt				
Yes	218 (11.3)	115 (13.6)	103 (9.5)	0.006
Family history of suicidal thoughts or attempt				
Yes	760 (39.7)	361 (43.0)	399 (37.1)	0.011
Parents separated				
Yes	608 (31.4)	325 (38.5)	283 (25.9)	< 0.001
Parents had violent arguments				
Yes	255 (13.3)	127 (15.2)	128 (11.8)	0.030
History of Alcohol Problems				
Family Hx of alcohol problems				
Yes	667 (34.5)	351 (41.5)	316 (29.0)	< 0.001
A parent drank or used drugs so much that it caused problems for the family				
Yes	408 (21.1)	218 (25.9)	190 (17.5)	< 0.001
Personal Hx of alcohol problems				
Yes	72 (3.7)	44 (5.2)	28 (2.6)	0.003
Family Hx of drug problems				
Yes	229 (11.8)	129 (15.3)	100 (9.2)	< 0.001
Alcohol in previous pregnancy				
Yes	180 (15.4)	117 (25.0)	63 (9.0)	< 0.001
Drinks per occasion in previous pregnancy	2.7 sd(2.5)	3.1 sd(2.7)	1.8 sd(1.5)	< 0.001
Smoking and Street Drug Use				
Any smoking in previous pregnancy				
Yes	319 (27.2)	188 (40.1)	131 (18.7)	< 0.001
Any street drug use in previous pregnancy				
Yes	52 (4.4)	39 (8.3)	13 (1.9)	< 0.001
Any smoking in 12 months prior to pregnancy				
Yes	1520 (26.8)	336 (39.9)	181 (16.7)	< 0.001

Characteristic	All Subjects	T-ACE*		
	N = 1929 n (%)	+ve N = 843 n (%)	-ve N = 1,086 n (%)	p value exact
Any smoking during 1st trimester of pregnancy				
Yes	427 (24.3)	273 (34.6)	154 (15.9)	< 0.001
Partner smokes				
Not at all	1,387 (73.3)	543 (66.5)	844 (78.6)	< 0.001
Any smoking during 3rd trimester of pregnancy				
Yes	30 (18.9)	185 (27.1)	117 (12.8)	< 0.001
Any street drugs in 12 months prior to pregnancy				
Yes	192 (9.9)	140 (16.6)	52 (4.8)	< 0.001
Any street drugs during first trimester				
Yes	65 (3.4)	56 (6.7)	9 (0.8)	< 0.001
Any street drugs during third trimester				
Yes	8 (0.5)	7 (1.0)	1 (0.1)	0.024
Drug problems in past				
Yes	75 (3.9)	45 (5.3)	30 (2.8)	0.004

* T-ACE score ≥ 2 is positive

Table 4

Alcohol use prior to and during pregnancy of women by T-ACE group

Characteristic	T-ACE*		
	+ve N=843 n (%)	-ve N=1,086 n (%)	p value exact
Binge episodes in 12 mo. prior to pregnancy			
Yes	295 (35.0)	155 (14.3)	< 0.001
Any alcohol in 12 mo. prior to pregnancy			
Yes	843 (100.0)	564 (52.1)	< 0.001
Amount of alcohol per sitting prior to pregnancy	2.73 <i>sd</i> (2.2)	1.84 (1.4)	< 0.001
Frequency of alcohol use prior to pregnancy			
No alcohol	0 (0.0)	522 (47.9)	< 0.001
≤ 1 time/month	386 (35.5)	310 (28.4)	
2 times/month–1/week	363 (43.1)	185 (16.9)	
2–3 times/week	149 (17.7)	68 (6.2)	
4 times/week–daily	46 (5.5)	6 (0.6)	
Drinks per occasion prior to pregnancy			
No alcohol	0 (0.0)	551 (50.7)	< 0.001
< 2 Drink/occasion	246 (29.6)	279 (25.7)	
2–4.9 Drinks/occasion	473 (57.0)	254 (23.4)	
5–9.9 Drinks/occasion	92 (11.1)	17 (1.6)	
≥ 10 Drinks/occasion	19 (2.3)	1 (0.1)	
Alcohol during 1st trimester, including prior to pregnancy recognition			
Yes	287 (33.8)	143 (14.4)	< 0.001
Frequency of alcohol use during 1st trimester of pregnancy			
No alcohol	556 (66.2)	934 (85.6)	< 0.001
≤ 1 time/month	179 (21.3)	114 (10.4)	
2 times/month–1/week	68 (8.1)	38 (3.5)	
2–3 times/week	26 (3.1)	5 (0.5)	
4 times/week–daily	11 (1.3)	0 (0.0)	
Amount of alcohol per sitting in 1st trimester of pregnancy	2.44 <i>sd</i> (1.9)	1.81 <i>sd</i> (1.3)	< 0.001

Characteristic	T-ACE*		p value exact
	+ve N=843 n (%)	-ve N=1,086 n (%)	
Frequency of Alcohol use mid-pregnancy			
No Alcohol	636 (93.1)	886 (97.1)	0.001
≤ 1 time month	47 (6.9)	27 (2.9)	
Any binge episodes mid-pregnancy			
Yes	48 (7.1)	16 (1.1)	< 0.001
Any alcohol during 3rd trimester			
Yes	66 (11.3)	44 (5.7)	< 0.001
Any binge episodes in postpartum period (first 10 weeks)			
Yes	68 (10.0)	17 (1.9)	< 0.001
Health care worker talked to you about alcohol use during pregnancy			
Yes	416 (64.1)	502 (58.7)	0.037
Partner alcohol freq			
No alcohol	78(9.5)	379 (35.3)	
Monthly	156 (19.1)	208 (19.3)	
Weekly	339 (41.5)	320 (29.7)	
Several times/week	222 (26.3)	142 (13.1)	< 0.001
Daily	22 (2.4)	26 (2.7)	

Table 5**Perinatal events, birth outcomes and postnatal events of women by T-ACE group**

Characteristic	T-ACE*		p value exact
	+ve N = 682 n (%)	-ve N = 913 n (%)	
Perinatal Events			
Preterm premature rupture of membranes (water broke 3 weeks before due date)			
Yes	47 (7.5)	30 (3.6)	< 0.001
Gestational hypertension			
Yes	177 (28.1)	180 (21.7)	0.006
Vaginal bleeding during pregnancy			
Yes	94 (14.9)	95 (11.5)	0.050
Eating disorder during pregnancy			
Yes	2 (0.3)	16 (1.9)	0.007
Treated for sexually transmitted infection during pregnancy			
Yes	17 (2.7)	12 (1.4)	0.092
Complained of swelling of hands or feet during pregnancy			
Yes	318 (50.6)	350 (42.2)	0.002
Blue or depressed during pregnancy			
Yes	124 (19.7)	120 (14.5)	0.009
Labor, Delivery and Postpartum Event			
Epidural during labor & delivery			
Yes	409 (63.1)	461 (55.3)	0.002
“Laughing gas” during labor & delivery			
Yes	286 (44.1)	300 (36.0)	0.002
Opiate during labor & delivery			
Yes	219 (33.8)	219 (26.3)	0.002
Birth weight (g)	3376.6 <i>sd</i> (505.9)	3379.7 <i>sd</i> (527.7)	0.909
Preterm delivery (< 37 weeks)			
Term	53 (8.2)	51 (6.0)	0.101
Breastfeeding			
Plans to not breastfeed	31 (4.6)	22 (2.4)	0.062
Planned duration of breastfeeding (weeks)	35.0 <i>sd</i> (31.1)	39.7 <i>sd</i> (27.4)	0.008

Table 6*Adjusted odds ratios for positive T-ACE score by pre-delivery characteristics*

Characteristic	AOR (95% CI)
Maternal Age Group	
30 and over	1.00
25–29	1.43 (1.05–1.94)
18–24	2.55 (1.58–4.09)
Income	
< \$40,000	1.00
\$40,000–\$80,000	1.72 (1.24–2.40)
> \$80,000	2.42 (1.69–3.48)
Non-Caucasian ethnicity	0.35 (0.25–0.48)
Smoked cigarettes during pregnancy	1.49 (1.09–2.05)
Drank in early pregnancy	2.24 (1.43–3.50)
Alcohol use in previous pregnancy	2.18 (1.47–3.24)
Binge episode in previous pregnancy	2.21 (1.70–2.88)
Low social support*	1.51 (1.13–2.04)
Poor network orientation**	1.75 (1.26–2.38)
History of depression	1.31 (1.03–1.56)

CI: confidence interval

AOR: Adjusted odds ratios are adjusted for all other characteristics in the table.

*Bottom 25th percentile on Social Support Index

**Top 25th percentile on Network Orientation Scale: Network orientation measures an individual's unwillingness to maintain, nurture or use those social supports that she has. Women were considered to have negative network orientation if they scored in the top 25 percent of all network orientation scores from this sample, meaning they were unwilling or reluctant to maintain, nurture or use those social supports that they had.

Logistic Regression

The multivariate modeling indicated that a positive T-ACE score was significantly associated with being less than 30 years of age, being Caucasian, and smoking during pregnancy, and with having a higher income, a history of depression, lower social support, poor network orientation (the ability to maintain, nurture, or use social supports), and a history of alcohol use and binge drinking during a previous pregnancy (Table 6).

Discussion

The T-ACE was developed in 1989 to standardize screening for risk drinking, and is more effective than medical record review and informal clinician questions in identifying women at risk for prenatal alcohol use (Chang, 2001; McNamara, Orav, Wilkins-Haug, & Chang, 2005, 2006; Sokol et al., 1989). Using a cut-off of 2 on the T-ACE, 43.6% of women had a positive T-ACE score, which is consistent with prevalences reported in other population-based studies (Alvik, Haldorsen, & Lindemann, 2005; Chang, 2001; McNamara, Orav, Wilkins-Haug, & Chang, 2005). Pregnant women with a positive T-ACE were more likely to report alcohol intake throughout pregnancy, including binge drinking (7.1%).

Although the majority of women cease drinking in pregnancy, up to 11% of women report some alcohol intake

in the third trimester, with the rates higher among T-ACE-positive women compared to T-ACE-negative women (11.3% vs 5.7%). This suggests that some women may experience abstinence fatigue, or may be unaware of the fetal risks associated with consumption in the third trimester, and that health care providers could remind women about the risks of alcohol use at this time. T-ACE-positive women were more likely to report alcohol problems, current alcohol use, alcohol use in previous pregnancies, a family history of alcohol problems, binge drinking, and more alcohol use by their partner. Given these associations, clinicians can be confident that using the T-ACE at routine visits would identify women at risk of alcohol misuse, who could be encouraged to abstain from alcohol when they are trying to become pregnant or when their contraceptive practices are unstable.

Clinicians should be aware that women identified by a positive T-ACE score are also more likely to be vulnerable in other areas that may have an impact on their pregnancy, because a positive T-ACE was associated with smoking, a history of depression, lower social support, and poor network orientation. Poor social support and poor network orientation have been identified as risk factors for suboptimal use of prenatal care, postpartum depression, and failure to breast feed (O'Hara & Swain, 1996; Schaffer & Lia-Hoagberg, 1997; Tarkka, Paunonen, & Laippala, 1998; Xie, He, Koszycki, Walker, & Wen, 2009). Postpartum depression is a risk factor for infant developmental problems, speech and language delay, and marital stress

(Grace, Evindar, & Stewart, 2003; O'Hara & Swain, 1996). As well, women with a positive T-ACE were at higher risk for preterm premature rupture of membranes, gestational hypertension, vaginal bleeding, and swelling during pregnancy. Given the finding that most women reported alcohol abstinence by the middle of their pregnancy, there is a missed opportunity for earlier intervention to address other threats to pregnancy associated with lifestyle, mental health and social support. In addition, attention to preconception health and lifestyle may reduce the risk of pregnancy complication and adverse birth outcomes (Abel, 1997; May & Gossage, 2001). Incorporating the T-ACE into routine practice may provide a fast, efficient way to identify women who would benefit from supplementary support in the prenatal period to optimize pregnancy and early parenting outcomes.

Women with a positive T-ACE were more likely to be under 30 years of age and Caucasian, and to report family income of over \$80,000 per year, indicating that socioeconomic status cannot be assumed as a marker for risk drinking prior to pregnancy, and alcohol use in early pregnancy is not uncommon among a population of medically low-risk Canadian women (Bingham, Shope, & Tang, 2005; Chambers et al., 2005; Ebrahim, Decoufle, & Palakathodi, 2000; Ebrahim, Diekman, Floyd, & Decoufle, 1999; Ebrahim et al., 1998; Ebrahim & Gfroerer, 2003; Phares et al., 2004; Prescott, Neale, Corey, & Kendler, 1997).

This evidence supports use of the T-ACE in routine care to identify women who are at risk for alcohol misuse and concurrently at risk for mental health problems, poor social support, and other lifestyle concerns. Consequently, training efforts should be directed at routine use of this tool for screening and appropriate referral for supports and services (Alberta Medical Association, 1999; Chang et al., 2005). In addition to using the T-ACE to identify women at higher risk, clinicians should be persistent in offering reminders and information on the importance of abstinence throughout pregnancy to all women, as this evidence shows rates of consumption increase in the third trimester in both at-risk and low-risk populations.

This prospective cohort of low-risk maternity patients in an urban health care setting was similar to all women giving birth in this health region in terms of age, ethnicity, parity, and education (Tough, Johnston et al., 2006). The study was conducted in Calgary, which has a population of 1,214,839 and is Canada's fifth-largest city (Statistics Canada, 2012). These findings are likely relevant to many urban centers with publicly-funded universal health care. Study enrolment and retention rates were high for a community-based study, indicating that these results may be generalized to other urban, low-risk maternity populations being served by a family physician. Although Canadian administrative data indicates that, in 2005, 10.5% of women consumed alcohol while pregnant (Public Health Agency of Canada, 2008), this study found 22.3% of women reported some alcohol consumption during pregnancy. The difference reinforces the validity of this data, because it suggests that participants were more

willing to reveal sensitive, personal information over the telephone to study interviewers than in the clinical settings where administrative data is gathered. A limitation of the study is the discontinuation of 334 women between the second and third questionnaires; however, the discontinuers did not differ by T-ACE score. Other limitations include the potential lack of generalizability to rural populations and women at high medical risk during pregnancy. Further work, in alignment with the SOGC guidelines, should include the implementation of strategies to address both alcohol use and other risk factors associated with an elevated T-ACE, such as social support, network orientation and mental health.

Acknowledgements:

We would like to gratefully acknowledge the support and assistance of the Community Perinatal Care Study Team and the Calgary Children's Initiative Advisory Council. This study was made possible with the support of the Maternity Care Clinic, the Grace Maternal Child Clinic, and the Low Risk Maternity Clinic (all of the Calgary Health Region).

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