SCREENING FOR FETAL ALCOHOL SPECTRUM DISORDERS BY NONMEDICAL COMMUNITY WORKERS

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ABSTRACT

Background
South Africa has the highest prevalence of Fetal Alcohol Spectrum Disorders (FASD) in the world yet many women have no access to clinic care or to physicians in their communities. The shortage of physicians trained in the diagnosis of FASD is even more severe. Thus there is a need to train community workers to assist in the delivery of health care.

Objectives
This study reports on the effectiveness of training community workers to screen for a possible diagnosis of a FASD.

Methods
Community workers in Cape Town, South Africa were trained to screen for FASD in 139, 18-month-old toddlers with prenatal alcohol exposure (PAE). Children were assessed according to the salient characteristics of individuals with PAE using height, weight, head circumference (OFC), philtrum, and lip measurements according to criteria set forth by the Institute of Medicine. Screen-positive children were referred for diagnostic assessment to a pediatrician reliably trained in the diagnosis of FASD.

Results
Of the screen-positive children, 93% received an FASD diagnosis suggesting that the screening procedure was highly sensitive. Diagnoses included 15% with fetal alcohol syndrome (FAS), 23% with Partial FAS, and 62% with Alcohol Related Neurodevelopmental Disorder (ARND, provisional).

Conclusion
The use of community workers to screen for FASD represents a promising approach to effective diagnosis of children affected by PAE in areas lacking adequate medical resources.

Key Words: *Fetal alcohol spectrum disorder, screening, prenatal alcohol exposure, community health workers, South Africa*

Prenatal alcohol exposure (PAE) produces a range of developmental deficits, collectively referred to as Fetal Alcohol Spectrum Disorders (FASD).[1] The most severely affected children on the spectrum show a characteristic pattern of anomalies termed Fetal Alcohol Syndrome (FAS) which consists of prenatal and/or postnatal growth retardation, a unique cluster of facial malformations, and neurodevelopmental disabilities.[2,3] Additionally, a substantial body of research has documented significant neurocognitive difficulties among individuals on the spectrum who do not meet full criteria for FAS but who fall along a continuum of disability and who are described as having Partial FAS (pFAS), Alcohol Related Neurodevelopmental

Disorder (ARND), or Alcohol Related Birth Defects (ARBD) according to the diagnostic schema proposed by the Institute of Medicine.[4,5] Although recent data indicating that FASD are more common in some populations throughout the world than previously thought, certain regions of South Africa are reported to have the highest measured prevalence rates of FASD reaching numbers as high as 135.1 to 207.5 per 1,000 (or 13.6 to 20.8%) among 1st grade students in the Western Cape Province.[6] These extraordinarily high rates demonstrate that alcohol exposure during pregnancy is a serious public health problem in South Africa.

South Africa is an upper middle income country, characterized by high levels of poverty and inequality, with many women living in poverty having no access to clinic care or to physicians in their communities. It is estimated that there are only[7.6] physicians for every 10,000 people in South Africa.[7] The shortage of physicians specifically trained in the diagnosis and treatment of children with FASD is even more severe. This is unfortunate in that research demonstrates that early intervention with individuals with a FASD is efficacious in ameliorating many early developmental deficits.[8] The shortage of medical health providers suggests that there is a pressing need for training non-medical personnel to aid in the identification of children who may need more in-depth evaluation and treatment. This study reports on the effectiveness of training of community workers to screen 18-month-old toddlers of participant women who reported drinking alcohol during pregnancy for a possible diagnosis of a FASD. To our knowledge, this is the first study to train and employ community workers to screen for a FASD.

This research was part of a larger randomized controlled screening and brief intervention program, funded by the NIAAA, designed to provide a home-based model in which peer counselors provided psycho-educational interventions and ongoing social support to sample women.

METHODS

Sampling Frame

In three townships outside of Cape Town, we identified 24 non-contiguous neighborhoods with defined geographical boundaries. These neighborhoods were highly similar in the percentages of formal and informal housing, shebeens (alcohol bars), amount of time living as a resident of Cape Town, and income.[9]

Participants

The research was approved by the Health Research Ethics Committee of Stellenbosch University in the Western Cape, South Africa (N08-08-218) and the Social Behavioral Institutional Review Board at the University of California at Los Angeles (G07-02-033) in the United States. Active consent for study participation by sample women and their children was obtained.

The sample consisted of 518, 18-month-old toddlers who had complete growth, facial, and neurocognitive data. Of that number, 136 (26%) of the mothers of these toddlers reported drinking alcohol during pregnancy. Table 1 presents demographic characteristics of the women who reported drinking during pregnancy compared to those who did not drink. Differences were noted between drinkers and non-drinkers on maternal age, marital status, HIV status, and number of antenatal clinic visits. Drinkers were younger, less likely to be married, more likely to be living with HIV, and to have significantly fewer antenatal clinic visits.

TABLE 1

	Drinkers (N=139)		Non-drinkers (N=383)		Total (N=522)		Estimated Mean/OR, Drinkers vs. Non-drinkers [2]	95%	CI [2]	P-Value [2]
	n	%	n	%	n	%				
Mean maternal age in years, SD	27.8	5.8	29.1	5.4	28.8	5.5	-1.26	2.33	0.18	0.022
Married or living with partner	55	39.6	240	62.7	295	56.5	0.40	0.27	0.60	0.000
Employed	28	20.1	103	26.9	131	25.1	0.66	0.41	1.06	0.088
Household monthly income $\geq$ 2001 Rand	80	61.1	232	62.9	312	62.4	0.93	0.62	1.40	0.719
Mean highest education level, SD	9.9	2.1	10.2	2.0	10.1	2.0	-0.35	0.74	0.04	0.078
HH has electricity	130	93.5	332	86.7	462	88.5	1.16	0.68	1.98	0.580
Lives in formal housing	51	36.7	101	26.4	152	29.1	1.13	0.81	1.58	0.455
Water on site	89	64.0	184	48.0	273	52.3	1.01	0.87	1.18	0.870
Flush toilet vs. other type	89	64.0	192	50.1	281	53.8	0.98	0.83	1.14	0.763
Women living with HIV	48	34.5	97	25.3	145	27.8	1.54	1.01	2.33	0.044
Mean weeks pregnant at discovery, SD	8.8	5.6	8.1	6.0	8.3	5.9	0.74	0.45	1.92	0.222
Mean weeks pregnant at baseline assessment, SD	25.7	8.0	26.5	7.6	26.3	7.7	-0.82	2.37	0.73	0.301
Mean number of antenatal clinic visits, SD	4.8	2.2	5.7	2.7	5.5	2.6	-0.89	1.40	0.38	0.001

Comparison of 18-month demographics of women who drank during pregnancy (n = 139) to those who did not drinking during pregnancy[1] (n = 383). [1]Total sample size is N=139 including N=132 regular entry participants and N=7 late entry participants. [2]From linear (continuous variables) or logistic (binary variables) random effects regressions, adjusted for neighborhood clustering.
Abbreviations: CI = Confidence Interval; FASD= Fetal Alcohol Spectrum Disorder; HH= Household; HIV= Human Immunedeficiency Virus; OR= Odds Ratio; SD= Standard Deviation.

MEASURES

***Derived Alcohol Use Disorders Identification Test (Derived AUDIT-C*).**

Alcohol use measures were obtained prior to pregnancy recognition, following pregnancy recognition, and at 18-month follow-up. All sample women were interviewed using the Derived *AUDIT-C* from the National Epidemiologic Survey on Alcohol and Related Conditions.[10] The *AUDIT-C* was embedded in a 194-item structured questionnaire developed for the study including sections measuring participant demographics (age, education level, marital status, employment status, and income), housing demographics (formal/informal housing, indoor water supply, electricity, and toilet facilities), and reproductive health.

The *Derived AUDIT-C* is a three-item questionnaire based on items reflecting alcohol consumption patterns and is highly correlated with the original 10-item *AUDIT* [11], which has been used extensively to assess alcohol use in women in the Cape Town region of South Africa.[12] The tool was developed to meet the challenges of brevity and ease of administration. The *Derived AUDIT-C* demonstrates good sensitivity and specificity for identifying risk drinking in pregnant and non-pregnant women and performs well across different racial and ethnic groups.

Bayley Scales of Infant and Toddler Development (BSID-III)

The *BSID-III*[13] is a standard series of measurements used primarily to assess the motor (fine and gross), language (receptive and expressive), and cognitive development of infants and toddlers, ages 1 to 42 months. This measure consists of a series of developmental play tasks and takes between 45 - 60 minutes to administer. Raw scores of successfully completed items are converted to scaled and composite scores. These scores are used to determine the child's performance compared with norms taken from typically developing children of the same age. For the current study, only the cognitive and motor scales were used. The language scale was excluded because of the possible cultural bias associated with this scale. Based upon the standardization sample, internal consistency scores for the cognitive and motor composite scores are .91 and .92, respectively. Correlations between the Wechsler Preschool and Primary Scale of Intelligence-Third Edition verbal, performance, and full scale IQs and the *BSID-III* cognitive scale range from .72 to .79. Correlations between the Peabody Developmental Motor Skills-Second Edition motor subtests and quotients on the *BSID-III* motor scale are .55 and .59.

PROCEDURES

Training of Screeners

Screeners were female high school graduates who did not live in the study neighborhoods but were from similar areas elsewhere in Cape Town. They were comparable to our sample group in terms of culture, age, marital status, and income. They were able to speak, read, and write in Xhosa and English. The screeners received training from the first author and the study's South African research team, who were familiar with the culture and values of the participants. Diagnostic training of screeners consisted of a description of the criteria for diagnosis of FAS presented in layman's language followed by a description of the measurements that they were being trained to take on each child. These measurements included height, weight, and occipitofrontal head circumference (OFC) based on the World Health Organization Growth Charts for Children: Birth to 24 Months.[14] In addition, using the Lip-Philtrum Guide developed by Astley[15] for African American children in the United States, screeners were trained to assess for two of the three facial features of FAS which included a flat philtrum or flat upper vermillion border (upper lip). All screeners were trained to reliability.

Description of the Process for the Diagnosis of FASD: Stages I and II

For the diagnosis of a FASD, growth and dysmorphology data were collected at 18 months (corrected age) using a two stage screening and diagnostic method. Eighteen months was chosen

as the time for diagnosis since it is difficult to make a diagnosis in newborns and very young infants. It was during the Stage I screening that the screeners were employed.

Stage I

Four key features of FAS were assessed in Stage I:

1. growth retardation;
2. two of the three features of the FAS facial phenotype flat philtrum or flat upper vermillion border of the lip;
3. central nervous system (CNS) dysfunction including small OFC; and,
4. gestational alcohol exposure.

Because growth retardation is a seminal feature of FAS, the heights and weights of all children at 18 months were measured in Stage I. The OFC was taken as the screening measure of Central Nervous System (CNS) integrity. All infants meeting criteria of height or weight or OFC $\leq 10^{th}$ percentile for age qualified for Stage II assessment. Using the Lip-Philtrum Guide developed by Astley[15], screeners also assessed each child for a flat philtrum or flat upper vermillion border (lip). The philtrum is the vertical groove between the nose and upper lip. The Lip-Philtrum Guide is a 5-point photographic guide that is used to objectively measure philtrum smoothness and the flatness of the upper vermillion border (lip). A rank of 1 reflects a deeply grooved philtrum and well-formed upper lip. As one moves up the guide from a rank of 1 to a rank of 5, the philtrum is portrayed as becoming smoother and the upper lip as becoming flatter. The rank of 5 reflects a philtrum or upper lip that is completely smooth. A rank of 3 reflects the population mean or 50^{th} percentile.

When using the Guide, the screener must be aligned with the child's face and the child must have a relaxed facial expression with no smile and with the lips gently closed. The screener holds the Lip-Philtrum Guide next to and parallel to the child's face and assigns the rank shown on the photograph that best matches each of the two features. The philtrum and upper lip are ranked separately so it is possible, for example, for a child to receive a philtrum rank of 5 and a lip rank of 3. A rank score of 4 or 5 on lip or philtrum was considered a positive feature significant for a referral to Stage II.

In sum, to screen positive for Stage II referral, toddlers had to meet criteria for at least one diagnostic criterion at or below the 10^{th} percentile in height, weight, or OFC, a flat philtrum (score 4 or 5) or flat upper vermillion border (score 4 or 5). All screen-positive children were referred for a more comprehensive Stage II examination and diagnosis.

Stage II

Participant diagnosis adhered to the modified Institute of Medicine (IOM) criteria according to the guidelines developed by Hoyme, et al.[5] Diagnostic classifications included: Fetal Alcohol Syndrome (FAS), Partial Fetal Alcohol Syndrome (pFAS), or Alcohol Related Neurodevelopmental Disorder (ARND, provisional). To receive a diagnosis of FAS a child had to have: postnatal growth retardation (height or weight $\leq 10^{th}$ percentile); at least 2 of 3 characteristic facial features (flat philtrum, flat upper vermillion border, palpebral fissures $\leq 10^{th}$ percentile); evidence of CNS involvement as demonstrated by OFC $\leq 10^{th}$ percentile or deficit developmental functioning as measured by standardized testing; and confirmation of PAE. For pFAS a child had to have 2 of 3 facial features, CNS involvement, and confirmation of PAE. For ARND, a child need not have growth retardation or facial features but must have CNS involvement and confirmation of PAE.

All toddlers were examined by the study pediatrician. The study pediatrician was trained in the assessment of FASD by a pediatric dysmorphologist who had expertise in the diagnosis of individuals with FASD and who was a major contributor to the epidemiological ascertainment study identifying the prevalence of FASD in the Western Cape of South Africa.[6] Following this training, the pediatrician underwent reliability training with the senior study clinician who has extensive experience and reliability in the use of the diagnostic system. Inter-observer reliability was obtained on 22 infants and toddlers. Kappa coefficients (*k*) were 0.91 for head circumference, 0.86 for palpebral

fissure length (within 1 mm), 0.95 for philtrum, and 0.95 for lip. Overall diagnostic reliability for a FASD achieved a *k*=1.00.

During Stage II assessment, palpebral fissure lengths were obtained with a ruler marked in millimeters recording the distance from the medial canthus to the lateral canthus. The characteristics of the upper lip and philtrum were reassessed using the Lip-Philtrum Guide.[15] The measure of CNS involvement included hard neurological signs as well as OFC $\leq 10^{th}$ percentile. In addition, all toddlers were administered the *BSID-III* by a trained study psychometrist. A child was considered to meet CNS criteria if they attained a score of < 85 on either the cognitive or motor scales of the *BSID-III*. Children were classified as having FAS, pFAS, ARND (provisional), or not having FAS. These diagnoses were confirmed through blind assessment by a rater in the United States using the *FAS Facial Photographic Analysis Software Version 2.0*, a computerized analysis of facial photographs (including measures of palpebral fissure lengths and lip).[16] Philtrum was assessed from frontal and ¾ view photographs of each child using the Lip-Philtrum Guide. Additionally, the rater examined growth parameters (height and weight), OFC measurements, and *BSID-III* scores to confirm diagnoses.

RESULTS

Fourteen toddlers met at least one or more of the Stage I screening criteria and were referred to the study pediatrician for a Stage II diagnostic work-up. Of the 14 toddlers who were referred, 13 (93%) met criteria for a FASD suggesting that the screening procedure was highly sensitive. The diagnostic breakdown of the 13 toddlers included 15% with FAS; 23% with pFAS; and 62% with ARND, provisional (75% of those with ARND met criteria based on head circumference $\leq 10^{th}$ percentile). A provisional diagnosis of ARND was necessary given the young age of the children and the need for more reliable measures of CNS involvement as they mature.

Mothers with FASD-positive toddlers did not differ on any demographic variables from mothers of FASD-negative toddlers (Table 2). As expected, there were significant differences between groups on all measures of alcohol use at each assessed time period. Table 3 presents these data. Mothers with FASD-positive children had higher *AUDIT-C* scores, higher quantity and frequency scores, and a higher number of binge episodes (defined as three or more drinks in a day) when compared to mothers of children who were FASD-negative. Mean *AUDIT-C* scores of the mothers of these FASD-positive toddlers were: 8.4 (SD = 3.2) prior to pregnancy recognition; 4.0 (SD = 4.4) following pregnancy recognition; and 5.2 (SD = 4.2) at 18-month follow-up. Average quantity of alcohol consumed per drinking occasion was 5.5 (SD = 2.7) prior to pregnancy recognition; 2.5 (SD = 3.2) following pregnancy recognition; and 2.7 (SD = 2.8) at 18-month follow-up. The frequency of binge episodes was 2.3 (SD = 2.3), 1.1 (SD = 2.1), and 1.0 (SD = 1.5), respectively, for each measured time period. Study findings resulted in a prevalence rate of 9.56% (13/136) of children whose mother's drank during pregnancy meeting criteria for a FASD and a total sample estimate of 2.5% (13/518).

TABLE 2

	FASD- Positive (n=13)		FASD-Negative (n=126)		Total (n=139)		Estimated Mean/OR, FASD vs. Not [2]	95%	CI [2]	P-Value [2]
	n	%	n	%	n	%				
Mean maternal age in years, SD	29.2	6.2	27.7	5.7	27.8	5.8	1.56	-1.79	4.92	0.358
Married or living with partner	6	46.2	49	38.9	55	39.6	1.56	0.50	4.84	0.445
Employed	4	30.8	24	19.0	28	20.1	1.89	0.54	6.61	0.318
Household monthly income 2001 Rand and above	6	46.2	74	62.7	80	61.1	0.53	0.17	1.65	0.273
Mean highest education level, SD	9.5	2.3	9.9	2.1	9.9	2.1	-0.37	-1.58	0.85	0.552
HH has electricity	11	84.6	119	94.4	130	93.5	0.58	0.09	3.65	0.564
Lives in formal housing	2	15.4	49	38.9	51	36.7	0.39	0.11	1.42	0.153
Water on site	5	38.5	84	66.7	89	64.0	0.73	0.37	1.47	0.383
Flush toilet vs. other type	4	30.8	85	67.5	89	64.0	0.58	0.32	1.06	0.078
Women living with HIV	7	53.8	41	32.5	48	34.5	2.66	0.88	8.05	0.084
Mean wks pregnant at discovery, SD	11.3	5.9	8.6	5.5	8.8	5.6	2.74	-0.48	5.96	0.095
Mean wks pregnant at baseline assessment, SD	26.7	9.2	25.5	7.9	25.7	8.0	1.30	-3.53	6.12	0.595
Mean number of antenatal clinic visits, SD	3.8	2.0	4.9	2.2	4.8	2.2	-1.19	-2.48	0.10	0.070

Comparison of 18-month demographics of women with FASD-positive children (N=13) to women with FASD negative children (n=126).[1]Total sample size is N=139 including N=132 regular entry participants and N=7 late entry participants. [2]From linear (continuous variables) or logistic (binary variables) random effects regressions, adjusted for neighborhood clustering.

Abbreviations: CI= Confidence Interval; FASD= Fetal Alcohol Spectrum Disorder; HH= Household; HIV= Human Immunedeficiency Virus; OR= Odds Ratio; SD= Standard Deviation

TABLE 3

	FASD-Positive (n = 13)		FASD-Negative (n = 126)		Estimated Mean OR[2]	95%	CI[2]	P-Value[2]
	n	%	n	%				
Alcohol use Prior to Pregnancy Recognition								
Mean AUDIT-C score, SD	8.4	3.2	5.1	3.4	3.40	1.40	5.40	0.001
Mean times per week drank alcohol, SD	1.7	2.1	0.7	0.9	1.11	0.44	1.78	0.001
Mean number of drinks per drinking occasion, SD	5.5	2.7	3.4	2.7	1.91	0.33	3.48	0.018
Mean number of drinks/week, SD	10.0	16.6	3.0	5.2	7.09	2.85	11.33	0.001
Mean number of times drank 3+ drinks in one day, SD	2.3	2.3	0.6	1.1	1.67	0.95	2.39	0.000
Alcohol Use after Pregnancy Recognition								
Mean AUDIT-C score, SD	4.0	4.4	1.5	2.8	2.55	0.79	4.32	0.005
Mean times per week drank alcohol, SD	1.2	2.1	0.2	0.6	1.00	0.48	1.51	0.000
Mean number of drinks per drinking occasion, SD	2.5	3.2	0.9	1.7	1.58	0.49	2.67	0.005
Mean number of drinks/week, SD	5.3	11.4	1.0	4.1	4.30	1.18	7.42	0.007
Mean number of times drank 3+ drinks in one day, SD	1.1	2.1	0.2	0.7	0.89	0.35	1.43	0.001
Alcohol Use at 18 Month Post Birth Follow Up								
Mean AUDIT-C score, SD	5.2	4.2	2.0	3.1	3.25	1.2	5.2	0.002
Mean times per week drank alcohol, SD	1.0	1.4	0.3	0.6	0.71	0.2	1.1	0.002
Mean number of drinks per drinking occasion, SD	2.7	2.8	1.1	1.9	1.58	0.4	2.7	0.009
Mean number of drinks/week, SD	4.3	7.4	1.0	2.4	3.46	1.4	5.4	0.001
Mean number of times drank 3+ drinks in one day, SD	1.0	1.5	0.2	0.4	0.81	0.4	1.1	0.000

Comparison of drinking behaviors of women with FASD-positive children (n = 13) to women of FASD-negative children (n = 126); [1]Total sample size is N=139 including N=132 regular entry participants and N=7 late entry participants; [2]From linear (continuous variables) or logistic (binary variables) random effects regressions, adjusted for neighborhood clustering.
Abbreviations: CI = Confidence Interval; FASD= Fetal Alcohol Spectrum Disorder; HIV= Human Immunedeficiency Virus; OR= Odds Ratio; SD= Standard Deviation.

DISCUSSION

The importance of this study is highlighted by the finding that screening for FASD can be easily mastered by nonmedical community workers. Given the short supply of physicians and allied health professionals in South Africa, this approach to the public health needs of women and children is promising. Further, the protocol for diagnosis based upon the Hoyme et al.[4] modification of the IOM criteria can be reliably used by community physicians to make a FASD diagnosis. One caveat to this conclusion is that a diagnosis of ARND, based upon head circumference measurements and early developmental testing such as that provided by the *BSID-III*, must be considered provisional until the child is older and more reliable neurocognitive measures can be employed. Central nervous system deficits require valid and reliable standardized test results for final diagnostic confirmation of a FASD if no structural brain anomalies or hard neurological signs are present.[17]

In contrast to the prevalence rates reported in populations of children in the Western Cape of South Africa[6], the rates observed in the current study are substantially lower. Although the lower rates found in our study population are encouraging, possible explanations for such differences deserve discussion. The reason for differences may relate to the fact that women sampled in the current study were Black Africans from an urban area of South Africa just outside Cape Town, whereas those in the Western Cape were primarily Cape Colored (mixed race) and were disproportionately more likely to come from rural areas of the wine growing region where the Dop System, although illegal, may still exist. The Dop System (after the Afrikaans word 'dop' meaning an alcoholic drink), is a program in which farm workers received payment in the form of a daily measure of cheap wine from farm owners. In 2003, a new *Liquor Act* outlawing the system was adopted by the South African Parliament.[18] Although now paid in cash, many workers still spend their wages on alcohol with abusive drinking found among both men and women.[19] The authors acknowledge this sampling bias stating that the results represent the "worst case scenario" for prevalence and severity of FASD.[6] Another difference in methodologies is reflected in the ages of study samples our sample was of 18-month-old children compared to the Western Cape sample of 1st grade children. Research suggests that diagnosis becomes clearer as children age[17] making diagnosis more definitive in older children. Finally, in the Western Cape sample, retrospective reports of alcohol consumption during pregnancy were employed as opposed to measures taken during pregnancy in our sample. Recent findings reveal that women may underreport drinking levels when queried during pregnancy and that retrospective reports correlate more highly with later neurocognitive and physical deficits associated with PAE.[20]

The results of the present study should be interpreted in light of its limitations. The findings in this study are limited by sampling constraints. This study has the advantage over other studies relying on small convenience samples in that appropriate sampling techniques were applied; nevertheless, the sample consisted of a small number of individuals from a fairly restricted geographic and culturally specific group, making generalization of prevalence estimates to larger and more diverse groups of individuals in South Africa difficult. Thus, prevalence rates should be viewed with caution and were not the intended purpose of the study. In addition, given the potentially sensitive or stigmatizing questions that were included in the self-report questionnaire, the use of such a measure to assess alcohol consumption may have resulted in under-reporting of alcohol use during the time periods assessed. However, the use of interviewers of the same cultural/ethnic backgrounds and the confidentiality of participant responses suggest to us that women were truthful in their reporting. Finally, specificity of screening could not be determined because children of mothers who did not drink were not screened or independently evaluated by the study pediatrician. This may not represent a significant limitation; however, since a history of PAE is required for any diagnosis of a FASD.

The results from the present study are encouraging suggesting that rates of FASD are lower than those observed in other regions of South Africa; however, findings reveal that 26%

(139/518) of women living in poverty from townships outside Cape Town drink during pregnancy and following the birth of their alcohol-exposed children. Thus, there continues to be a need for education about drinking during pregnancy and an economically feasible method of identifying children who have been affected by PAE. The World Health Organization has estimated that 57 countries face health worker shortages; 36 of these countries are in sub-Saharan Africa.[21] One of the solutions has been a focus on task shifting--medical and health service tasks that previously were performed by higher level cadres are shifted or delegated to lower level cadres.[22] This study demonstrates that such an approach is promising and that community workers can effectively screen for FASD in areas lacking adequate medical resources.

A question remains concerning the need for services for children who receive a diagnosis of an FASD. All children who received a diagnosis in our sample were referred to the Cape Mental Health Society (CMHS) a local community organization with special care treatment centers that work primarily with children who have special needs. In addition, we will continue to follow these children to age 5 years. Although not an intervention for toddlers, a promising approach has been described by Adnams and colleagues of a classroom intervention for a small sample of 1st grade students with FAS in the Western Cape Region of South Africa.[23] The intervention consisted of cognitive control therapy (CCT), which instructs children in strategies that facilitate their ability to acquire and organize information more effectively. Study staff worked collaboratively with regional educational professionals and school personnel in developing the intervention and children's cognitive processing deficits and strengths were identified in order to aid in intervention planning. Findings were that children who received CCT demonstrated marked improvements in classroom behavior. The intervention group also showed qualitative improvements in academic achievement, writing, and communication skills, according to teacher report; improvements in self-efficacy, motivation, self-confidence, and emotionality, according to therapist report; and general school achievement, attitude towards learning, and self-confidence, as reported by school staff.

In spite of these encouraging results, in light of the multiple risks often experienced by children with FASD, designing effective interventions is challenging. Interventions that seek to prevent drinking during pregnancy, remediate primary deficits, as well as mitigate the various environmental liabilities that often accompany a history of PAE may yield the most positive outcomes. Such approaches may necessitate focusing not only on the child but on their caregiving environment as well. These approaches must include efforts to improve parenting skills, teach caregivers to connect with community resources, and/or directly enhance caregiver psychosocial functioning. Such an approach has proven successful in our work with this population and may serve as a model for future interventions provided in community settings by community workers.[24]

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REFERENCES

1. Warren KR, Hewitt BG, Thomas JD. Fetal Alcohol Spectrum Disorders: Research challenges and opportunities. Alcohol Res Health 2011;34:4-14.

2. Jones KL, Smith DW. Recognition of the fetal alcohol syndrome in early infancy. J Lancet 1973;302:999-1001.
3. Kodituwakku PW. Neurocognitive profile in children with fetal alcohol spectrum disorders. Dev Disabil Res Rev 2009;15:218-224.
4. Hoyme HE, May PA, Kalberg WO, et al. A practical clinical approach to diagnosis of fetal alcohol spectrum disorders: Clarification of the 1996 Institute of Medicine criteria. Am Acad Pediatrics 2005;115:39-47.
5. Stratton KR, Howe CJ, and Battaglia FC. Fetal alcohol syndrome: Diagnosis, epidemiology, prevention, and treatment. Washington DC: National Academies Press, 1996.
6. May PA, Blankenship J, Marais AS, et al. Approaching the prevalence of the full spectrum of fetal alcohol spectrum disorders in a South African population-based study. Alcohol Clin Exp Res 2013;37:818-30.
7. Kaiser Family Foundation. Global Health Facts: Physicians (Per 10,000 Population) 2013. http://kff.org/global-indicator/physicians (February 6, 2014). Archived by WebCite® at http://www/webcitation.org/6NBzmgWzf .
8. Streissguth AP, Barr HM, Kogan J, Bookstein FL. Understanding the Occurrence of Secondary Disabilities in Clients with Fetal Alcohol Syndrome (FAS) and Fetal Alcohol Effects (FAE): Final Report to the Center for Disease Control. Seattle: University of Washington, Fetal Alcohol and Drug Unit, 1996.
9. Rotheram-Borus MJ, le Roux IM, Tomlinson M, et al. Philani Plus (+): A Mentor Mother community health worker home visiting program to improve maternal and infants' outcomes. Prev Sci 2011;12:372-388.
10. Dawson DA, Grant BF, Stinson FS. (2005). The AUDIT-C: Screening for alcohol use disorders and risk drinking in the presence of other psychiatric disorders. Compr Psychiat 2005;46:405-416.
11. Saunders JB, Aasland OG, Babor TF, de la Fuente JR, Grant M. Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption--II. Addict Biol 1993;88:791-804.
12. Pitpitan EV, Kalichman SC, Eaton LA, et al. Co-occurring psychosocial problems and HIV risk among women attending drinking venues in a South African township: a syndemic approach. Ann Behav Med 2013;45:153-62.
13. Bayley N. Bayley Scales of Infant and Toddler Development-Third Edition: Administration Manual. San Antonio, TX: Harcourt Assessment, 2005.
14. World Health Organization. The world health report 2006: working together for health, 2006. http://www.who.int/iris/handle/10665/43432#sthash.cIvM3LeN.dpuf
15. Astley SJ. Diagnostic guide for fetal alcohol spectrum disorders: The 4-digit diagnostic code. 3rd ed. Seattle WA: University of Washington, 2004.
16. Astley SJ. FAS Facial Photographic Analysis Software Version 2.0. Seattle, WA: University of Washington, 2012.
17. Bertrand J, Floyd RL, Weber MK, et al. National Task Force on FAS/FAE. Fetal Alcohol Syndrome: Guidelines for Referral and Diagnosis. Atlanta, GA: Centers for Disease Control and Prevention, 2004.
18. Merten M. New Liquor Bill outlaws 'dop' system. Mail & Guardian Online, 2003. URL:http://mg.co.za/article/2003-09-05-new-liquor-bill-outlaws-dop-system. (February 2, 2014). Archived by WebCite® at http://www/webcitation.org/6NC4TfS2Y
19. Morojele NK, London L, Olorunju SA, Matjila MJ, Davids AS, Rendall-Mkosi KM. Predictors of risk of alcohol-exposed pregnancies among women in an urban and rural area of South Africa. Soc Sci Med 2010;70:534-542.
20. Hannigan JH, Chiodo LM, Sokol RJ, et al. A 14-year retrospective maternal report of alcohol consumption in pregnancy predicts pregnancy and teen outcomes. Alcohol 2010;44:583-594.
21. de Onis M, Onyango A, Borghi E, Siyam A, Blössner M & Lutter C for the WHO Multicentre Growth Reference Study Group. Worldwide implementation of the WHO Child Growth Standards. Public Health Nutr 2012;15:1603-1610.
22. Zachariah R, Ford N, Philips M, et al. Task shifting in HIV/AIDS: opportunities, challenges and proposed actions for sub-Saharan Africa. Transactions of the Royal Society of Tropical Medicine and Hygiene 2009;103:549-58.

23. Adnams CM, Kodituwakku P, Hay A, et al. Patterns of cognitive-motor development in children with Fetal Alcohol Syndrome from a community in South Africa. Alcohol Clin Exp Res 2001;557-562.
24. Rotheram-Borus MJ, Tomlinson M, le Roux IM, Harwood JM, Comulada S, O'Connor MJ, Worthman C. A Cluster randomised controlled effectiveness trial evaluating perinatal home visiting among South African mothers/infants, PLOS One, *in press*.