

SOCIO-ECONOMIC AND DEMOGRAPHIC DETERMINANTS OF ANAEMIA IN ANAEMIC PREGNANT WOMEN IN HIGH-PREVALENCE REGIONS OF NIGER

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ABSTRACT

Introduction: Anaemia in disadvantaged pregnant women is a major public health problem in most sub-Saharan African countries in general and in Niger in particular, where its prevalence is above the WHO severity threshold of 40%. **Methods:** The aim of this descriptive cross-sectional study was to determine the socio-economic and demographic factors associated with anaemia in pregnant women attending antenatal clinics in Niger. After consultation, each woman was tested for anaemia by measuring her hemoglobin level systematically with a haemoglobinometer of the HemoCue Hb 301 type, followed by an individual interview if her hemoglobin level was <11g/dl. **Results:** The results showed that anaemia was more prevalent in pregnant women with an average age of 25.4 years, no schooling (71.3%), no income-generating activity (92.9%), an average household size of 7.9 peoples, living in monogamous households (73.4%), in a family (55.8%) and living in traditional homes (89.5%). Anaemia is more prevalent among women where the seasonal migration is the main source of household income (33.2%). The average total expenditure on food was 96.34 \$/household/month, or 12.20 \$/person/month. The factors significantly associated with anaemia in pregnant women were household size (p=0.007) and origin (p=0.00). Significant relationships were also observed between anaemia and expenditure on staple foods, and between anaemia and expenditure on foods of animal origin, condiments, and breakfasts and snacks, with P-values greater than 0.05. **Conclusion:** the factors significantly associated with anaemia in pregnant women were household size, origin and expenditure on food consumption for staple foods, animal products and breakfast and snacks. However, there was no relationship between the age, level of education, profession, religion, ethnic origin or economic activities of the heads of household and anaemia, and between anaemia and living conditions

Keywords: Hemoglobin, Hemocue, Iron deficiency, monogamous household, Niger.

INTRODUCTION

The living conditions of pregnant women in vulnerable households are poor. Infrastructure is one of the pillars of economic development. Access to drinking water, health services and electricity improves household living conditions and has a positive impact on women's health, given that cooking over a wood fire is dangerous to health. In addition, the availability of infrastructure, particularly roads, lowers transaction costs and consequently the price of foodstuffs and their diversification on rural markets, thereby increasing household purchasing power.

The INS and World Bank study (2011) reported that a household living in a rural area has a per capita consumption level that is 27% lower than that of an urban household. What's more, two out of three people in urban areas use hygienic latrines, whereas only one in twenty people in rural areas use these types of facilities.

According to Touati-Mecheri (2011), the nutritional status of pregnant women is influenced by the educational and socio-economic level of the environment in which they live. Furthermore, women with a better socio-economic status tend to avoid anaemia during pregnancy, to have an optimal lifestyle, to have good prenatal care and to give birth in maternity units where the baby's birth weight is measured (WHO, 2019). On the other hand, women from lower socio-economic groups are more likely to have high-risk pregnancies, have unhealthy lifestyles and give birth at home, with a greater likelihood that their newborns will have a low birth weight.

In 2008, WHO estimated that around 30% (468 millions) of women aged between 15 and 49 were anaemic, at least half of them due to iron deficiency. The prevalence of anaemic women is highest in Africa (between 48% and 57%) in South-East Asia, where there are 182 million women of childbearing age and 18 millions pregnant women (Kouira and Djebbari, 2015). Anaemia is a major problem in most sub-Saharan African countries in general (Anoni, 2017) and in Niger in particular, where in recent years the prevalence of anaemia among pregnant women has always been above the 40% threshold considered a severe public health problem by the WHO. Pregnant women with poor nutritional status, living in difficult living conditions and receiving a poor diet, are more likely to be anaemic, to give birth to low-birth-weight new-borns and to offer them less milk during breastfeeding (WHO, 2016). Subsequently, during their first years of life, these infants may show reduced physical growth, i.e. not encountering the conditions necessary for the expression of their genetic potential.

In Niger, the vast majority of the population is destitute, with a high illiteracy rate and a total lack of knowledge about balanced nutrition (INS, 2017). Niger's demography is very specific and has a considerable influence on poverty and the standard of living of households in general, and pregnant women in particular. Moreover, eight out of ten people live in rural areas, which are often difficult to access and offer few opportunities for productive employment (INS and WB, 2013). In economic terms, while poor households spend 2.3% of their food budget on meat and fish, middle-income households spend 5.6%. Socially, human development indicators show a significant gap between men and women in terms of health, education, literacy and access to resources and services. Living conditions and the environment in which pregnant women live are factors whose influence on nutritional status can no longer be justified.

To this end, the state of knowledge on the relationship between anaemia and these characteristics deserves particular interest in order to improve the nutritional situation of women in Niger. The aim of this study is therefore to determine the socio-economic and demographic factors associated with anaemia in pregnant women with a haemoglobin level of less than 11g/dl in Niger, using the HemoCue Hb 301 device.

METHODS

The study was carried out in Niger in the regions of Tillabéry and Dosso, on the one hand in the health districts (HDs) of Kollo, Gothey, Torodi, Dosso, Falmey and Gaya recording the highest cases of anaemia in pregnant women, and on the other hand in the CSIs also presenting significant cases of anaemia in pregnant women, which are necessary to reach the sample size of this study. These are CSI Garankedey, CSI Bangoutara, CSI Lacouroussou, CSI Mokko, CSI Kargui-Bangou, CSI Mangué-Koira, CSI Tondobon, CSI Tanda, CSI Bengou, CSI Gaya 3, CSI Falmey, CSI Sebèri, CSI Bangoubanda, CSI N'Dounga, CSI Urbain Kollo, CSI Gothèye, CSI Koulikoira, CSI Saga-Fondo, CSI Torodi and CSI Makalondi. In addition, a survey form containing open and closed questions was used to collect data from anaemic pregnant women seen for ante-natal consultations at their facility at the time of the survey.

Type and size of sample

Cross-sectional descriptive study conducted from 8 March to 19 August 2024 on 380 anaemic pregnant women attending antenatal clinics at Integrated Health Centres (IHCs).

Information to be collected

In each IHC, on the basis of non-probability sampling for convenience, the anaemia test was carried out on each woman to systematically measure the haemoglobin level with a haemoglobinometer of the HemoCue Hb 301 type using a capillary blood sample from the left middle finger, followed by an individual interview using a questionnaire if the woman had a haemoglobin level <11g/dl on :

Socio-demographic characteristics to describe the living conditions of anaemic pregnant women from a financial and social point of view: type of dwelling, source of household income and monthly amount drawn, household size, type of dwelling, source of drinking water, source of lighting, type of latrine, source of energy for cooking, waste management, physical activity, age, marital status, educational level, ethnicity, religion, occupation. Exclusion criteria: pregnant women with a haemoglobin level of 11g/dl or more and refusal to be surveyed.

Monthly food expenditure precedes the survey to determine household food expenditure on the basis of the frequency and monthly amounts spent on the consumption of staple foods, foods of animal origin, condiments, and breakfast and snacks. The monthly food expenditure for these four (4) expenditures items was then obtained either:

- By summing the various weekly expenses and multiplying by 4 to obtain a monthly figure ;
- By summing the various daily expenses multiplied by the frequency of purchases per week multiplied by 4 to convert them to a monthly basis.

Data processing and analysis

Excel, SPSS and Epi info were used to enter and analyse the data, and to produce the graphs. In addition, the chi2 test was calculated to look for significant associations between the socio-demographic variables, food expenditure and anaemia. The statistical significance level chosen was 0.05.

Ethical and administrative considerations

Approval of the research protocol with a research authorisation was obtained from the Ministry of Public Health, Population and Social Affairs. During the survey, the purpose of the study was explained and the data were collected anonymously after the pregnant women had given their consent.

RESULTS

The average age of pregnant females was 25.4 ± 6.33 years, with extremes of 14 and 42 years. The age groups 25-39 and 18-24 were in the majority, 47.4% and 45% respectively. Although the age of the woman was not correlated with the occurrence of anaemia in the present study, mild anaemia affected the 18-24 age group more than the 25-39 age group, by a difference of 1.6%, whereas moderate anaemia affected the 25-39 age group more, by 12.9%.

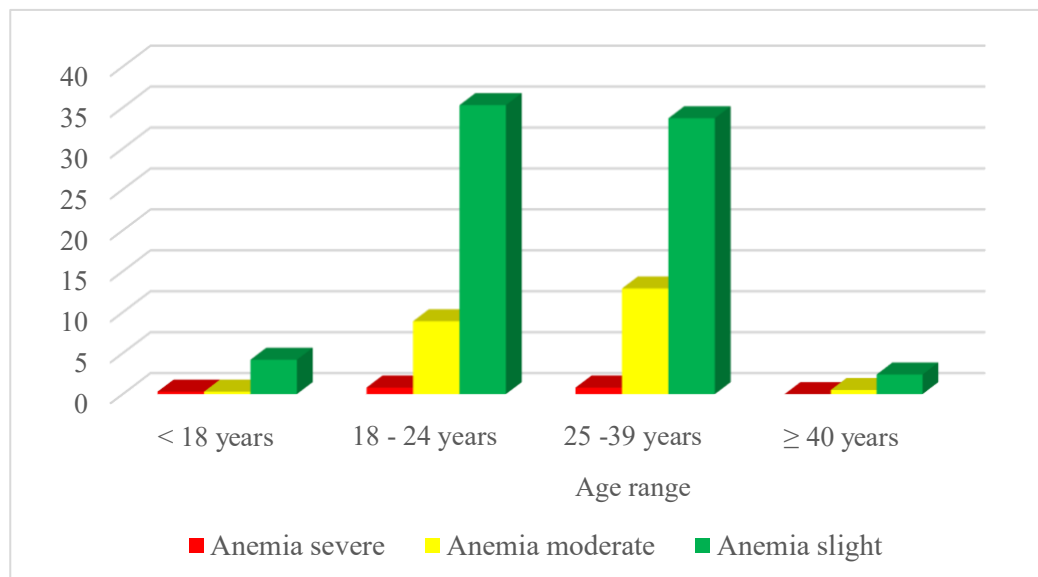


Figure 1: Distribution of pregnant females by age group and anaemia status

Table 1: Socio-cultural and demographic characteristics

Features		N	%
Religion	Catholic	19	5.0
	Muslim	361	95.0
Ethnic group	Zarma- Songhaï	207	54.4
	Gourmantché	24	6.3
	Haoussa	69	18.2
	Peulh	58	15.3
	Touareg	22	5.8
Marital status	Divorced	1	0.3
	Married	378	99.5
	Widow	1	0.3
Matrimonial regime	Monogamy	279	73.4
	Polygamy	101	26.6
Level of education	Illiterate	244	64.2
	Koranic	27	7.1
	College	56	14.7
	Primary	37	9.7
	Secondary	9	2.4
	Superior	7	1.8
Profession	Seamstress	14	3,7
	Civil servant	8	2.1
	Housekeeper	343	90.3
	Small shopkeeper	5	1.3
	School	10	2.6
Total		380	100.00

Muslim women accounted for 95.0% in the study. Zarma-Songhaï women were in the majority at 54.4%. Widows and divorcees accounted for only 0.3% each, compared with 99.5% of married women. Polygamy and monogamy were 26.6% and 73.4% respectively. Around 28.6% had attended school and 7.1% had at least one income-generating activity.

About 66.6% of the population lived in banco houses, and 55.8% lived in families. Nearly 67.1% had no access to electricity, and 7.4% used modern energy sources for cooking. Household size averaged 7.9 people per household, with 55.5% of households containing 1 to 7 people, 33.4% of households containing 8 to 14 people and 11.1% with a household size ≥ 15 peoples as shown in table 2.

Table 2: Living conditions of anaemic pregnant women

Living conditions		N	%
Type of habitat	Case	87	22.9
	House in Banco	253	66.6
	Half-hard	8	2.1
	Cement house	32	8.4
Housing type	Couple	168	44.2
	With the family	212	55.8
Light source	Electricity	125	32.9
	Solar energy	42	11.1
	Fire	3	0.8
	Battery lamp	102	26.8
	Chargeable lamp	107	28.2
	Portable light	1	0.3
Energy source for cooking	Firewood	350	92.1
	Biomass	2	0.5
	Coal	5	1.3
	Gas	23	6.1
Household size	< 8	211	55.5
	8 - 14	127	33.4
	≥ 15	42	11.1
Total		380	100.0

The consumption of non-potable water was 37.7%, 35.3% of which came unprotected wells; 67.3% of the households of pregnant women with anaemia did not have a latrine. Approximately 67.4% disposed of their household waste in the open. 10% of these women were physically active outside their daily household activities as shown in table 3.

Table 3: Hygienic/sanitary living conditions.

Hygienic/sanitary living conditions		N	%
Source of drinking water	Surface water	9	2.4
	Drilling/ Village pump	184	48.4
	Unprotected well	134	35.3
	Protected well	5	1.3
	Tap for running water	48	12.6
Type of latrine	Flush toilet	19	5.0
	Traditional latrine	89	23.4
	Ventilated improved latrine	16	4.2
	No latrine/nature	254	66.8
	Bucket/tinette	2	0.5
Waste management	Burn	5	1.3
	Put in the rubbish bins	10	2.6
	Deposit in a closed pit	1	0.3
	Deposit in an open pit	3	0.8
	Dispose of in the natural environment	256	67.4
	Put aside	105	27.6
Physical activity	No	342	90.0
	Yes	38	10.0
Total		380	100.0

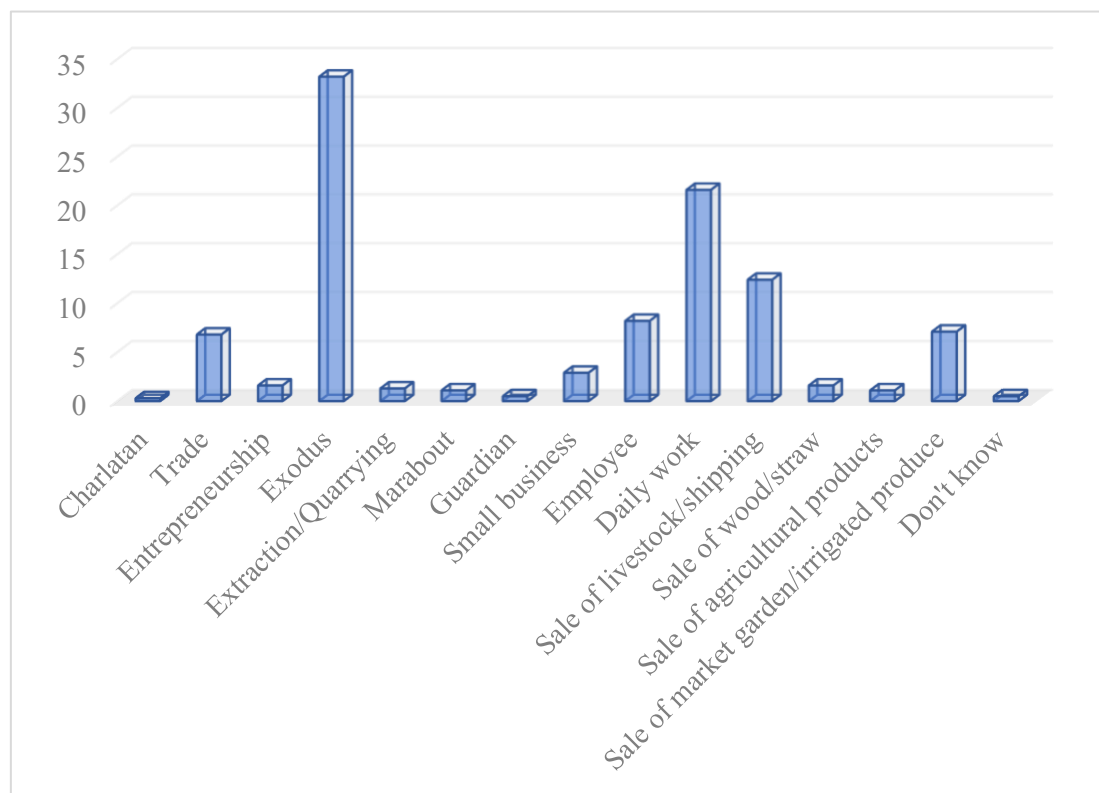


Figure 2: Main source of monetary income for heads of household

The exodus represented the main source of monetary income for the spouses, at 33.2%, followed by day labour at 21.6%.

The average monthly amount derived from the spouses' main sources of monetary income was 140.78 \$, or 84676 FCFA in households where the anaemic pregnant women knew their spouses' monthly income as shown in table 4.

Table 4: Average monthly income from the main sources of income

Average monthly amount from main sources of income	Value
Median	124.69 \$
Average	140.78 \$
Standard deviation	110.63 \$

In the households of anaemic pregnant women, the average monthly expenditure was: 65.88 \$ (i.e. 39627.33 FCFA) for staple foods, 8.71 \$ (i.e. 5236.71 FCFA) for animal foods, 18.49 \$ (i.e. 11122.24 FCFA) for condiments and 3.26 \$ (i.e. 1961.38 FCFA) for breakfasts and snacks.

Table 5: Monthly expenditure on staple foods, foods of animal origin, condiments, and breakfasts and snacks.

Value (USD)	Monthly expenditure on staple foods	Monthly expenditure on food of animal origin	Monthly expenditure on condiments	Monthly expenditure on breakfasts
Median	62.60 \$	3.33 \$	9.98 \$	0.00 \$
Average	65.88 \$	8.71 \$	18.49 \$	3.26 \$
Standard deviation	28.13 \$	14.75 \$	17.37 \$	6.22 \$
Minimum	0.00 \$	0.00 \$	1.66 \$	0.00 \$
Maximum	162.93 \$	99.76 \$	99.76 \$	26.60 \$

The average total monthly expenditure on food in households was 96.34 \$ (57947.66 FCFA), or 12.20 \$ (7335.15 FCFA) per individual as shown in table 6.

Table 6: Total monthly food expenditure in households and per individual in USD.

Monthly expenditure	Median	Average
Basic foodstuffs	62.60 \$	65.88 \$
Food of animal origin	3.33 \$	8.71 \$
Condiment	9.98 \$	18.49 \$
Breakfast and snacks	0.00 \$	3.26 \$
Total expenditure/household/month	75.90 \$	96.34 \$
Expenditure/individual/month	9.61 \$	12.20 \$

The factors significantly associated with anaemia in pregnant women were household size and origin. There was no significant relationship between ethnicity, religion, marital status, level of education, occupation, housing type, main source of income, marital status and anaemia as shown in table 7.

Table 7: Association between anaemia and certain characteristics

Independent variable	Dependent variable	
	Anaemia	
Features	Chi2 test	Value of P
Source	51.10	0.00*
Ethnic group	10.41	0.23
Religion	4.01	0.13
Marital status	3.74	0.44
Level of education	9.20	0.51
Profession of pregnant women	4.44	0.81
Housing type	1.56	0.45
Type of habitat	5.88	0.43
Main source of income	18.97	0.89
Main source of drinking water	13.25	0.21
Main source of lighting	8.74	0.55
Type of latrine	11.44	0.17
Matrimonial regime	1.75	0.41
Household size	14.20	0.007*

Approximately 79.5% of monthly expenditure on staple foods in the households of anaemic pregnant women was less than 83.13 \$ (50000 CFA francs). Monthly expenditure of less than 8.31 \$ (5000 CFA francs) on foods of animal origin, condiments, and breakfasts and snacks was 74.7%, 44.8% and 84.7% respectively. There were highly significant associations between anaemia and monthly expenditure staple foods, animal products, condiments, and breakfast and snacks as shown in table 8.

Table 8: Association between food expenditure and anaemia

Monthly expenditure		Anaemia			Chi2	P
		Severe	Moderate	Slight		
Basic foodstuffs	< 83.13 \$	6 (1.6%)	60 (15.8%)	236 (62.1%)	6.47	0.03*
	≥ 83.13 \$	1 (0.3%)	26 (6.8%)	51(13.4%)		
Foods of animal origin	< 8.31 \$	7 (1.8%)	73 (19.2%)	204 (53.7%)	9.08	0.01*
	≥ 8.31 \$	0 (0.0%)	13 (3.4%)	83 (21.8%)		
Condiments	< 8.31 \$	5 (1.3%)	47 (12.4%)	118 (31.1%)	6.95	0.03*
	≥ 8.31 \$	2 (0.5%)	39 (10.3%)	169 (44.5%)		
Breakfasts and snacks	< 8.31 \$	7 (1.8%)	80 (21.1%)	235 (61.8)	7.63	0.02*
	≥ 8.31 \$	0 (0.0%)	6 (1.6%)	52 (13.7%)		

DISCUSSION

Anaemia was more prevalent in pregnant women with an average age of 25.4 ± 6.33 years with extremes of 14 and 42 years. The 25-39 and 18-24 age groups were in the majority, at 47.4% and 45% respectively, which means that they are the most exposed to the problem of anaemia. Statically, mild anaemia affected the 18-24 age group more than the 25-39 age group, by a difference of 1.6%, whereas moderate anaemia affected the 25-39 age group more, by 12.9%. In general, pregnant teenagers are more susceptible to anaemia during pregnancy than adults. As a result, the prevalence of anaemia in this study was 49.8% in pregnant women under/equal to 24 years of age. Although there was no significant relationship ($p > 0.05$) between the age of pregnant women and anaemia, it remains a risk factor reported in the studies by Baidy et al. (1996). These results are in agreement with those of Sass et al. (2017), Meda et al. (1999), and Demmouche and Moulessehoul in 2010, where these authors all found that anaemia is not correlated with age. In the study by Minkobame et al. (2021), the mean age of parturients was 26.8 ± 6.5 years, with extremes of 15 and 42 years. The majority of parturients were aged 15-24 years and 25-34 years, but there was no significant difference in age between anaemic and non-anaemic parturients. On the other hand, other studies have shown that pregnant women under the age of 20 were twice as likely to be anaemic as older women. (Schol et al., 1994). Furthermore, Galan et al. (1998) demonstrated in a sample of 6,648 women that haemoglobin levels increase significantly from the age of 35.

Anaemia was more common among pregnant women living in monogamous households (73.4%), but statistical analysis showed no significant association ($p=0.41$) between anaemia and marital status. This could be explained by the fact that pregnant women in polygamous households enjoy better living conditions than those in monogamous households. In addition, a difference in economic life may mean that many households remain monogamous in countries such as Niger with almost 99% of the community Muslim, where the Islamic religion strongly encourages polygamy. In contrast, a significant relationship was found in the study by Sass et al. (2017). Keith et al. (2007) reported a 53% predominance of monogamy compared with 37% of polygamy among the women in its study in the Maradi region of Niger.

Ethnic origin was not associated ($p> 0.05$) with the occurrence of anaemia in pregnant women, unlike the studies by Sass et al. (2017) and Tounkara (2011), who both found significant relationships between these two factors in their work. In this study, there was no significant link ($p=0.13$) between religion and anaemia, as in the work of Minkobame et al. (2021), where religion was not associated with anaemia in parturients, unlike Yissou in Burkina Faso (1997), who found a higher proportion of severe anaemia in animists than in Christians. Furthermore, Meda et al. (1999) found that membership of the Muslim religion was associated with a statistically significant risk of anaemia. Nevertheless, among Muslims, attachment to certain traditional values, social beliefs, taboos and dietary prohibitions, and other attitudes may appear to be important risk factors for anaemia during pregnancy.

Anaemia was more prevalent among pregnant women living in traditional homes (89.5%) and in families (55.8%). No significant difference ($p> 0.05$) was found between the type of dwelling, the living arrangement and women's exposure to anaemia. These results differ from those of Kouira and Djebari (2015) in Algeria, where 58% of women lived in traditional houses (with or without a garden) compared with 42% who lived in a flat, and 60% of pregnant women lived with their partner compared with 39% who lived with their partner's family. According to the INS and BM (2013), only one person in ten lived in a house with walls made of permanent materials (cement, concrete, fired bricks, etc.), while one household in eight ($1/8$) lived in a house with a roof made of sheet metal, concrete or tiles and one in six ($1/6$) lived in a house with a cement or concrete floor. In fact, the average house in Niger is built of rammed earth, from the walls to the roof and the floor. In this respect, the population is massively poorly housed, with major disparities between areas where people live and between regions. All these factors can influence the haemoglobin status of pregnant women.

The majority of anaemic pregnant women were married (99.5%) and no significant difference ($p=0.44$) was observed between these two factors. This result is significantly higher than that of Kasia et al. (2020), for whom 53.8% of patients were married, and the 81% of women surveyed who were married by UNICEF in Niger in its study carried out in Maradi (Keith et al., 2007). Anaemia was more prevalent among pregnant women who had not attended school (71.3%) in this study, compared with 28.6% who had attended formal school, with a predominance of secondary school (14.7%), which means that illiterate women were more likely to be anaemic than educated women. Secondly, although the level of education was not correlated ($p = 0.51$) with anaemia, educated women would have very good preventive knowledge. This result is similar to other work carried out by Sass et al. (2017) and Sellam and Bour (2014), where no significant relationship was observed between women's

level of education and anaemia, unlike the study by Ouzennou et al. (2018). In addition, a study carried out in the Kenitra region by Aboussaleh et al. (2009) showed that the prevalence of anaemia decreased with women's level of education. However, these results are entirely different from those of Demmouche and Moulessehouli (2010), who found that 42.34% anaemic women had an average level of education and a minority of illiterate women (09.9%).

Statistical analysis shows that there is no significant relationship ($p = 0.81$) between women's occupation and anaemia, despite the fact that anaemia is much more prevalent (92.9%) among pregnant women with no income-generating activity. These results corroborate those of Sass et al. (2017) and Tounkara (2011), both of whom recorded a high rate of anaemia among women with no occupation in their studies and who, moreover, found no association between these two factors. These results are not consistent with those of Kasia et al. (2020) in Cameroon, who found that 67.1% of their patients were salaried.

With regard to the economic activities of heads of household, anaemia is more prevalent among pregnant women, where the exodus is the main source of monetary income for spouses (33.2%), followed by day labour (21.6%), the sale of livestock/fat (12.4%), salaried employment (8.2%), trade (6.8%) and the sale of market garden produce (7.1%). According to the statistical analysis of the chi2 test, household income is not related ($p=0.89$) to anaemia in pregnant women. However, a head of household with a stable source of income can put his wife in better living conditions than one without. This is not the case in the present study, where anaemia is more frequent among pregnant women from these households. This similarity of results was demonstrated in 2007 by UNICEF in its final report on the Maradi study in Niger, where 51% of the women replied that their husbands' main activity was farming, 18% said that their husband was a trader and 8% that he was a civil servant (Keith et al., 2007). According to INS-SAP (2016) in Niger, agriculture remains the main activity (i.e. 72.5%) most practised by heads of household in all regions except Agadez, where it is practised by only 8.5% of heads of household. In the study by Muteba Kalala (2014) in Kinshasa, the majority of heads of household in the well off neighbourhood were wage earners (66%), as were those in the average neighbourhood, whereas in the poor neighbourhood, heads of household were involved either in petty trading (31%) or in handicrafts, where there are all sorts of small trades (29%). In Niger, according to the INS and BM (2013), the income poverty rate is highest among households headed by own account workers, i.e. most of whom are farmers. Indeed, poverty in Niger is primarily a rural issue, and remains closely linked to the level of development of agricultural production. In this study, the average monthly amount derived from spouses' main sources of monetary income was 140.78 \$, or 84676 CFA francs, in households where anaemic pregnant women knew their spouses' monthly income, which means that in Niger, in most cases, women have no idea about their husbands' monetary income. In fact, a husband who is financially stable will be able to take good care of his wife in terms of prenatal care and good nutrition. This result is higher than that of INS/SAP (2015) in Niger, where the average monthly income was FCFA 50957 per household and FCFA 11078 per head. This result does not match that of Kouira and Djebbari (2015) in Algeria, for whom 60% of pregnant women had a high standard of living and a household income of over 30000 Da, 29% had a medium standard of living and 12% had a low standard of living (household income of less than 10000 Da).

In this study, the consumption of non-potable water in the households of pregnant women with anaemia was 37.7% and 62.3% benefited from potable water. Drinking water was obtained from unprotected wells (35.3%), village boreholes/pumps (48.4%), surface water (2.4%), protected wells (1.3%) and running water taps (12.6%). In the final report of the UNICEF study in Niger, more than half (51.17%) of girls' and women's households in the Maradi region had no access to drinking water (Keith et al., 2007). They get their water from wells (41.23%), boreholes (34.88%), nearly 2/3 of which are in urban areas, taps (9.30%, all urban), and marshes, the hygiene of which often leaves much to be desired (8.46%). Overall in Niger, according to INS-SAP (2016), the proportion of households using an improved water source was 52.1%, compared with 47.9% of households using other sources (surface water, open wells and others).

Nearly 67.3% of households with anaemic pregnant women did not have a latrine, of which 66.8% defecated in the open and 0.5% in a tinette which was then dumped in the bush or fields. For pregnant women, access to a sanitary means of excreta disposal is still a luxury for many households. However, the use of unhygienic toilets can be the cause of infectious diseases that can lead to anaemia if certain standards are not respected. In Niger in the INS-SAP study (2016), more than three out of four households (77.1%) used the bush as a toilet, only 5.4% of households used improved toilets and 17.6% of households used traditional latrines. These results are similar to those of the INS and BM (2013), where three out of four individuals lived in households where there was a lack of sanitary latrines. In fact, only 17% of people live in a dwelling with a flush toilet. In addition to the three quarters who did not use a toilet, almost 7% of people used a simple pit. The same similarity was demonstrated by Keith et al. (2007) in the Maradi region of Niger, where only 1/3 of pregnant women used latrines and 70% of girls defecated in the bush or elsewhere (fields, roads, etc.). Almost all anaemic pregnant women lived in households where firewood was the main source of cooking (92.1%) and only 7.4% used modern energy sources (gas and coal). This correspondence was demonstrated by the INS and BM (2013) in its study in Niger. Similar results emerge from the work of INS-SAP (2016) in Niger, where nearly 9 out of 10 households (86.8%) used firewood as their main fuel, while the use of other fuels, namely electricity (0.1%), coal (0.6%) and gas (1.0%), remained very low among all households. The use of wood for cooking is harmful to the health of pregnant women and the foetus, as the smoke from the wood is toxic. This toxicity can also cause anaemia following an infection. With regard to waste management in this study, 67.4% of respondents threw their household waste out into the open, 1.3% burnt it, 2.6% put it in rubbish bins, 0.3% in a closed pit, 0.8% in an open pit and 27.6% put it next to the house on the ground. According to UNICEF in the Maradi region of Niger, rubbish is thrown away in the yard (9%) or outside (91%), with the preferred places being: gutters and dustbins in 14% of cases (in town), rubbish dumps (17%) quite often not far from the house, the bush (22%) or, for 38%, just in front of, behind or next to the house in a hole or on the ground (Keith et al., 2007). Poor hygiene conditions within households increase the risk of women contracting germs and diseases, which can expose them to infections that can cause anaemia.

The use of electricity as a source of lighting is only 32.9% in the households of pregnant women with anaemia. In other words, in Niger, electricity is most often used in urban areas and almost never in rural areas. This does not allow women to be financially independent or to diversify their income, because electricity is above all a potential

source of income-generating activities for women in poor households, particularly in the sale of refrigerated and frozen food products. In addition, the income that can be derived from the use of electricity will help to improve the living conditions of rural households in terms of care and nutrition. This finding corroborates that of the INS and BM (2013) in Niger, for which the main source of lighting was the battery lamp, for eight out of ten people. Also in Niger, analysis of the distribution of households according to lighting method showed that more than eight out of ten households (87.1%) used battery-operated lamps as their source of lighting, with electricity coming in second place with 9.9% of households (INS-SAP, 2016). In India and Bangladesh, the evaluation of electrification projects has also shown that this type of investment encourages the use of irrigation techniques, thereby reducing the prevalence of poverty (Songco, 2002). In addition, for households with limited access to the market, there are opportunities for preserving fresh food (such as meat, fish, vegetables and fruit). However, the lack of electricity is a real problem for poor people.

Household size averaged 7.9 persons per household, so a highly significant relationship ($p = 0.007$) was observed between anaemia and household size in the present study. This result confirms that of Sass et al. (2017), who demonstrated a significant relationship between anaemia and household size. In Kinshasa, Muteba Kalala (2014) found an average household size of around 7 people in the well-off and poor neighbourhoods, and 6 in the middle neighbourhood. In Niger's Maradi region, 67% of households have an average of 7 to 11 people (or more), 10% of households have 1 to 3 people, and 23% have 4 to 6 (Keith et al., 2007). Consequently, having too many dependents increases women's workload. Another important aspect of anaemia morbidity and undernourishment is vulnerable households where the heads of household have low purchasing power. As household size increases, the quality of food decreases, which seems to have a negative impact on the nutritional situation of pregnant women.

Anaemia was significantly associated with place of origin ($p < 0.05$) and was more prevalent in pregnant women from rural areas. This can be explained by the fact that in rural areas, pregnant women live in poorer conditions than in urban areas. This result corroborates that of Ouzennou et al. (2018) in Morocco, where their analysis of the results showed that anaemia was positively associated with women's place of origin, and similarly for Sass et al. (2017), who found a significant link between health status and place of origin in Nouakchott. In developed countries, anaemia affects 10-20% of women from affluent backgrounds and more than 30% of women from disadvantaged backgrounds (Harir et al., 2015).

Households in a better financial situation have more diversified eating habits, and they also spend more money on a greater variety of healthy and nutritious food products than poor households. In this study, the average monthly expenditure on food in the households of anaemic pregnant women was : 65.88 \$, or 39627.33 FCFA for staple foods, 8.71 \$ (or 5236.71 FCFA) for foods of animal origin, 18.49 \$ (or 11122.24 FCFA) for condiments and 3.26 \$ (or 1961.38 FCFA) for breakfasts and snacks; This gives a total average expenditure on food consumption of 96.34 \$/household/month (57947.66 FCFA), or 12.20 \$/person/month (7335.15 FCFA), which is much higher than the average monthly food expenditure of 33653 FCFA per household found by PAM in 2010 in Niger. In the same study, 79.5% of monthly expenditure on staple foods was less than 83.13 \$. Monthly expenditure of less than 8.31

\$ on food of animal origin, condiments, and breakfasts and snacks was 74.7%, 44.8% and 84.7% respectively. There are very significant associations between anaemia and the various items of monthly food consumption expenditure in the households of pregnant women with anaemia. According to INS/SAP (2015) in Niger, on a national scale, household expenditure is low overall regardless of their level of food insecurity. Indeed, a household spends an average of 52017 FCFA per month or 7796 FCFA per person per month or 260 FCFA per day. Muteba Kalala (2014) observed monthly food expenditure of 391460 CFA francs in a well-off neighbourhood, 198260 CFA francs in an average neighbourhood and 136436 CFA francs in a poor neighbourhood in Kinshasa. This enabled him to find in his study monthly expenditure per individual of around 48933 FC in the well off neighbourhood, 33043 FC in the average neighbourhood and 17055 FC in the poor neighbourhood. According to the study by the INS and BM (2013) in Niger, a household in the first quintile has an annual consumption of around 108000 FCFA per person. A third of this amount is spent on millet and 27000 FCFA on other cereals and tubers, which naturally leaves very little for other important foods such as meat and fish. As a result, individuals in this group consume one kilogram of meat per person per year. In contrast, households in the fifth quintile have an annual consumption of around 196000 FCFA per person. These households spent only 25000 CFA francs on millet, almost 11000 CFA francs on meat and fish (some 5 kilograms of meat per person per year) and over 12000 CFA francs on milk and dairy products. Similarly, in the joint INS-SAP/PC study (2016) in Niger, severely food-insecure households spent only 23996 FCFA per month on food. Moderately food-insecure and at-risk households spent 30760 FCFA and 34126 FCFA per month respectively on food. Food-secure households spent 40441 FCFA per month on food. This can be explained by the fact that vulnerable households buy less often or rarely food with high nutritional value, such as meat products for their heme iron content, and fruit and vegetables rich in vitamins and minerals, and consume relatively more of their own agricultural produce.

CONCLUSION

In the present study, the factors significantly associated with anaemia in pregnant women were household size, origin and expenditure on food consumption for staple foods, animal products and breakfast and snacks. However, there was no relationship between the age, level of education, profession, religion, ethnic origin or economic activities of the heads of household and anaemia, and between anaemia and living conditions (type of dwelling, However, it is clear that these factors contribute to the onset of anaemia in pregnant women during pregnancy. In Niger, rural women are the most disadvantaged in terms of optimal lifestyle hygiene, access to antenatal care and nutritional education, and access to a diversified diet rich in bio-available iron (such as the consumption of meat products, fish, eggs, etc.) due to limited access to the market and the economic purchasing power of heads of household, especially as more than half of the rural population is poor. As a result, the prevalence of anaemia in rural areas is higher than in urban areas, and the nutritional situation of vulnerable groups such as pregnant women is always at risk. Government authorities should make available to pregnant women at Integrated Health Centres (IHCs) with iron-folic acid supplements, good antenatal care, deworming, standards for small families, contraception and health education policies to improve the burden of anaemia.

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Conflicts of Interest

The authors declare no conflicts of interest.

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