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·Original Article·

A case-control study of risk factors for male infertility in Nigeria

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Abstract

Aim: To evaluate the association between selected potential socio-demographic and behavioral risk factors and infertility in Nigerian men. **Methods:** There were two groups in this study. One group consisted of 150 men with proven male infertility, and the other consisted of 150 fertile men with normal semen parameters. Both were matched for age, place of residence and key socio-demographic variables. They were compared for sexual history, past medical and surgical history, past exposures to sexually transmitted infections and treatment, past and current use of drugs as well as smoking and alcohol intake history. **Results:** Infertile men were significantly more likely than fertile men to report having experienced penile discharge, painful micturition and genital ulcers, less likely to seek treatment for these symptoms and more likely to seek treatment with informal sector providers. Multivariate analysis showed that male infertility was significantly associated with bacteria in semen cultures, self-reporting of previous use of traditional medications and moderate to heavy alcohol intake, but not with smoking and occupational types. **Conclusion:** Infertility is associated with various proxies of sexually transmitted infections (STIs) and poor healthcare-seeking behavior for STIs in Nigerian men. *(Asian J Androl 2005 Dec; 7: 351–361)*

Keywords: male infertility; Nigeria; semen analysis; genital infection; smoking; alcohol; risk factor

1 Introduction

Available evidences suggested that male infertility is an important but neglected reproductive health issue in Nigeria. Published studies indicated that the male factor accounts for 20 %–50 % of the causes of infertility in different parts of the country [1, 2]. However, very little has been done to identify the original causes of male infertility in the country, and several reports on the major part of male infertility is unexplained [2]. Ojengbede *et al.* [3] screened infertile men in Ibadan with the alpha-glycosidase test and found cases where occlusion of the vas deferens may be responsible for infertility. Similar studies revealed high rates of hyperprolactinemia [4, 5], anti-sperm antibodies [6] and genital infections [7] in Nigerian men presenting with infertility. However, these

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studies failed to explore the background causes of these abnormalities, and the absence of a control group also made it difficult to interpret the findings.

Studies from several populations around the world [8–10] indicated that smoking, types of occupation, alcohol and coffee intake and nutritional factors are risk factors of male infertility. To date, the substantive information is still lacking on the importance of these and other related conditions as risk factors for male infertility in Nigeria. Such information is critical, as it would enable the design of programs to prevent male infertility in the country.

Ibeh *et al*. [11] first reported higher concentrations of aflatoxin in infertile Nigerian men than those in fertile controls and concluded that the consumption of native diets containing this contaminant may predispose to male infertility. Although the results of this study still need to be confirmed, it nevertheless points out the possibility that locally endemic factors may be important in the causation of male infertility in Nigeria.

Important local factors may be important for male infertility in Nigeria including infections, such as tuberculosis and mumps that may damage the male reproductive system directly or indirectly. Sexually transmitted infection (STI) is another common problem that has been poorly investigated for its association with male infertility in Nigeria. Several sexually transmitted bacteria such as *Neisseria gonorrheae* and *Chlamydia trachomatis* are highly prevalent in Nigeria [12], which are known to damage the male genital tract. There are reports indicating high rates of infertility among males attending STI clinics in Nigeria [13], and it would be relevant to the determination of the relationship between previous exposure to STIs and infertility in Nigerian men. Since the pattern of sexual behavior has a direct connection with the prevalence of STIs, it would be relevant to the determination of the impact of polygamy and sexual relationships with multiple partners, both being common phenomena in Nigeria.

Other equally important factors with high prevalence in Nigeria include previous exposure to drugs, smoking and alcohol, concurrent medical illnesses, as well as surgical procedures, such as hernia repairs and the use of native medications.

The objective of this study was to evaluate the association between infertility and selected socio-demographic and behavioral factors in Nigerian men. In the absence of currently effective methods for treating a large proportion of men suffering from infertility, the results of this study are expected to be useful for identifying relevant interventions for preventing male infertility in Nigeria.

2 Materials and methods

2.1 Patients

The study was a case-control study conducted at the Reproductive Health Clinic of the Women's Health and Action Research Center, Benin City, Nigeria, from 1 January 1999 to 31 December 2003. The cases were 150 men found to have abnormal semen parameters when their wives presented for investigation and treatment of infertility in the clinic. The controls were 150 men with normal semen parameters and their spouses were pregnant at the time of the study.

All the cases were identified from couples presenting to the clinic requesting investigation and treatment of infertility. A detailed history of infertility was elicited from the couples, and physical and special investigations were carried out, including hysterosalpingography and/or laparoscopy to evaluate tubal factor, hormone assay for ovulation assessment and trans-vaginal ultrasound scan as part of ovulation assessment and to exclude uterine and endometrial abnormalities. Only those identified as having semen anomalies as the only cause of their infertility and consented to participate in the fully explained protocol were included as cases in the study. Among the 150 couples identified with male-factor only infertility, 89 (59.3 %) had primary infertility and 61 (40.7 %) had secondary infertility ranging of 3–15 years (median 8.5 years). Thus, they all had definite evidence of infertility as defined by World Health Organization (WHO) [14].

The controls were selected from men with proven fertility. Their wives were pregnant recently or delivered within 6 months of the study. These women were identified at the Reproductive Health Clinic and the study was explained to them. The women were asked to inform their partners and to request them to present in the clinic to participate in the study. The study was further explained to the presented men in great detail and only those who gave consent were included in the study. Once an infertile men was identified, a fertile control was matched to him for age and place of residence.

2.2 Semen analysis

Semen analyses were conducted in both cases and

controls after abstinence of three days at least, using established WHO criteria [15]. The analyses were done twice at least two weeks apart to eliminate the possibility of a diurnal variability in the reported semen results. Only those with consistent results were included.

According to the WHO criteria [15], normal sperm concentration was accepted as greater than 20 million/mL; oligozoospermia as 5–20 million/mL and severe oligozoospermia as less than 5 million/mL. Motility was described as normal if 50 % or more of sperms were progressively motile within 60 min of ejaculation. Sperm morphology described the number of normal spermatozoa with an ovoid head, stainable acrosome head and a normal mid-piece and a tail. Although the WHO previously accepted 30 % as normal, Kruger *et al*. [16] have described strict criteria where less than 14 % normal morphology would be abnormal. The 4th edition of the WHO manual in use at the time of the study [15] did not specify a value for morphology and thus, we have not included this in the assessment. All semen samples were cultured using standard procedures to determine the presence of pathogenic organisms in the samples.

2.3 Study protocol

Following the initial assessments, a three-part-study protocol was designed to document the findings uniformly in both cases and controls. In the first part, we documented detailed information on the socio-demographic characteristics of the respondents–age, marital status and type of marriage, occupation, religion and educational background.

The second part included information on their sexual behavior and their previous symptoms suggestive of STIs, genital tract infections and other medical/surgical illnesses. If they had experienced these symptoms, we then asked how long the symptoms had lasted and where and how they had been treated. We also asked whether they smoked or took alcohol, and if so the types, duration and amount taken over time. In particular, we distinguished between cigarette and marijuana smoking to identify possible independent effects of these practices on male fertility. We also asked questions on their use of medications, either routinely or for the indicated medical conditions.

In the final part, we recorded the results of physical examination and laboratory tests conducted in both cases and controls. In particular, we recorded the presence of the testicles within the scrotal sacs and whether or not they had varicocoele or urethral discharge at the time of the study. We also recorded the results of semen analyses.

Specially trained nurses completed all protocols in private and the subjects were assured of confidentiality of the information obtained. All infertile men received appropriate treatment and counseling as part of the infertility work-up and treatment in the clinic. The Human Ethics Committee of the University of Benin Teaching Hospital approved the study protocol.

2.4 Data analysis

Data analysis consisted of calculation of responses to the questions for both cases and controls. The results of any differences were compared by ANOVA, chi-squared test or chi-squared test for trends as appropriate. Odds ratios and confidence intervals were calculated to measure the independent effects of the variables. A multivariate logistic regression was carried out to determine the pooled effects of the various variables, enabling us to rank the risk factors for male infertility regarding their possible relative effects.

3 Results

The results of semen analysis performed on the fertile and infertile men were shown in Table 1. As expected, infertile men had lower sperm concentration, poorer sperm motility and lower percentage of viable forms of spermatozoa than fertile men. Twelve (8.0 %) infertile men had sperm counts above 20 million/mL, but they also had lower sperm motility (< 50 %) and lower percentages of viable forms (< 30 %). Thus, poor motility and abnormal sperm morphology were presented as the sole abnormalities in 8.0 % of infertile men. Similarly, infertile men were significantly more likely to have bacterial organisms in semen cultures than fertile men. Sixty-eight of 150 infertile men (45.0 %) grew various bacterial organisms in their semen compared to 37 of 150 (24.7 %) fertile men ($P < 0.01$). The most common organisms grown were *Staphylococcus aureus, Streptococcus fecalis, Trichomonas vaginalis* and *Candida albicans*.

The socio-demographic characteristics of the cases and controls are presented in Table 2. Fertile and infertile men were similar in all respects, including age, educational backgrounds, marital status and types of family, They were all from identical ethnic groups. Their religious and occupational backgrounds were also similar (data not shown). The mean ± SD age of infertile men

Table 1. Results of semen analysis by fertility status.

Variables	Fertile		Infertile		*P*
	n	percentage (%)	*n*	percentage (%)	
Semen concentration					
> 20 million/mL	145	96.7	12	8.0	
> 10 – 20 million/mL	5	3.3	15	10.0	
> 5 – 10 million/mL	–		17	11.3	
< 5 million/mL	–		64	42.7	
Azoospermia	–		42	28.0	< 0.001
Motility					
> 50 %	147	98.0	26	17.3	
30 %–50 %	3	2.0	23	15.3	
< 30 %	–		59	39.4	
Azoospermia	–		42	28.0	< 0.001
Viable form					
0	–		13	8.7	
> 50 %	132	88.0	25	16.7	
30–50 %	17	11.3	35	23.3	
< 30 %	1	0.7	35	23.3	
Azoospermia	–		42	28.0	< 0.001
Semen culture					
No growth	113	75.3	82	55.0	
Positive bacterial growth	37	24.7	68	45.0	< 0.001

was 37.3 ± 4.8 years, whereas fertile men were aged 37.5 ± 6.1 years; the results were not statistically significant.

The reported pattern of sexual activity in the cases and controls were presented in Table 3. There were no significant differences between fertile and infertile men in their reported patterns of sexual activity. The reported numbers of sexual episodes in the preceding week, the current number of sexual partners and the number of sexual partners ever had were also similar between the cases and controls.

The frequencies of self-reporting of symptoms of STIs and the pattern of health seeking for reported STI symptoms were presented in Table 4. The infertile men were significantly more likely to report recurrent penile discharge, painful urination, genital ulcer and testicular pain than fertile men. But there were no significant differences between the two groups in rates of self-reporting of recurrent itching in the genital area and testicular swelling. The number of episodes and duration of each episode did not differ significantly between the two groups (data not shown).

The patterns of treatment seeking for reported symptoms of STIs in both groups were also shown in Table 4. Different forms of treatment of STI symptoms had been reported in this community, including self-treatment, informal sector treatment with traditional medicines and patent medicine dealers and formal sector treatment in hospitals and certified health providers [17]. However, only those reporting treatment with formal health providers had been presented here as "receiving treatment", and those reporting informal treatments were categorized as "not treated", because the latter had not been proven to be evidence-based. Overall, infertile men were more likely to report treatment with informal sector providers (data not shown). By contrast, fertile men were significantly more likely to report that they received treatment with formal sector providers for their reported penile discharge, painful urination, itching genital area, genital ulcer and testicular pain.

Regarding past history of medical and surgical condi-

Table 2. Socio-demographic characteristics by fertility status. [a]Other ethic groups, including Kwale, Hausa, Ijaw, Owan, Idoma, Rivers, Jukun. NS: not significant.

Variables	Fertile		Infertile		*P*
	n	Frequencies (%)	*n*	Frequencies (%)	
Age (years)					
< 30	6	4.0	8	5.3	
30–34	19	12.7	32	21.3	
35–39	40	26.7	41	27.3	
40–44	51	34.0	48	32.0	
45–49	27	18.0	13	8.7	
50+	7	4.7	8	5.3	NS
Educational level completed					
None	11	7.4	8	5.3	
Primary	14	9.3	19	12.7	
Secondary	40	26.7	41	27.3	
Tertiary	85	56.7	82	54.7	NS
Marital status					
Single	4	2.7	6	4.0	
Married	138	92.0	136	90.7	
Separated	4	2.7	3	2.0	
Divorced	2	1.3	3	2.0	
Cohabiting	2	1.3	2	1.3	NS
Type of family					
Monogamy	116	77.3	122	81.3	
Polygamy	28	18.7	21	14.0	
Not stated	6	4.0	7	4.7	NS
Ethnic group					
Urhobo	12	8.0	12	8.0	
Estsako	4	2.7	9	6.0	
Yoruba	14	9.3	13	8.7	
Bini	41	27.3	39	26.0	
Ishan	20	13.3	27	18.0	
Igbo	39	26.0	28	18.7	
Itshekiri/Isoko	7	4.7	7	4.7	
Others[a]	13	8.8	15	10.0	NS

tions, there were no differences between the two groups in their self-reporting of mumps, diabetes, hypertension, hypothyroidism, hyperthyroidism and cancer as well as their use of drugs known to depress testicular function, such as antihypertensives, antidepressants, cimetidine, nitrofurantoin and sulphasalazine (data not shown). However, 4.1 % of fertile men reported native medications repeatedly in the past, compared to 33.8 % of infertile men ($P < 0.01$). Eleven infertile and four fertile men reported that they had previous surgical operations in their genital areas. The differences between the groups were not statistically significant. The types of surgical operations (inguinal herniorrhaphies, testicular biopsy and repair of testicular maldescent and varic-ocoelectomy)

Table 3. Experiences of sexual activity in fertile and infertile men. NS: not significant.

Variables	Fertile		Infertile		*P*
	n	percentage (%)	*n*	percentage (%)	
No. episodes of sexual intercourse per week					
0–1	32	21.3	33	22.0	
2–4	111	74.0	98	65.3	
5–10	2	1.3	13	8.7	
Not sexually active	2	1.3	2	1.3	
Not stated	3	2.0	4	2.7	NS
No. current sexual partners					
1	70	46.7	83	55.3	
2	52	34.7	31	20.7	
3–4	23	15.3	28	18.7	
5–6	4	2.7	4	2.7	
Greater than 7	1	0.7	4	2.7	NS
No. sexual partners over lifetime					
0	5	3.3	7	4.7	
1–10	116	77.3	102	68.0	
11–20	23	15.3	30	20.1	
21–25	5	3.3	7	4.7	
Over 26	1	0.7	4	2.7	NS

were not statistically different between the two groups.

Finally, we compared the pattern of smoking and alcohol intake in fertile and infertile men (Table 5). There were no significant differences between them in the proportions reporting that they had ever smoked; however, infertile men were more likely to report longer duration of smoking. The types of smoking (cigarettes or marijuana) and the frequency of smoking did not differ between the two groups. Likewise, they did not differ in the proportions reporting use of alcohol. However, infertile men were more likely to be heavy drinkers. About 42.2 % of infertile men reported that they drank 1–2 glasses of alcohol per day compared to 12.9 % of fertile men ($P < 0.01$).

The results of the multivariate logistic regression of the risk factors for male infertility were presented in Table 6. The model identified 18 variables as possible predictive factors for male infertility in this population. However, after multivariate analysis, the following variables turned out to be important: poor sperm motility and low percentage of viable forms, lack of paternity with current wife or another partner, penile discharge, painful micturition, genital ulcer, use of referral hospital and chemists for treatment of STIs, use of native medications and excessive intake of alcohol (1–2 glasses of alcohol per day). Men who reported having had recurrent penile discharge were nearly eight times more likely to be infertile than those with no such history (OR: 7.8; CI: 2.9–21.5, $P < 0.01$). Also, men who reported having had recurrent pain on micturition were more likely to be infertile than men who did not give such histories (OR: 2.2; CI: 1.02–4.71, $P < 0.05$).

Other significant associations in the results were presented in Table 6. Previous genital ulcers and native medications increased the odds of being infertile nine times and nearly 12 times respectively. Also, men who drank more than 1–2 glasses of alcohol a day were more likely to be infertile than those drank less quantities of alcohol (OR: 6.05; CI: 1.81–22.30, $P < 0.01$). With respect to healthcare-seeking behavior for STIs, our results showed that men who reported that they used a referral hospital (teaching hospital) for treatment of their symptoms were at least 83 % less likely to be infertile than those using other forms of treatment (OR: 0.17; CI: 0.02–0.86, $P < 0.05$). By contrast, those who reported that they used chemists (patent medicine sellers) were more likely to be infertile than those using other forms of treatment (OR: 8.2; CI:

Table 4. Number and percentages reporting symptoms and treatment of STIs by fertility status. NS: not significant.

Variable	Fertile		Infertile		*P*
	n	percentage (%)	*n*	percentage (%)	
Penile discharge	24	16.0	63	42.0	0.003
Treated	23	95.8	35	55.6	
Not treated	1	4.2	28	44.4	0.001
Painful urination	51	34.0	74	49.3	0.05
Treated	50	98.0	45	60.8	
Not treated	1	2.0	29	39.2	0.004
Itching in genital area	48	32.0	59	39.3	NS
Treated	45	93.8	33	55.9	
Not treated	3	6.2	26	44.1	0.001
Genital ulcer	2	1.3	27	18.0	0.003
Treated	2	100	20	74.0	
Not treated	0		7	26.0	0.005
Testicular swelling	0	0.0	7	4.7	NS
Treated	0		3		
Not treated	0		4		NS
Testicular pain	6	4.0	18	12.0	0.002
Treated	6	100	12	66.7	
Not treated	0		6	33.3	0.005

2.1–36.6, $P < 0.001$). The other relationships in the logistic regression model were not statistically significant.

4 Discussion

The study was designed to identify potential risk factors for male infertility in southern Nigeria. The results showed significant associations between male infertility and previous exposures to sexually transmitted diseases, native medications and moderate-to-heavy alcohol intake. Men who reported having had repeated episodes of penile discharge, painful micturition, genital ulcers and testicular pain were significantly more likely to be infertile than those not reporting such episodes. As these are recognized to be important proxies for STIs in this population, it suggests greater exposures to STIs in infertile men than that in fertile controls. However, contrary to our hypothesis, there were no significant differences in the patterns of reported sexual behavior (i.e. number of sexual partners and sexual frequency) between the cases and controls, which suggests that the increased prevalence of STIs in infertile men may be due to other mechanisms rather than increased sexual activity. A possible mechanism could be that infertile men may be less likely to practice protective sex (e.g. using condoms) than fertile men, a relationship that was not explored in this study.

The results also showed that bacterial colonies were more likely to be grown in the semen of infertile men than the fertile controls. Thus, there are substantial evidences that both present and past genital tract infections are more prevalent in infertile men than those in fertile controls. Several reports have documented significant associations between STIs, genital tract infections and male infertility in Nigeria [7, 12]. However, the strength of this association has not been determined because of difficulties in establishing a causal relationship between prior exposures to genital tract infections and male infertility. Indeed, there have been questions raised in other populations [18] as to whether STIs and genital

Table 5. History of cigarette smoking and alcohol consumption in fertile and infertile men. NS: not significant.

Variables	Fertile		Infertile		*P*
	n	percentage (%)	*n*	percentage (%)	
Ever smoked	52	34.7	69	46.0	NS
Duration of smoking (years)					
1–5	37	71.2	22	31.9	
6–10	11	19.2	24	34.8	
11–15	1	1.9	13	18.8	
≥ 16	5	9.6	10	14.5	0.02
What did you smoke?					
Cigarette	41	78.8	46	66.7	
Marijuana	6	11.5	3	4.3	
Cigarette and marijuana	4	7.7	20	28.9	
Cocaine	1	1.9	–		NS
Frequency of smoking					
Daily	31	59.6	55	79.7	
Weekly	10	19.2	4	5.8	
Monthly	2	3.8	1	1.4	
Occasionally	9	17.3	6	8.7	
Stopped	–	3	4.3	NS	
No. (%) taking alcohol	116	77.3	116	77.3	NS
Amount of alcohol consumed					
1–2 glasses a day	15	12.9	49	42.2	
1–2 glasses a week	14	12.1	24	20.7	
1–2 glasses a month	12	10.3	6	5.2	
Occasionally	75	64.7	35	30.2	
Stopped	–		2	1.7	0.002

infections are causes of male infertility due to the early recognition and prompt treatment of these infections in these populations. However, it is well known that sexually transmitted organisms, such as *N. gonorrheae* and *C. trachomatis*, can cause epididymitis, inflammation of the vas deferens, prostatitis and urethritis [19], conditions which can all predispose to male infertility. Since *N. gonorrheae* and *C. trachomatis* make significant contributions to the burden of STIs in Nigeria [20], there can be no doubt that they would equally contribute to male infertility through this causal pathway. However, further studies are warranted, especially longitudinal studies that document the fertility history of men treated for various forms of STIs, as well as those use more robust markers of sexually transmitted diseases as endpoints for comparison.

Apart from the increased prevalence of STIs, another determinant of male fertility in our sample was the pattern of healthcare-seeking behavior for reported symptoms of STIs. It is well known that early and appropriate treatment of STIs can reverse the symptoms and prevent long-term complications. However, if treatment is delayed or carried out using inappropriate methods and drugs, the chances of developmening major complications are increased. The results indicated that infertile men were significantly more likely than fertile men to self-treat or to report using informal sector providers (traditional healers, chemists and patent medicine sellers)

Table 6. Adjusted odds ratios and confidence intervals (CI) for predictors of male infertility. RC: reference category.

Variables	Odds ratios	CI (95 %)	Variables	Odds ratios	CI (95 %)
Age (RC 45–49)			**Viable form (RC > 50)**		
< 30	1.16	0.2–5.0	< 50 %	4.94	2.3–10.8
30–34	1.47	0.4–4.7	**Culture (RC no growth)**		
35–39	0.89	0.2–2.7	Positive bacteria growth	0.94	0.1–15.4
40–44	0.82	0.2–2.4	**Paternity with present wife (RC yes)**		
50 +	0.42	0.1–1.4	No	2.69	1.4–5.3
			Paternity with another wife (RC yes)		
Marital status (RC cohabiting)			No	4.21	2.1–8.5
Single	1.50	0.2–15.5	**Smoking (RC no)**		
Married	0.98	0.1– 7.1	Yes	1.496	0.8–3.0
Separated	0.75	0.1–8.8	**Use of native medications (RC yes)**		
Divorced	1.50	0.1–21.3	No	11.89	3.4–41.5
			Past experience of genital ulcers (RC yes)		
Religion (RC Anglican)			No	8.8	3.7–9.2
Moslem	825.6	0.0–1.3	**Past experience of penile discharge (RC no)**		
Pentecostal	0.61	0.2–1.7	Yes	7.8	2.9–21.5
Catholic	0.52	0.2–1.5	**Past experience of painful urination (RC no)**		
Jehovah witness	825.6	0.0–9.6	Yes	2.2	1.0–4.7
			Use of referral hospital for STI treatment (RC no)		
Type of marriage (RC polygamy)			Yes	0.17	0.02–0.86
Monogamy	1.05	0.3–3.4	**Use of patent medicines for STI treatment (RC no)**		
			Yes	8.2	2.1–36.6
No. years trying to impregnate (RC 1–4)			**Frequency of smoking (RC occasionally)**		
5–10	0.95	0.5–1.9	Daily	1.90	0.8–7.4
11–15	0.18	0.0–0.9	Weekly	0.25	0.1–2.6
Over 15 years	3.30	0.4–31.0	Monthly	0.70	0.1–9.2
			Alcohol (RC no)		
Semen count (RC > 20 million)			Yes	1.15	0.6–2.3
10–20 million	1.000	0.0–0.1	**Quantity of alcohol (RC occasionally)**		
5–10 million	0.000	0.0–0.4	>1–2 glasses daily	7.14	2.3–22.4
< 5 million	1.000	5.0–112.1	>1–2 glasses a week	3.33	1.2–9.4
			>1–2 glasses a month	0.47	0.0–4.7
Motility (RC > 50 %)					
< 50 %	59.98	7.9–453.9			

to treat their STI symptoms and less likely to use formal providers (doctors, health centers and hospitals). Our early study [17] had shown that informal sector providers offer poor and ineffective treatment for STIs in Nigeria as compared to formal sector providers. Thus, the results of this study suggest poor treatment of STI symptoms to be strongly associated with male infertility in Nigeria. Clearly, any efforts to reduce the prevalence of male infertility in Nigeria must focus not only on the primary and secondary prevention of STIs, but also on improving the skills of health providers to offer quality treatment.

This study also showed that infertile men were more likely to report having used native medications. However, the direction of this effect is presently not known. Some men are known to use native medications as a form of treatment of male infertility, whereas others use native drugs as a habit, or for treatment of some other illnesses. To date, it is not known to what extent native medications suppress or improve spermatogenesis. Thus, the

results of our study may be an artifact indicating either that infertile males use native medications to treat their infertility or that native medications may predispose to male infertility. Further studies are needed to determine the direction of these relationships.

Although this study showed that a higher proportion of infertile men reported having ever smoked and that infertile men had longer duration of smoking, the results of the association between smoking and male infertility were not significant in the multivariate analysis. It was contrary to published findings in other populations [10] which consistently showed a strong association between cigarette smoking and male infertility. Our results may be due to the confounding effects of several social behaviors with smoking in this population, such as heavy alcohol intake, low socio-economic status and having multiple sexual partners. Despite the failure to show statistically significant independent effects of smoking on male infertility, we believe that the avoidance of smoking should still be included in programs that address male infertility in this population. This is because of the strong impact of smoking on male infertility that has been described in other populations and the fact that moderate association was indeed demonstrated in the bivariate analysis in this study.

Our results showed that moderate to heavy alcohol intake significantly increased the odds of male infertility in the sample. This confirmed the results from other populations [8], which showed a link between moderate-to-heavy alcohol intake and male infertility. However, the mechanism underlying this relationship is presently unclear. It may reflect the fact that men remaining infertile become depressed and begin to drink as a consequence rather than there being a direct relationship between alcohol intake and male infertility. Nevertheless, the results of our study suggested that any program to prevent male infertility in Nigeria should include measures to reduce the level of alcohol consumption in the country.

This case-control study could be criticized on the basis that its results were based on self-reporting of events rather than on more robust indicators. However, such indicators, especially those relate to STIs, were difficult to find in our population as they represented past events that were often poorly investigated and reported in official data. We consider that our cautious interviewing, coupled with a detailed explanation of the study protocol to the participants limited the chances of recall bias. Furthermore, syndromic management of STI relying on the elicitation of symptoms is currently the method recommended by the Nigerian Federal Ministry of Health for the treatment of STIs in health facilities.

In conclusion, the results of this study showed a significant association between male infertility and various proxies of sexually transmitted diseases and poor healthcare-seeking behavior for STIs among Nigerian men. Other significant risk factors for male infertility in this population include use of native medications and moderate-to-heavy alcohol intake, while cigarette smoking may be acting in mild or indirect ways. Efforts to address these problems will make significant contributions to reducing the prevalence of male infertility in Nigeria.

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