ALCOHOL EXPOSURE AMONG PREGNANT WOMEN IN SUB-SAHARAN AFRICA: A SYSTEMATIC REVIEW

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ABSTRACT

Background
The prevalence of general alcohol use in many countries of sub-Saharan Africa (SSA) is high. However, research examining alcohol use in among pregnant women within this population is limited. A review of the current status of research examining the prevalence of alcohol exposed pregnancies (AEP) is required to inform future research aiming to decrease this occurrence and its subsequent socio-economic complications.

Objective
The primary objective was to identify all published papers estimating prevalence and risk-factors of alcohol use among pregnant women in SSA. A secondary objective was to determine changes in alcohol use following pregnancy recognition.

Methods
PubMed/Medline, Embase, IPA, CINAHL were systematically searched using MeSH terms and keywords from inception date to March 2013. Studies from SSA reporting prevalence of alcohol use among pregnant women were included.

Results
Twelve studies were identified. Studies varied significantly according to design and study population. Prevalence of alcohol use during pregnancy ranged from 2.2%-87%. The most important risk-factors for alcohol use included tobacco use, partner violence, urban living, and having a male partner who drank alcohol. Only three studies examined changes in alcohol use prior to and following pregnancy recognition with absolute reductions of between 9% and 15%.

Conclusions
Although the burden of alcohol use during pregnancy is likely a significant problem, limited data currently exist for the majority of SSA countries. Furthermore, significant variation likely exists within various populations. Further research is required to explore alcohol use in pregnancy. Strategies to decrease AEP must be developed and implemented in standard pre-natal care.

Key Words: *Sub-Saharan Africa, alcohol, pregnancy, women, systematic review, fetal alcohol spectrum disorder*

Several countries of sub-Saharan Africa (SSA) are consistently ranked by the World Health Organization (WHO) as having among the highest per-capita rates of alcohol consumption in the world.[1] Literature specifically examining alcohol consumption among women in many areas of SSA have found rates to be high and possibly increasing.[2] Among women who drink in South Africa, Zambia and Chad 30-50% report binge drinking. The prevalence of women drinking alcohol in these countries ranges from 15-30%.[2] A high prevalence of alcohol consumption combined with limited public health resources, especially for non-communicable diseases, creates a substantial potential for alcohol-exposed pregnancies (AEP). Public health campaigns to decrease alcohol use during pregnancy in most SSA countries are virtually non-existent. Fetal alcohol spectrum disorder (FASD), a consequence of AEP's, is thought to be rising in parts of SSA[3] which is cause for concern due to its significant social and economic consequences.[4,5]

The Republic of South Africa is considered to have the highest incidence of FASD in the world, with a prevalence of 68-89 per 1000 in certain areas.[6-8] The now illegal "dop system," (remuneration of farm workers with alcohol) was historically practiced on wine farms in the Western Cape, likely contributing to the currently high levels of alcohol dependence and corresponding high rate of FASD.[7] There is a disproportionate amount of research on prenatal alcohol exposure and FASD in South Africa compared to other SSA nations even though per-capita alcohol consumption in countries including Uganda, Nigeria, Rwanda, Burundi and Namibia are thought to be higher than that of South Africa.[1] Recent research reporting risk factors for AEP have found that smoking, ethnicity, pre-pregnancy alcohol consumption, exposure to violence, and age of drinking onset are important predictors of pre-natal alcohol exposure. Conversely, knowledge of FASD, higher levels of maternal education, and multiparity may be protective against maternal alcohol use.[9] Previous research has shown that interventions such as motivational interviewing and public awareness campaigns to high risk groups can decrease alcohol use in pregnancy.[10,11] It is likely that many countries within SSA, which likely carry a significant but largely unreported burden of AEP, may also benefit from such interventions. The identification of specific populations in need of such interventions, as well as populations in need of basic epidemiologic research on the prevalence of AEP, is urgently required in order to create awareness and to begin to reduce the disease burden of FASD.

The objective of this study was to systematically identify and review the literature evaluating the prevalence of and risk factors for alcohol use in pregnancy in SSA. Secondly, we sought to determine the degree to which alcohol consumption changed among study cohorts following knowledge of pregnancy.

METHODS

Systematic Search

We conducted a systematic computerized search from inception to March 2013 to identify all potentially eligible studies. Two investigators (CLC and TDR) trained in database searching independently carried out the systematic search. We applied the following algorithm in both medical subject heading (MeSH) and free text words. In PubMed and Medline, the MeSH terms "pregnancy", AND "ethanol" AND "Africa south of the Sahara" were combined as were the individual country names of each sub-Saharan African country with "pregnancy" AND "alcohol". The countries of SSA include all countries of Africa except Morocco, Tunisia, Libya, Algeria and Egypt (43 countries in total). In addition, the terms "pregnancy" AND "Africa" AND "alcohol" were also combined as were "pregnancy" AND "ethanol" AND "Africa". In Embase, individual names of each sub-Saharan African country OR "Africa south of the Sahara" AND ("alcohol" OR "drinking behavior") was searched to further identify eligible studies. A similar strategy was applied to Embase, the Cumulative Index to Nursing and Allied Health Literature (CINAHL), International Pharmaceutical Abstracts (IPA), and Google Scholar™. Searches were exploded and/or focused where appropriate. Reference lists of all

identified articles were manually searched for pertinent articles.

Eligibility Criteria

Studies were included if they: 1) represented populations from SSA (as defined by the United Nations), and; 2) presented the prevalence of alcohol exposure, or information required to calculate prevalence, among pregnant women during any stage of pregnancy. Studies reporting the prevalence of alcohol use among populations that included pregnant women as a subgroup were considered, provided the relevant data on the pregnant subgroup could be abstracted. Studies where the prevalence of alcohol use in pregnant women could not be separated from a larger study population were excluded, as were studies that did not specify the population was from a country in SSA. Case control studies were included if the selection of cases and controls were not determined by a factor known to be in the causal pathway of alcohol exposure in pregnancy (i.e. FASD-based selection). Studies were considered regardless of language of publication.

Data Abstraction

Data were entered into a Microsoft Excel workbook developed *a priori*. The following variables were collected from each study: year, country, study design, population, sample size, response rate of study subjects, study setting, screening tool(s) used, HIV prevalence, and percentage change in alcohol exposure prevalence prior to versus after knowledge of pregnancy. In addition, a separate worksheet was created onto which risk factors for alcohol use, along with corresponding risk ratios and 95% confidence intervals were recorded. Two investigators (CLC and TDR) independently reviewed and collected variables from identified studies. Any discrepancies were discussed and reconciled.

Quality Assessment

As no validated tool exists for assessing studies on alcohol use in pregnancy, a quality assessment tool was created. Using the STROBE statement reporting guidelines[12] as a guide we created a five-point quality assessment tool that was applied to all included studies. The following items were assessed: 1) use of validated alcohol abuse screening tool (1 point), 2) response rate (> 80% = 1 point), 3) clear definition of alcohol use for quantity and frequency (1 point), (4) clear description of sampling strategy (1 point), and (5) a clear definition of the intended study population (1 point). Studies were scored independently by two investigators (CLC and MOW). Any disagreements were resolved through discussion. All studies scoring four or greater were considered high quality studies, while those scoring less than four were considered low quality studies.

Statistical Analysis

Descriptive statistics were reported for all data collected. As significant heterogeneity was observed between studies no formal statistical pooling was possible.

RESULTS

Twelve studies meeting all inclusion criteria were identified from four SSA countries. Nine studies were from South Africa[8,13-20], one from Nigeria[21], one from Ghana[22], and one from Uganda[23] (Table 1). With the exception of one cohort study, all were cross-sectional in design. Four studies reported risk factors for alcohol use during pregnancy (Table 2). Of the twelve studies, seven achieved a quality score of four or greater.[9,13-16,18,23]

TABLE 1A Studies from the Western Cape province of South Africa

Study	Region	Quality Score	Study Design	Timeframe	Sample Size	Response Rate (%)	Study Setting	Locale	Screening Tool	HIV Positive (%)	Periconceptual Alcohol use (%)	Post Recognition Alcohol Use (%)
(13)	Western Cape	4	Cross-Sectional	May 1995-July 1996	636	99.8	17 antenatal clinics	Mixed	Survey	ND	ND	42.8
(14)	Western Cape	5	Cross-Sectional	March 2008	323	98	1 antenatal clinic	Urban	AUDIT	ND	35.3	20.2
(15)*	Western Cape	5	Cross-Sectional	May 2009-December 2010	1,145	96	24 neighborhoods	Peri-urban	Derived AUDIT-C	29	25	ND
(9)*	Western Cape	5	Cross-sectional	May 2009-January 2010	619	99.8	24 neighborhoods	Peri-urban	Derived AUDIT-C	25.8	27.0	ND
(16)	Western Cape	4	Cross-Sectional	October 2009-February 2010	119 (out of 2120 total)	91	Six alcohol-serving venues	Peri-urban	Modified AUDIT	11.2	ND	87.4

* O'Connor et al.(9) describes a more detailed analysis for the first 619 subjects enrolled out of a final total of 1145 enrolled and described in Tomlinson et al.(15)
HIV: Human Immunodeficiency Virus; AUDIT: Alcohol Use Disorders Identification Test, AUDIT-C: shortened Alcohol Use Disorders Identification Test; ND: Not Described

TABLE 1B Studies from provinces of South Africa other than Western Cape

Study	Region	Quality Score	Study Design	Timeframe	Sample Size	Response Rate (%)	Study Setting	Locale	Screening Tool	HIV Positive (%)	Periconceptual Alcohol use (%)	Post Recognition Alcohol Use (%)
(17)	Mpumalanga	2	Cross-Sectional	April-June 2010	1502	ND	48 primary care clinics	Rural	1 month recall	19.3	ND	6.5
(18)	KwaZulu-Natal	4	Cross-sectional	July 2008-April 2010	1201	76	8 PMTCT programs	Mixed	Brief AUDIT-C	100	17.2	4.5
(19)	Limpopo	0	Cross-Sectional	3-month period	46	ND	1 primary healthcare clinic	Rural	24-hour recall (1 weekday and 1 weekend day)	0	ND	2.2
(20)	Gauteng	2	Cohort	7-week period during 1990	953	59.8	Antenatal clinics	Urban	Prenatal Stressors Questionnaire	ND	ND	4.6

HIV: Human Immunodeficiency Virus; PMTCT: Prevention of Mother-to-Child Transmission; AUDIT-C: shortened Alcohol Use Disorders Identification Test; ND: Not Described

TABLE 1C Studies from other sub-Saharan African Countries

Study	Country	Quality Score	Study Design	Timeframe	Sample Size	Response Rate (%)	Study Setting	Locale	Screening Tool	HIV Positive (%)	Periconceptual Alcohol use (%)	Post Recognition Alcohol Use (%)
(23)	Uganda	5	Cross-Sectional	June-August 2006	610	98.7	1 antenatal clinic	Urban	Consumption habits survey & CAGE questionnaire	8.9	33.8	24.8
(21)	Nigeria	1	Cross-sectional	ND	518	ND	3 antenatal clinics	Rural	WHO substance use survey	ND	ND	2.5
(22)	Ghana	2	Cross-Sectional	July-October 2010	397	99	10 antenatal clinics	Rural	Structured questionnaire	ND	ND	20.4

HIV: Human Immunodeficiency Virus; AUDIT: Alcohol Use Disorders Identification Test; CAGE: Alcoholism Questionnaire; ND: Not Described; WHO: World Health Organization

Western Cape Province

Of the nine studies from South Africa five[8,13-16] were from the Western Cape Province (two had overlapping study samples) and four[17-20] were from other provinces of South Africa. The studies from the Western Cape Province reported the highest overall alcohol consumption rates during pregnancy, ranging from 20% – 43%. One study from the Western Cape Province reported alcohol consumption prevalence to be 87%; however the study population was identified through attendance at drinking establishments and therefore likely does not represent any typical population.[16] O'Connor *et al*. reported risk factors for drinking prior to pregnancy recognition (Table 2).[9] The most important predictors in the multivariate analysis included use of tobacco (odds ratio 4.96; 95% CI 2.01-12.27) and partner violence (odds ratio 2.68 ;95% CI 1.79-4.00).[9] Other statistically significant risk factors included being single and having access to utilities such as water, electricity, and indoor plumbing. Among the studies in this region only one reported changes in drinking behavior following recognition of pregnancy. Vythilingum *et al*. found a 15% reduction in drinking from 35% pre-recognition to 20% post-recognition.[14] No statistical analysis was conducted on pre vs. post pregnancy recognition alcohol exposure.

TABLE 2A Risk factors for AEP (post-pregnancy recognition)

Study	Population	Risk Factor	RR/PR/OR (95% CI)
(23)	Urban Ugandan women attending antenatal clinic	Age (per year)	0.99 (0.97, 1.00)
		Married	0.88 (0.77, 1.01)
		Employment	0.91 (0.78, 1.06)
		Attended secondary school or higher	0.91 (0.78, 1.05)
		Belief that alcohol affects babies health	1.07 (0.88, 1.30)
		Previous pregnancy	0.96 (0.83, 1.11)
		Previous live birth	0.91 (0.80, 1.05)
		HIV infected	1.14 (0.98, 1.32)
		Religion prohibits alcohol	0.81 (0.65, 1.00)
		Current smoker	1.23 (1.15, 1.32)
		Male partner drinks	1.33 (1.15, 1.54)
		Has friends who drink	1.22 (1.00, 1.49)
		Binge drinking prior to pregnancy recognition	1.04 (0.73, 1.47)
(14)	Women attending one antenatal clinic in Western Cape, South Africa	Periconceptual alcohol use	4.522, p<0.0001

AEP: Alcohol-Exposed Pregnancy; HIV: Human Immunodeficiency Virus; RR: Risk Ratio; PR: Prevalence Ratio; OR: Odds Ratio; CI: Confidence Interval

TABLE 2B Risk factors for AEP (pre and post-pregnancy recognition)

Study	Population	Risk Factor	RR/PR/OR (95% CI)
		Age (per year)	0.98 (0.94, 1.01)
		Married	0.29 (0.11, 0.77)
		Highest education level secondary (vs. none/primary)	0.91 (0.57, 1.44)
		Highest education level tertiary (vs. none/primary)	0.75 (0.32, 1.75)
		Employed	0.76 (0.54, 1.05)
		Formal housing	0.95 (0.66, 1.37)
		Water on site	1.54 (1.01, 2.35)
		Has computer, internet, phone, car, landline	1.65 (1.13, 2.42)
	HIV positive women attending PMTCT	Urban area (vs. rural)	3.81 (2.09, 6.95)
(18)	clinic in KwaZulu-Natal Province, South	Peri-urban area (vs. rural)	2.44 (1.40, 4.25)
	Africa	Multigravida	1.15 (0.76, 1.75)
		Mental health GHQ score	1.08 (1.02, 1.15)
		Tobacco use	2.35 (1.35, 4.10)
		Previous treatment for STI	1.47 (1.06, 2.04)
		Number of sexual partners in last year	1.57 (1.14, 2.15)
		Number of visits with friends/relatives in past month	1.03 (1.01, 1.05)
		Attends temple/church	0.74 (0.51, 1.06)
		Attends community meetings	1.67 (1.19, 2.34)
		Any conflict at home	0.84 (0.48, 1.48)

AEP: Alcohol-Exposed Pregnancy; HIV: Human Immunodeficiency Virus; PMTCT: Prevention of Mother-to-Child Transmission; GHQ: General Health Questionnaire; STI: Sexually Transmitted Infection; OR: Odds Ratio; CI: Confidence Interval

TABLE 2C Risk factors for AEP (pre-pregnancy recognition)

Study	Population	Risk Factor	RR/PR/OR (95% CI)
(23)	Urban Ugandan women attending antenatal clinic	Age (per year)	1.04 (1.02, 1.05)
		Married	1.62 (1.15, 2.26)
		Employment	1.37 (1.07, 1.76))
		Attended secondary school or higher	0.83 (0.65, 1.06)
		Belief that alcohol affects babies health	0.55 (0.42, 0.72)
		Previous pregnancy	1.90 (1.42, 2.51)
		Previous live birth	1.87 (1.43, 2.44)
		HIV infected	1.51 (1.08, 2.11)
		Religion prohibits alcohol	0.49 (0.36, 0.66)
		Current smoker	2.29 (1.28, 4.09)
		Male partner drinks	2.47 (1.95, 3.12)
		Has friends who drink	3.16 (2.36, 4.24)
(9)	All pregnant women in 24 neighborhoods of Western Cape, South Africa	Mother's age	0.94 (0.90, 0.97)
		Single vs. married/living together	1.54 (1.01, 2.36)
		Sum: water, electricity, flush toilet	1.32 (1.09, 1.57)
		Use Tobacco	4.96 (2.01, 12.27)
		Number of lifetime partners	1.15 (1.06, 1.25)
		Partner violence	2.68 (1.79, 4.00)
		Weeks pregnant at pregnancy recognition	1.04 (1.00, 1.07)

AEP: Alcohol-Exposed Pregnancy; HIV: Human Immunodeficiency Virus; RR: Risk Ratio; PR: Prevalence Ratio; OR: Odds Ratio; CI: Confidence Interval

Other South African Provinces

Four studies from other provinces of South Africa (Table 1b) reported significantly lower rates of alcohol use than in Western Cape (2.2% - 6.5% following pregnancy recognition). Desmond *et al.* from KwaZulu-Natal, South Africa reported that alcohol consumption was 17.2% prior to pregnancy recognition and decreased to 4.5% following recognition.[18] While this study did not analyze risk factors for alcohol consumption following recognition of pregnancy, it found that several variables were associated with alcohol consumption during any stage of pregnancy. The most significant variables included living in urban or peri-urban areas and use of tobacco (Table 2b). The remaining studies did not examine alcohol as a primary outcome, but rather as a risk factor for other outcomes.

Other Sub-Saharan African Countries

Three studies outside of South Africa were identified (Table 1c). Adusi-Poku *et al*. examined 397 pregnant women at 10 ante-natal clinics in rural Ghana and found the prevalence of alcohol use was 20% following pregnancy recognition, although the rate of alcohol use pre-pregnancy recognition was not measured.[22] The study from Uganda found the prevalence of alcohol consumption among pregnant urban women to be 34% prior to pregnancy recognition, which reduced to 25% following recognition.[23] Interestingly, they found that while most women either stopped or reduced alcohol consumption following knowledge of pregnancy, 11% increased alcohol consumption. This study was unique as it determined predictors of alcohol consumption both prior to and following knowledge of pregnancy. In the univariate analysis, smoking, having a male partner who drinks alcohol and having friends that drink alcohol were each statistically significant predictors of drinking alcohol after knowledge of pregnancy. There were numerous predictors of drinking prior to knowledge of pregnancy (Table 2a). A study from Nigeria interviewed a random sample of 518 pregnant women visiting the antenatal clinic at one of three general hospitals.[21] Although the primary aim of this study was to assess self-medication during pregnancy, questions related to alcohol consumption were also asked. Overall, 2.5% of pregnant women admitted to using alcohol.

DISCUSSION

In this systematic review, we identified 12 studies that reported alcohol consumption during pregnancy in the countries of SSA. While the majority of the studies came from South Africa, three studies assessed alcohol exposure during pregnancy in other SSA nations. Significant heterogeneity in the prevalence of alcohol consumption among studies indicates that alcohol consumption is highly variable in different populations. Even within the province of Western Cape in South Africa there were significant differences, though longitudinal effects may have also contributed.

Identification of women at high risk of consuming alcohol following recognition of pregnancy is of utmost importance when implementing preventive strategies for FASD. This systematic review only identified one study, from Uganda, that specifically examined alcohol use following pregnancy recognition in detail.[23] This study found that predictors of alcohol use prior to recognition differed significantly from predictors following recognition. Studies from developed countries such as Denmark, New Zealand and the US have found that consistent predictors of continued alcohol use following pregnancy recognition included frequency and amount of alcohol use prior to pregnancy recognition and various psychosocial stressors.[24-26] These predictors are, perhaps, markers of alcohol addiction. More studies are required focusing on risk factors for alcohol consumption following pregnancy recognition among women in SSA in order to develop and examine strategies specifically targeting those at high risk of alcohol exposed pregnancies.

The availability of pediatric mental health services in SSA, and developing countries in general, is extremely limited. A recent systematic review clearly demonstrates an enormous gap between needs and resource availability.[27] The consequences of a high burden of FASD in children is thereby likely amplified in SSA compared to developed countries with a significant mental health infrastructure.

Addressing barriers to the provision of mental health services would provide much-needed support to both pregnant women who may be at risk of consuming alcohol, as well as children affected by FASD.[28]

The high prevalence of alcohol consumption in many of the studies identified justifies the need for additional research and intervention aimed at reducing alcohol consumption. Recently, novel methods of detecting AEP have been developed.[29] Fetal biomarkers such as fatty acid ethyl esters from the meconium of a neonate have been shown to be both reasonably sensitive and specific surrogate markers of alcohol consumption during the second and third trimesters. To date, no studies utilizing these biomarkers have been conducted in sub-Saharan Africa to determine alcohol prevalence statistics.

This study is subject to several limitations. First, it is possible that relevant studies were not identified in the systematic search if the primary focus was not alcohol use during pregnancy. Although a broad search was conducted, studies assessing alcohol consumption as a secondary endpoint may have not been captured in our search strategy. Further, the results reported in the studies that were included are subject to error. As alcohol is generally considered harmful in pregnancy and culturally inappropriate for women to consume in some regions, women may not have been willing to truthfully or accurately disclose alcohol use, thus under-estimating true prevalence. It is unlikely, however, that the prevalence of alcohol consumption would be over-estimated. Publication bias, whereby the results of research showing low levels of AEPs remained un-published, could have increased the proportion of studies showing a high AEP prevalence in this systematic review. However, given the relative paucity of research in this area we do not believe this to be a significant bias. Finally, our quality assessment tool has not been validated. While this does not change the overall results of the study any inferences based on either high or low quality studies should be interpreted with caution.

CONCLUSION

Although the burden of alcohol use during pregnancy likely results in significant socio-economic consequences, few data exist for the majority of SSA countries. Furthermore, significant variation likely exists within countries and more research is urgently required. Strategies to decrease AEP must be developed (or improved where they already exist) and should play a role in standard pre-natal care in all health facilities.

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REFERENCES

1. World Health Organization. Global status report on alcohol. Geneva; 2004.
2. Martinez P, Røislien J, Naidoo N, Clausen T. Alcohol abstinence and drinking among African women: data from the World Health Surveys. BMC Public Health 2011 Jan;11(1):160.
3. May PA, Gossage JP, Marais A-S, Hendricks LS, Snell CL, Tabachnick BG, et al. Maternal risk factors for fetal alcohol syndrome and partial fetal alcohol syndrome in South Africa: a third study. Alcoholism, Clinical and Experimental Research 2008 May;32(5):738–53.
4. Popova S, Stade B, Bekmuradov D, Lange S, Rehm J. What do we know about the economic impact of fetal alcohol spectrum disorder? A systematic literature review. Alcohol and Alcoholism 2011;46(4):490–7.
5. Sood B, Delaney-Black V, Covington C, Nordstrom-Klee B, Ager J, Templin T, et al. Prenatal alcohol exposure and childhood behavior at age 6 to 7 years: Dose-response effect. Pediatrics 2001 Aug 1;108(2):e34–e34.
6. May PA, Gossage JP, Jones KL, Robinson LK. The epidemiology of fetal alcohol syndrome and partial FAS in a South African community. Drug and Alcohol Dependece 2008;88(505):259–71.

7. May P, Brooke L, Gossage JP, Croxford J, Adnams C, Jones KL, et al. Epidemiology of fetal alcohol syndrome in a South African community in the Western Cape Province. American Journal of Public Health 2000 Dec;90(12):1905–12.
8. Viljoen DL, Gossage JP, Brooke L, Adnams CM, Jones KL, Robinson LK, et al. Fetal alcohol syndrome epidemiology in a South African community: a second study of a very high prevalence area. Journal of Studies on Alcohol 2005 Sep;66(5):593–604.
9. O'Connor MJ, Tomlinson M, Leroux IM, Stewart J, Greco E, Rotheram-Borus MJ. Predictors of alcohol use prior to pregnancy recognition among township women in Cape Town, South Africa. Social Science & Medicine 2011 Jan;72(1):83–90.
10. Floyd RL, Sobell M, Velasquez MM, Ingersoll K, Nettleman M, Sobell L, et al. Preventing alcohol-exposed pregnancies: a randomized controlled trial. American Journal of Preventive Medicine 2007 Jan;32(1):1–10.
11. Chersich MF, Urban M, Olivier L, Davies L-A, Chetty C, Viljoen D. Universal prevention is associated with lower prevalence of fetal alcohol spectrum disorders in Northern Cape, South Africa: a multicentre before-after study. Alcohol and Alcoholism 2012;47(1):67–74.
12. Von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Lancet 2007;370:1453–7.
13. Croxford J, Viljoen D. Alcohol consumption by pregnant women in the Western Cape. South African Medical Journal. 1999;89(9):962–5.
14. Vythilingum B, Roos A, Faure S, Geerts L, Stein D. Risk factors for substance use in pregnant women in South Africa. South African Medical Journal 2012;102(11):851–4.
15. Tomlinson M, O'Connor MJ, le Roux IM, Stewart J, Mbewu N, Harwood J, et al. Multiple Risk Factors During Pregnancy in South Africa: The Need for a Horizontal Approach to Perinatal Care. Prevention Science 2013 Mar 9;ePub ahead of print.
16. Eaton LA, Kalichman SC, Sikkema KJ, Skinner D, Watt MH, Pieterse D, et al. Pregnancy, alcohol intake, and intimate partner violence among men and women attending drinking establishments in a Cape Town, South Africa township. Journal of Community Health 2012 Feb;37(1):208–16.
17. Matseke G, Peltzer K, Mlambo G. Partner violence and associated factors among pregnant women in Nkangala district , Mpumalanga. South African Journal of Obstetrics and Gynaecology 2012;18(3):77–81.
18. Desmond K, Milburn N, Richter L, Tomlinson M, Greco E, van Heerden A, et al. Alcohol consumption among HIV-positive pregnant women in KwaZulu-Natal, South Africa: prevalence and correlates. Drug and Alcohol Dependence 2012 Jan 1;120(1-3):113–8.
19. Mostert D, Stevn N, Temple N, Olwagen R. Dietary intake of pregnant women and their infants in a poor black South African community. Curationis 2005;28(4):12–9.
20. Ramchandani PG, Richter LM, Stein A, Norris SA. Maternal prenatal stress and later child behaivoral problems in an urban South African setting. Journal of the American Academy of Child and Adolescent Psychiatry 2010;49(3):239–47.
21. Abasiubong F, Bassey EA, Udobang JA, Akinbami OS, Udoh SB, Idung AU. Self-medication: potential risks and hazards among pregnant women in Uyo, Nigeria. The Pan African Medical Journal 2012 Jan;13:15.
22. Adusi-Poku Y, Edusei AK, Bonney A a, Tagbor H, Nakua E, Otupiri E. Pregnant women and alcohol use in the Bosomtwe district of the Ashanti region-Ghana. African Journal of Reproductive Health 2012 Mar;16(1):55–60.
23. Namagembe I, Jackson LW, Zullo MD, Frank SH, Byamugisha JK, Sethi AK. Consumption of alcoholic beverages among pregnant urban Ugandan women. Maternal and Child Health Journal 2010 Jul;14(4):492–500.
24. Strandberg-Larsen K, Nielsen NR, Andersen A-MN, Olsen J, Grønbaek M. Characteristics of women who binge drink before and after they become aware of their pregnancy. European Journal of Epidemiology 2008 Jan;23(8):565–72.
25. Mallard SR, Connor JL, Houghton LA. Maternal factors associated with heavy periconceptional alcohol intake and drinking following pregnancy recognition: A post-partum survey of New Zealand women. Drug and Alcohol Review 2013 Jul;32(4):389–97.
26. Harrison PA, Sidebottom AC. Alcohol and drug use before and during pregnancy: an examination of use patterns and predictors of cessation. Maternal and Child Health Journal 2009 May;13(3):386–94.
27. Kieling C, Baker-Henningham H, Belfer M, Conti G, Ertem I, Omigbodun O, et al. Child and

adolescent mental health worldwide: evidence for action. Lancet 2011 Oct 22;378(9801):1515–25.

28. Saraceno B, van Ommeren M, Batniji R, Cohen A, Gureje O, Mahoney J, et al. Barriers to improvement of mental health services in low-income and middle-income countries. Lancet 2007 Sep 29;370(9593):1164–74.
29. Koren G, Hutson J, Gareri J. Novel methods for the detection of drug and alcohol exposure during pregnancy: implications for maternal and child health. Clinical Pharmacology and Therapeutics 2008 Apr;83(4):631–4.