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Original article

Association between pesticide exposure and infertility of couple in the Boucle du Mouhoun region: A case-control study

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ABSTRACT

Introduction: Several pesticides act as endocrine disrupting chemicals. Our objective was to study the relation between pesticide exposure and infertility in couples in the Boucle du Mouhoun region.
Patients and methods: We implemented a case-control study with recruitment of hospitals cases and a retrospective collection of data from the registers, supplemented by a face-to-face-administered questionnaire. The sample size was calculated at 35 cases 70 controls. The dependent variable was the infertility (primary or secondary). The main independent variable was the exposure (direct or indirect) to pesticides. Univariate, bivariate and multivariate logistic regression analyses with random effect were implemented and the statistical significance level was 5%.
Results: The women controls had a better knowledge of pesticides (81.43% versus 45.71%) and were less exposed both directly (4.29%) versus 14.29%) and indirectly (34.29% versus 51.43%) Exposure to pesticides was noted in 48.57% of male cases against 62.86% of male controls. In the bivariate analysis, direct exposure to pesticides led to 3.72 (95%CI: 0,81-17,05) times more risk for infertility as compared to non-exposure. At the multivariate analysis, the adjusted odds ratio (ORA) of direct exposure versus non-exposure was 5 (95%CI: 0.87–28.92); and indirect exposure versus non-exposure had an ORA of 2.85 (95%CI: 1.01–8.04),
Conclusion: In the Boucle du Mouhoun region, couples experiencing infertility knew less about pesticides and were more exposed to them than couples who had no childbearing difficulties. Pesticides were a risk factor for the couple's infertility both in direct and indirect exposure.

1. Introduction

Infertility is defined as the inability of a couple to achieve pregnancy after 12 months of unprotected intercourse. Infertility is said to be primary when the couple has never had a child and secondary if there has been at least one child in the history of the couple.[1] About 15% of the world's population is affected by infertility[1] with male and female factors contributing almost equally. The incidence of infertility is increasing, drawing attention to environmental factors, genetic factors no longer being able to explain everything. The etiologies of infertility are diverse and include factors such as genetic mutations, chromosomal abnormalities, lifestyle, ovulation disorders, infections, and idiopathic infertility.

The infertility prevalence rate in population in Ouagadougou the capital city of Burkina Faso was 9.3% (95% CI: 7.0; 12.2) and 10.4% (95% CI: 7.9; 13.5) for men and women, respectively. The primary and secondary infertility prevalence rates were 4.8% (95% CI: 3.2; 7.2) and 4.4% (95% CI: 2.9; 6.7) respectively for men and 6.8% (95% CI: 4.8; 9.4) and 3.6% (95% CI: 2.2; 5.7) for women. Considering only infertile participants, primary infertility concerned 52.3% (95% CI: 37.2; 67.0) and 65.3% (95% CI: 50.6; 77.6) of men and women respectively. The infertility rate in hospital among women visiting gynecology services was 17.76% (IC95%: 16.81; 18.75) among whom 8,57% (IC95%: 7.90; 9.31) was cases of primary infertility.[2,3] Many health professionals are hypothesizing that the increasing prevalence of infertility among couples may be related to pesticides exposure as shown by studies.

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Several studies have shown that prolonged exposure to various chemical substances such as endocrine disruptors in the form of pesticides, fertilizers and industrial products (plasticizers and phytoestrogens), is associated with low fertility by disrupting various hormonal circuits.[4,5] The increased use of pesticides and insecticides in agriculture and in the environment is hazardous because these substances are toxic, persistent and bio accumulate.

Exposure to pesticides in women is associated with reduced fertility, stillbirths, premature births, low birth weight, spontaneous abortions, developmental disorders and multiple ovarian disorders.[6] Exposure to pesticides would also be associated with alterations in time-to-pregnancy.[7]

Pesticides interfere with the synthesis, storage, release and transport of hormones as well as the recognition and binding of receptors and post-receptor activation. These effects can lead to a modulation of the concentration of hormones and dysfunctions of the ovarian cycle. Most pesticides act as endocrine disrupting chemicals.[8]

The exposure of pregnant women to endocrine disruptors can affect the fetus and early exposure from the first moments of life would lead to disturbances in the normal development of reproductive organs and predispose to diseases in adulthood.[9] Exposure during the neonatal period would also negatively impact the reproductive health of future generations and lead to transgenerational effects on reproduction in both women and men.[10]

The Boucle du Mouhoun Region is also called the granary of Burkina Faso because it is one of the regions where agricultural activity is predominant. During the last three decades, pesticides and herbicides were extensively used in the whole country including the Boucle du Mouhoun Region. It is a region of around two millions inhabitants, of whom at least 80% are working in agriculture and providing 19% of the country's cereal production. Pesticides are widely used in this region and 45%, of the pesticides there are not homologated. Finally, it is common for producers to use pesticides reserved for cotton cultivation on fruits and vegetables. Actually the presence of a high concentration of cypermethrin (1–100 mg/kg DM) and deltamethrin (12–146 mg/kg DM) was found at the analysis of sample of fruits, vegetables and cereals treated with pesticides.[11] At the same time, health services are facing more and more demands for infertility treatment. Our objective was to study the relation between pesticides' exposure and infertility in couples in the Boucle du Mouhoun region in Burkina Faso.

2. Patients and methods

2.1. Study design and population

We implemented a case-control study with recruitment of cases in hospitals and retrospective collection of data from the registers of selected health facilities, supplemented by a questionnaire administered face to face. The survey took place from February 11 to 28, 2019 and concerned consultations from january 1st to December 31st, 2018 in the health district of Dédougou, in four health facilities including health and social promotion centers (CSPS) of Soukuy and Tionkuy, the Regional Hospital of Dédougou and the Urban Medical Center.

2.2. Sampling and sample size

The respondents' selection was made from the consultation registers of the gynecology services for the cases and the maternity registers for the controls. Were included as cases, couples living together and who desired a child without success for at least 12 months; who did not use any contraceptive method during this period; where one of the partners consulted in one of the gynecological services of the study area for difficulty in conceiving; where the female partner is aged between 18 and 40 years; and the male partner between 18 and 49 years.

Were included as controls, fertile couples whose last child is aged 12 months maximum and the female partner was followed up in one of the maternity unit in the study area.

Female partners whose maternity data were incomplete or who had an obvious cause of infertility (tubal ligation, hysterectomy, history of chemotherapy, radiotherapy, etc.) were excluded. Were also excluded men who had an obvious cause of infertility (history of vasectomy, non-descent of the testicles, accident of any type with complications such as sexual impotence or castration, history of prostate cancer, radiotherapy, infections, endocrine hypogonadism and sexual dysfunction …).

Considering a 95% confidence interval, a two-sided alpha error of 5%, a power of 80%, a case/control ratio of 1:2, an odds ratio of 4 and a prevalence of pesticide exposure in the general population of 20%,[2] the sample size was calculated at 33 cases rounded to 35 and 66 controls rounded to 70 meaning a total of 105 participants. The controls were matched to the cases using groups of ages and gender variables. We used the formula for calculating sample size in a case-control study, automated by open-epi platform (http://www.openepi.com/MatchCC/MatchCC.htm)

2.3. Data collection and statistical analysis

A survey form was used to collect data from delivery room and gynecological consultation registers. Each case was matched with two controls of the same age group. Once cases and controls were identified, their phone numbers were used to invite them to be part of the survey and seek their consent to participate. Then the spouse was also contacted for the administration of another specific questionnaire. The collected data was entered into a database using Epi data software, processed and analyzed using R.4.0.2 and SAS software in version 9.4.

We implemented simple and multivariate logistic regressions with random effect. The dependent variable was the infertility (primary or secondary) with a yes/no modalities. The main independent variable was the female partner's exposure to pesticides, which can be direct (the pesticide was directly used by the female partner whatever the reason and whatever the protective measures implemented) or indirect (the female partner was exposed through another individual (husband), without having to directly handle the pesticide). For example, women can be exposed indirectly either by washing the dirty clothes of their spouses or directly by handling pesticides in the fields. In the main analysis, the main independent variable was the female partner's exposure to pesticide which was a combination of direct and indirect exposure to pesticides. Subgroup analyses considered indirect and direct exposure to pesticides in two different models.

Univariate, bivariate and multivariate logistic regression analyses with random effect were implemented and the statistical significance level was 5%. In the bivariate analysis crude (non-adjusted) odd ratios were displayed, showing the association between the dependent variable and different independent variables, regardless of interactions and confounding factors. In the multivariate analysis, the initial model included all covariates associated at a significance level of $p = 0.2$. The final model considered a significance level of $p = 0.05$. The covariates included age, occupation, education level, alcohol consumption, smoking status and knowledge of pesticides.

3. Results

3.1. Socio-demographic and epidemiologic characteristics

A total of 72.38% of controls and cases were recruited at the regional hospital center of Dédougou. The women aged between 18 and 30 years represented 55.24%, the housewives 70.48% and the illiterate participants 58.09%. The cases were proportionally more represented in all these categories than the controls, with an exception on the level of education where the controls were more represented in the illiterate group (62.86% versus 48.57%) (Table 1). The controls had a better knowledge of pesticides (81.43% versus 45.71%), were less exposed both directly (4.29%) versus 14.29% and indirectly (34.29%) versus

Table 1
baseline socio-demographic Characteristics of the couples.

VARIABLES		Case		Control		Total sample	
		Number	%	Number	%	Number	%
Female partners							
Health facility	Dedougou Regional Hospital	31	88.57	45	64.29	76	72.38
	Urban medical centre	4	11.43	0	0	4	3.81
	Soukuy health facility	0	0	15	21.43	15	14.29
	Tionkuy health facility	0	0	10	14.29	10	9.52
	Total	35	100	70	100	105	100
Age group (years)	18–30	23	65.71	35	50.00	58	55.24
	31–35	6	17.14	23	32.86	29	27.62
	36–40	6	17.14	12	17.14	18	17.14
Occupation	Housewife	27	77.14	47	67.14	74	70.48
	Formal sector	3	8.57	12	17.14	15	14.29
	Informal sector	3	8.57	7	10.00	10	9.52
	Other	2	5.71	4	5.71	6	5.71
Education level	None	17	48.57	44	62.86	61	58.09
	Primary school	14	40.00	10	14.29	24	22.86
	Secondary school or more	4	11.43	16	22.86	20	19.05
Male partner							
Age group (years)	18–30	9	25.71	9	12.86	18	17.14
	31–40	21	60.00	36	51.43	57	54.29
	41–49	5	14.29	25	35.71	30	28.57
Occupation	farmer	18	51.43	24	34.29	42	40.00
	Formal sector	9	25.71	15	21.43	24	22.86
	Informal sector	6	17.14	25	35.71	31	29.52
	Other	2	5.71	6	8.57	8	7.62
Education level	None	15	42.86	39	55.71	54	51.43
	Primary school	10	28.57	12	17.14	22	20.95
	Secondary school or more	10	28.57	19	27.14	29	27.62

51.43% (Table 1).

The typical male case was between 31 and 40 years (54.29%), farmer (40%) or illiterate (51.43%). Smoking and alcohol consumption were found in 8.57% and 34.29% of cases respectively and 18.57% and 50% of controls, respectively. Exposure to pesticides was noted in 48.57% of cases against 62.86% of male controls (Table 1).

Infertile women (Table 2) had a mean duration of couple life of 6.46 years. There was 85.71% primary infertility and 54.29% of them wanted a child for at least 5 years and the mean duration of infertility was 6.37 years. The infertility was diagnosed by a physician in all cases and the woman was the origin in 97% of cases. Only 28.57% of the spouses visited a doctor and 19.23% of them were the origin of the infertility.

Among the control women (Table 3) the mean number of gestures was 3 and the mean number of children 3.83; 18.57% had experienced a miscarriage and 15.71% had lost a child. The dystocic deliveries represented 41.43% of all deliveries (see Table 4).

3.2. Infertility risk factors within the couple

At the bivariate analysis (see Table 5), the exposure to pesticides was associated to the couple infertility with a crude odd ratio (COR) of 1.84 (95%CI: 0.79–4.30). The CORs of the direct and indirect exposure were 3.72 (95%CI: 0.81–17.05) and 2.03 (95%CI: 0.87–4.71), respectively. Being between 31 and 35 years old or between 36 and 40 years old for women and 31–40 years old or 41–49 years old for men, as well as consuming alcohol were factors promoting fertility within the couple.

At the multivariate analysis, the adjusted odds ratios (AOR) of the exposure, the direct and indirect exposure to pesticides versus non-exposure were 2.91 (95%CI: 1.003–8.46), 5 (95%CI: 0.87–28.92) and 2.85 (95%CI: 1.01–8.04), respectively.

4. Discussion

4.1. Pesticide and fertility

While the odds ratios of the female partner's exposure, the direct or indirect exposure compared to non-exposure to pesticides were all showing a deleterious effect of pesticides on fertility, only the associations of the exposure and indirect exposure were statistically significant at the multivariate analyses. The borderline relation between direct exposure and infertility may be the result of the qualitative evaluation of the participants' exposure since several studies have demonstrated the role of pesticides on couple infertility.[12,13] The women' exposure to pesticides is under-estimated in general in Sub-Saharan Africa. The different pathways of female exposure to pesticides encompass direct exposure (direct application of pesticides in the field with very often inadequate protective equipment, education and training) the indirect exposure including occupational exposure (exposure from residues remaining on soil, foliage or crops, exposure while weeding, hoeing, planting, thinning, checking for disease, harvesting, packaging or transporting crops). Indirect exposure includes also non-occupational exposure (contaminated clothes washing, re-use of empty pesticides containers). Even though pesticides exposure is estimated to be the same for men and women, sex differences in biological characteristics (higher level of adipose tissue on average and experience of more hormonal changes in women during pregnancy, lactation, or menopause) leads to an increased susceptibility for the latter.[14,15]

Pesticides are compounds likely to reduce the quality of sperm in exposed workers. Most of them affect the male reproductive system through mechanisms such as reduction in sperm count, density, motility and viability, inhibition of spermatogenesis, inducing sperm DNA damage and increasing abnormal sperm morphology. Reduction in the weight of the testicles, epididymis, seminal vesicle and ventral prostate, degeneration of the seminiferous tubules, modification of plasma levels of testosterone, FSH-LH, decrease in level and activity of the antioxidant enzymes in the testes and inhibition of testicular steroidogenesis are other possible mechanisms.[16,17] Another specific mechanism of action may be the interference with normal $Ca2+$ signaling in human sperm through activation of the sperm-specific CatSper $Ca2+$ channel, which is vital for male fertility. Twenty-eight of 53 analyzed pesticides were found to induce $Ca2+$ signals in human sperm at 10 μM.[18]

Table 2
baseline epidemiologic Characteristics and pesticides exposure.

VARIABLES				Case		Control		Total sample	
				Number	%	Number	%	Number	%
Female partners									
Gynaecologic history		Fibrome		1	2.86	00			
		Ovarian kyste		0		0			
		Inflammatory pelvic disease		0		0			
		Mens cycle disorder		6	17.14	0			
		Genital infections		0		0			
Life style	Exposure to gonadotoxic		Yes	0		0			
			No	32	91.43	70	100.00		
	Smoking status		Yes	0		0			
			No	35	100.00	70	100.00		
	Drugs consumtion		Yes	0					
			No	35	100.00	70	100.00		
	Steroid anabolic intake		Yes	0					
			No	35	100.00	70	100.00		
	Alcohol consumption		Yes	0		17	24.29		
			No	35	100.00	53	75.71		
Duration of life as couple (years)		<6		15	42.86	70	100		
		6–14		20	57.14				
Knowledge of pesticides		Yes		16	45.71	57	81.43	73	69.52
		No		19	54.29	13	18.57	32	30.48
Direct exposure to pesticides		Yes		5	14.29	3	4.29	8	7.62
		No		30	85.71	67	95.71	97	92.38
Indirect exposure to pesticides		Yes		18	51.43	24	34.29	42	40
		No		17	48.57	46	65.71	63	60
Male partner									
Medical history		Parotidite in the childhood		0		0			
		Chronic prostatite		0		0			
Surgical history		Torsion of the testicle		0		0			
		Testicle trauma		0		0			
Life style	Exposure to gonadotoxic		Yes	0		1	1.43	1	0.95
			No	34	97.14	69	98.57	103	98.09
	Smoking status		Yes	3	8.57	13	18.57	16	15.24
			No	32	91.43	57	81.43	89	84.76
	Drugs consumption		Yes	0		0			
			No	35	100	70	100	105	100
	Steroid anabolic intake		Yes	0		0			
			No	35	100	70	100	105	100
	Yes		Yes	Yes	34.29	35	50.00	47	44.76
			No	No	65.71	35	50.00	58	55.24
Exposure to pesticides			Yes	Yes	Yes	44	62.86	61	58.10
			No	No	No	26	37.14	44	41.90
Knowledge of pesticides risks on health			Yes	Yes	Yes	65	92.86	91	86.67
			No	No	No	5	7.14	14	13.33
Knowledge of pesticides effects on the environment			Yes	Yes	Yes	65	92.86	92	87.62
			No	No	No	5	7.14	12	11.43
Harm experienced			Yes	Yes	Yes	68	97.14	101	96.19
			No	No	No	2	2.86	4	3.81

Table 3
Characteristics of the infertility among cases.

VARIABLES		Cases		
		Numbers	%	Means
Have a child	Yes	5	14.29	
	No	30	85.71	
Duration of the desire of a child	<5	16	45.71	
	5–12	19	54.29	
Infertility medical diagnosis	Yes	35	100	
	No	0		
Origin of the infertility in the couple (female partner)	Yes	34	97.14	
	No	1	2.86	
Duration of life as a couple (years)	<6	15	42.86	6.46
	6–14	20	57.14	
Medical visit by the male partner	Yes	10	28.57	
	No	25	71.43	
Origin of the infertility in the couple (male partner)	Yes	5	19.23	
	No	21	80.77	
Mean duration of the infertility			6.37	
Type of the infertility	Primary	30	85.71	
	Secondary	5	14.29	

Table 4
The controls'obstetric history.

Variables	Controls		
	Numbers	%	Mediane
Number of gestures			3
Number of children			3,83
Miscarriage (yes)	13	18.57	1
Deceased children	11	15.71	1
Antenatal visits	70	100.00	
Delivery (eutocic)	41	58,57	
Term pregancy	70	100.00	
Birth weight			
Low weight	4	5.71	
Normal weight	66	94.29	
Gender of the child (female)	34	48.57	

4.2. Age, mean duration of couple life and fertility

A husband's age between 41 and 49 years was the only factor positively and significantly associated with the couple's fertility. Reproductive function gradually declines with age in men, but usually men go

Table 5
Bi and multivariate logistic regression with random effect of the couple's risk factors for infertility.

Variables	Crude odd ratio (CI 95%)	Adjusted odd ratio (CI 95%)
Model 1: Exposure to pesticides (direct or indirect) as important independent variable (Cases n = 35; controls n = 70)		
Exposure to pesticides (direct or indirect)		
No	1	1
Yes	1.84 (0.79–4.30)	**2.91 (1.003–8.46)**
Age (years)		
18–30	1	
31–35	0.40 (0.14–1.15)	0.78 (0.23–2.68)
36–40	0.76 (0.25–2.36)	2.20 (0.47–10.29)
Age of the male partner (years)		
18–30	1	1
31–40	0.58 (0.20–1.73)	0.62 (0.18–2.13)
41–49	0.20 (0.05–0.78)	**0.14 (0.02–0.88)**
Alcohol consumption		
No	1	1
Yes	0.52 (0.22–1.23)	0.48 (0.16–1.43)
Smoking		
No	1	1
Yes	0.41 (0.11–1.59)	0.70 (0.15–3.37)
Occupation (Women)		
household	1	
Informal sector	0.75 (0.17–3.21)	
formal sector	0.43 (0.11–1.72)	
Occupation (men)		
farmer	1	
Informal sector	**0.32 (0.11–0.96)**	
formal sector	0.80 (0.28–2.28)	
Education level (women)		
None	1	
Primary school	**3.62 (1.33–9.89)**	
Secondary or more	0.65 (0.18–2.26)	
Education level (men)		
None	1	
Primary school	2.17 (0.76–6.18)	
Secondary or more	1.37 (0.51–3.67)	
Knowledge of pesticides		
No	1	
Yes	**0.19 (0.08–0.48)**	
Model 2: Direct exposure to pesticides as important independent variable (Cases n = 35; controls n = 70)		
Direct exposure to pesticides		
No	1	1
Yes	3.72 (0.81–17.05)	5 (0.87–28.92)
Age (years)		
18–30		1
31–35		0.64 (0.19–2.14)
36–40		1.73 (0.37–8.09)
Age of the male partner (years)		
18–30		1
31–40		0.68 (0.20–2.31)
41–49		0.17 (0.03–1.03)
Alcohol consumption		
No		1
Yes		0.65 (0.23–1.80)
Smoking		
No		1
Yes		0.63 (0.14–2.88)
Model 3: Indirect exposure to pesticides as important independent variable (Cases n = 35; controls n = 70)		
Indirect exposure to pesticides		
No	1	1
Yes	2.03 (0.87–4.71)	**2.85 (1.01–8.04)**
Age (years)		
18–30		1

Table 5 (*continued*)

Variables	Crude odd ratio (CI 95%)	Adjusted odd ratio (CI 95%)
Model 1: Exposure to pesticides (direct or indirect) as important independent variable (Cases n = 35; controls n = 70)		
31–35		0.82 (0.24–2.84)
36–40		2.31 (0.49–10.87)
Age of the male partner (years)		
18–30		1
31–40		0.66 (0.19–2.25)
41–49		**0.15 (0.03–0.93)**
Alcohol consumption		
No		1
Yes		0.49 (0.16–1.44)
Smoking		
No		1
Yes		0.73 (0.15–3.51)

on producing semen until death. Semen quality deteriorates around the age of 60.[19] We do not have an explanation for the finding that men aged 41 to 49 in our study are at the origin of less infertility compared to the age group of 18–30 years, for example. However, data show that in this age group, men are still in their full potential to produce good quality semen.

In women, reproductive function also declines with age. It is significantly reduced between the ages of 35 and 40 and stops usually between the ages of 45 and 50. In our crude analysis we found that women in the age group of 31–35 were twice less infertile than their counterparts aged 36–40. In infertile women, advanced age is also a risk factor of a poor ovarian response during medically assisted procreation by artificial insemination.[20]

Among the couple 57.14% have been living together for at least six years and 45.71% of the cases wanted a child since five years. Actually, 1/6 couple experiences a delayed conception. Among couples desiring a child, conception occurs in 30% of cases in the first month, 75% of after 6 months, 90% and 95% after one and two years, respectively. The time periods of five and six years calculated in our sample seems very long. However, we found that this corresponded to a certain social reality where couples practically never visit a gynecologist after an unsuccessful first year in the search of a child. Other work in Burkina Faso reported similar delays of 64 and 70 months living together and without children[2,21]

4.3. *Alcohol, tobacco and fertility*

In women, the effects of alcohol also affect hormonal regulation and reproductive functions. At high doses (more than 3 drinks in one occasion) alcohol consumption is linked to menstrual cycle disorders, spontaneous abortions, low birth weight, intrauterine and postnatal growth retardation, congenital and neural tube defects, premature delivery … .[5] A dose-dependent association was also found between alcohol consumption and increased plasma concentrations of ACTH and glucocorticoids due to enhanced secretion of CRH by the hypothalamus. Alcohol would also increase estrogen concentrations and reduce the secretion by the hypothalamus of GnRH and GRH. It is also likely that the increase in blood estrogen concentration lowers the concentration of FSH and affects follicular development and the process of ovulation. However, the exact mechanism is not known.[5,22] Our study presented paradoxical results, although not statistically significant. It should be noted that in our work, alcohol consumption data were qualitative. Knowing that low doses of alcohol can improve the libido, our results raised the issue of the threshold dose of alcohol harmful to reproductive functions as well as its mechanism of action.

Excessive smoking, both direct and indirect, increases ovulatory disorders in young women, early pregnancy loss, premature deliveries and low birth weight. Decreased ovarian reserves, fertility, and pregnancy rates was shown in women who smoke.[23] Our results did not support these evidences. Smoking is not common among women in our study area. It is found only in husbands. As we did not collect quantitative data on tobacco consumption among husbands, we believe that a classification bias may have been introduced and led to a distortion of the tobacco and fertility association, because there would be more smokers wrongly included in the control group.

4.4. Study limitations

The classification as "exposed" and "unexposed" was qualitative, and someone who was classified as "unexposed" might be actually exposed and vice versa. Indirect exposure through food was not considered in our data collection. These biases could lead to under or overestimate the association between pesticides exposure and the couple's fertility. The consumption of alcohol or tobacco was collected qualitatively (yes or no), probably leading to misclassification biases where women and men who did not consume enough (the toxicity threshold was not reached) of alcohol or tobacco were classified as smokers or alcohol consumers. These biases might have distorted the association between alcohol, tobacco and infertility. Also among the controls, couples who experienced miscarriages or child deaths were not excluded. Both miscarriages and early child deaths can be proxies for infertility in some situations. There too, a misclassification bias may have been introduced which led to a distortion of the results. Finally using a high expected odds ratio (4.0) probably gave a small sample size. This could have affected results and caused wide confidence intervals and the non-significance of several odds ratios.

5. Conclusion

In the Boucle du Mouhoun region, couples experiencing infertility knew less about pesticides and were more exposed to them than couples who had no childbearing difficulties. Pesticides were a risk factor for the couple's infertility both in direct and indirect exposure. Some flaws in the study protocol and implementation may have weakened the different associations between the dependent and main independent variables. Despite the non-statistically significant results, this study confirmed the deleterious effect of pesticides in the life and harmony of the couple and suggested more robust studies to confirm these associations.

Authors' contribution

Eric Nagaonlé Somé: Conceptualization – Methodology – Supervision - Project administration - Statistics analysis - Writing Original Draft; Writing - Review & Editing, Isidore Tiandiogo Traoré: Writing - Review & Editing, Salif Hadirou Tamdamba: Data curation - statistics analysis - Review & Editing, Béatrice W. Nabaloum: Methodology – Investigation - Review & Editing, Maxime K Drabo: Review & Editing.

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Declaration of competing interest

None.

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