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A utilitarian comparison of two alcohol use biomarkers with self-reported drinking history collected in antenatal clinics

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ABSTRACT

Background: Alcohol use is reported accurately among pregnant women in some populations.
Methods: Self-reported alcohol use via the AUDIT and 90-day recall for 193 women from antenatal clinics was compared to biomarker results: phosphatidylethanol (PEth) from bloodspots and ethyl glucuronide (EtG) in fingernails.
Results: AUDIT was positive for 67.9% of respondents, and 65.3% directly reported drinking. Individual biomarkers detected less drinking (PEth = 57.0%, EtG = 38.9%) than self-report. But 64.8% had drinking-positive values (>8 ng) on one or both biomarkers, which was not significantly different from self-report. Biomarkers indicated that 3.1% −6.8% of drinkers denied drinking. Combined biomarker sensitivity was 95% −80% and specificity 49% −76% for drinking in the previous 7–90 days. Combined biomarker results have their best yield (89.6%) and accuracy (78.8%) when measuring 90 day drinking.
Conclusions: Women reported their alcohol use accurately, and the combined use of PEth and EtG is supported.

1. Introduction

In parts of the Western Cape Province (WCP) of South Africa (SA) there is a subculture of regular binge drinking. It is common for 35–50% of women of childbearing age to drink 2–9 alcoholic beverages each night on most Fridays and Saturdays [1,2]. This is the major factor creating a high prevalence of fetal alcohol spectrum disorders (FASD) in the general population of some communities of the WCP. These communities have the highest documented prevalence of FASD anywhere in the world; 17–28% of children in first grade classes have been found to have FASD [3–6].

Over the past twenty years, members of our SA research team have judged the local reporting of alcohol use to be extremely candid and forthright among women and men in the WCP [1,2,7,8]. Furthermore, we have found that reports of alcohol use, childbearing, and other personal information across various datasets collected in these populations were reliable. Associations between self-reported alcohol use data and specific alcohol-related outcomes, specifically diagnoses within the continuum of FASD, correlated significantly with seemingly credible levels of alcohol exposure in multiple samples and studies [3–6,8,9], yet the accuracy of the basic alcohol reporting had not been tested against biomarkers of alcohol use. Therefore, we embarked on this study to assess the accuracy of alcohol-use reporting in these SA communities.

In studies of alcohol use reporting carried out in some populations, women are believed to be less than honest and accurate when providing alcohol-use information, [10–12] especially in prenatal clinic settings in Western Europe. This finding has been reported when sensitive alcohol-specific biomarkers were employed using appropriate biological specimens [13–16]. However, there is also ample evidence that many populations report quite accurately if

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proper interviewing techniques are used, rapport is built, and multiple measures of alcohol use over time are used [16–23].

1.1. Study objectives: cross validation for a utilitarian understanding

There were two objectives in this study. The first objective was to assess whether the maternal population of the WCP of SA is accurate in the overall reporting of alcohol use during pregnancy by utilizing objective biomarkers of drinking. Second, we sought to estimate how accurate, sensitive, and specific each of the two biomarkers was for detecting any level of alcohol use in this population through comparison of the biomarker results with self-report. It is a comparative validity study of the two methods to determine their utility for use in both antenatal clinic applications and for research purposes.

This manuscript compares positive and negative results from two self-reported alcohol-use measurements with results from two alcohol-use biomarkers. The self-report measures are the World Health Organization Alcohol Use Disorders Identity Test (AUDIT) [21], and standard measures of alcohol use by quantity and frequency (Q-F) [7]. The two biomarkers are ethyl glucuronide (EtG) and phosphatidylethanol (PEth), two metabolites of alcohol consumption that can be measured in various biological specimens (e.g. urine, blood, or cutaneous substances). They both have been found to be specific to alcohol use and are sensitive to moderate to heavy intake of alcohol over specific windows in time [25,26].

2. Methods

2.1. Measures and sampling

The two biomarkers were measured from different biological materials. Phosphatidylethanol (PEth) was measured in bloodspots from finger pricks and ethyl glucuronide (EtG) was measured in fingernail clippings totalling 50–100 mg or more. Both specimens were collected from 193 pregnant women attending community health care antenatal clinics that serve the vast majority of the local community population. The average gestation of the respondents at the time of bloodspot collection and simultaneous interview was 19.7 (±SD of 7.5) weeks. These participant interviews contained an array of maternal risk factors encountered during the index pregnancy, with an emphasis on dietary intake and alcohol consumption. The questionnaire contained two techniques for collecting and summarizing self-reported alcohol use. The AUDIT [21] was used with a cut off score of 4 for a high degree of sensitivity for measuring current alcohol use at the light to moderate range and above. Also well-established quantity/frequency (Q-F) questions were used that covered alcohol use at time of interview and specific time periods up to three months prior to the interview. All participants lived in one of two small towns and surrounding rural areas of the WCP.

2.2. Key time periods for measuring prior alcohol use

The three categories and time periods of particular interest for the biomarker analyses were: a) those using alcohol seven days prior to the interview, b) those consuming alcohol 30–90 days prior to the interview, and c) those who were self-reported abstainers throughout the previous 90 days. Both PEth and EtG are reported to be sensitive, direct, alcohol-specific biomarkers for most individuals [24–26]. PEth as a biomarker in blood samples has a half-life of five to seven days, and is accurate for measuring moderate consumption in the past seven days, and sustained, heavy consumption up to three weeks [27]. EtG collected from fingernails is purported to be accurate for detecting moderate to heavy drinking up to three months prior to sample collection [28,29]. Because most drinking occurs over the weekends for over 90% of alcohol users in this particular SA population [2,7], bloodspots and interviews for the PEth biomarker analyses were collected only on Monday or Tuesday clinics to provide accurate measures of drinking. Furthermore, since the fingernail samples record longer-term alcohol use, they were collected at either first contact, at the same time as the blood samples and interviews were collected, or at a scheduled return visit to the participant's home 1–2 weeks later, once the nails had grown to an appropriate length (3 mm).

2.3. Maternal questionnaire

The self-report questionnaire was developed specifically for epidemiology studies of the prevalence and characteristics of FASD via active case ascertainment and the clinical diagnosis of FASD in the WCP. To establish rapport, nonthreatening questions about general maternal health and diet were asked first, and the interview moves to information on health, diet, and childbearing. Alcohol consumption responses are more accurate in such a format, especially embedded within the context of dietary questions [30]. Multiple measures of alcohol use in the previous 90 days were asked, paying special attention to alcohol brands and containers commonly used in this population (vessels measurement), as respondents were shown pictures of standard containers of local brands. This sequencing and vessels technique assists in accurate reporting and calibration of the amounts consumed [31,32]. Alcohol was measured in standard US units where one drink equals: a 340 ml can/bottle of beer (5–5.5% ethanol), 120 ml of wine (11% ethanol), 95 ml of wine (13.5% ethanol), or 44 ml of distilled spirits (43%

Table 1
Positive Cases of Alcohol Usage as Indicated by Two Biomarkers among Females in the Antenatal Period (N = 193).

Significant EtOH Usage	PEth + (≥8 ng/mL)	EtG + (≥8 ng/mg)	Positive cases on one or both biomarkers	Positive on both biomarkers
Positive	110 (57.0%)	75 (38.9%)	125 (64.8%)	62 (32.1%)
Negative	83 (43.0%)	118 (61.1%)	68 (35.2%)	131 (67.9%)

Table 2
Association between Self-Reported AUDIT score and Drinking Detected by PEth, EtG, and both biomarkers combined among Female Participants ($N = 193$). Classification Tables and Statistics.

AUDIT score	PEth Result		EtG Result		Positive cases on one or both biomarkers	
	Negative	Positive	Negative	Positive	Negative	Positive
Negative (0–4)	46 (23.8%)	16 (8.3%)	56 (29.0%)	6 (3.1%)	42 (21.8%)	20 (10.4%)
Positive (>4)	37 (19.2%)	94 (48.7)	62 (32.1%)	69 (35.8%)	26 (13.5%)	105 (54.4%)
	$\chi^2 = 36.250$, df = 1, $p < .001$, $\varphi = .433$		$\chi^2 = 32.742$, df = 1, $p < .001$, $\varphi = .412$		$\chi^2 = 42.303$, df = 1, $p < .001$, $\varphi = .468$	
	(+ by PEth)/(+ by AUDIT) =83.9%		(+ by EtG)/(+ by AUDIT) =57.3%		(+ by 1 or both biomarkers)/ (+by AUDIT) =95.4%	
	Z = 4.53, $p < .001$		Z = 7.40, $p < .001$		Z = 2.37, $p = .018$	