World Journal of Innovative Research (WJIR)
ISSN: 2456-8236, Volume-2, Issue-3, March 2017 Pages 01-09

Seroprevalence and Factors Associated with *Herpes simplex virus* type 2 Infection in Women and their Newborns in Douala, Cameroon

Koanga Mogtomo Martin Luther, Eloumou Elouki Landry, Embolo Enyegue Elisee Libert, Kojom Foko Loick Pradel, Ntatou Lemouchele Idriss, Nkeumacha Ida Patrick, Assokom Okoubalimba Eliane Vanessa, Assam Assam Jean-Paul, Ngono Ngane Annie Rosalie

Abstract **— Herpes simplex virus (HSV) infections are among the most widespread sexually-transmitted diseases (STDs) all over the world. This study aimed to determine the prevalence and factors associated with HSV-2 infection among women and their newborns. A two-month cross sectional and prospective study took place at the District hospital of Deido in the town of Douala, Cameroon. A total of 90 mothers aged 17-42 years old attending this health facility because of pediatric consultation and vaccinations of their newborns were included in the study. Blood samples were obtained from each mother and newborn, centrifuged and obtained sera were used to look for Immunoglobulin against HSV using ELISA-based method. In addition, complementary data of mothers and their newborns were documented. Mean age of mother and newborns was 28.9 ± 3.5 years old and 5.2 ± 4.1 months respectively. The prevalence of Herpes simplex virus type 2 was 90% (95% CI: 83.8 – 96.2) and 74.7% (95% CI: 65.7 – 83.7) in mothers and their babies respectively. The rate of postnatal HSV-2 transmission was of 10.3% (95%CI = 82.4% – 97.0%). Neonates aged 1-3 months and 4-6 months was 31 (OR = 30.7; 95%CI = 5.7 – 163.7; P-value < 0.0001) and 7 (OR= 6.9; 95%CI =1.2 – 37.3; P-value < 0.0001) times more at risk for HSV-2 infections than older ones. This study pointed out a high prevalence of Herpes simplex Virus type-2 in mothers and their babies. Clinicians should be aware of including HSV infections in the differential, how recognize and properly treat neonatal HSV infections with the ultimate aim to efficiently mitigate mother-to-child transmission.**

Index Terms**— Herpes simplex virus type 2, Epidemiology, Mother-to-child transmission, Cameroon**

Koanga Mogtomo Martin Luther, Department of Biochemistry, University of Douala, Douala, Cameroon,
Eloumou Elouki Landry, Department of Biochemistry, University of Douala, Douala, Cameroon
Embolo Elisee Libert, Department of Biochemistry, University of Douala, Douala, Cameroon,
Kojom Loick Pradel, Department of Animal Biology, University of Douala, Douala, Cameroon
Ntatou Lemouchele Idriss, Department of Biochemistry, University of Douala, Douala, Cameroon
Nkeumacha Ida Patrick, Department of Biochemistry, University of Douala, Douala, Cameroon,
Assokom Eliane Vanessa, Department of Biochemistry, University of Douala, Douala, Cameroon
Assam Assam Jean-Paul, Department of Biochemistry, University of Douala, Douala, Cameroon
Ngono Ngane Annie, Department of Biochemistry, University of Douala, Douala, Cameroon

I. INTRODUCTION

Herpes simplex virus (HSV) infections are among the most widespread sexually-transmitted diseases (STDs) all over the world [1]. These infections are caused by two viruses, HSV-1 and HSV-2 belonging to the *Herpesviridae* family and *Alphaherpesviridae* subfamily respectively and are characterized by short reproductive cycles, host cell destruction during active replication and the ability to establish lifelong latency in sensory neural ganglia. The former is mainly involved in orolabial infections meanwhile the latter in genital infections referred to as genital herpes. However, some authors reported these both viruses could be responsible for either orolabial or genital infections [1]. Genital herpes is one of the main STDs reported worldwide and the leading cause of genital ulcerations [1]. The prevalence of HSV-2 varies from area to another and mainly known vary as a function of geographical zone, gender and risk factors such as sexual intercourse [1]. An estimated 417 million people aged 15-49 years old (11.0%) worldwide were living with HSV-2 infection in 2012 [3]. The highest prevalence rates, up to 80% sometimes, are reported in adults living Sub-Saharan countries followed by the Americas. The burden of the infection is commonly recorded to be higher in females than males [1], [2] and the highest number of people newly-infected was adolescents [3].

Sexual route is the main route associated with the transmission of HSV-2 between humans [2], [4] although women may transmit the virus to their babies especially during delivery [5]. Most infected people are unaware that they have the infection as genital herpes infections often have no symptoms or mild symptoms that go unrecognized [3]. Furthermore, there is possibility for the virus of being transmitted from asymptomatic carriers. Thus, control of these infections remains difficult especially in developing countries. In addition, an important proportion of women acquire genital HSV infection during are either asymptomatic or have non-specific symptoms and thus can transmit virus to their neonates in utero or at the time of delivery. Infections in neonates are often deadly in the absence of early detection owing to the immaturity of their immune system [1].

In spite of their high prevalence in Cameroon, a few studies previously addressed the epidemiology of HSV-2 infections [4]-[8]. Suligoi and colleagues reported a prevalence of HSV-2 infection of 37.1% in adolescents and adults from the northern region of the country attending the general medical

outpatient ward for reasons other than STDs [4]. More recently, Njimbam and coworkers found a prevalence of HSV-2 infection of 88% in patients living with HIV infection at a hospital of the town of Yaounde (Centre region, Cameroon) [8]. However, to our knowledge no studies addressed the mother-to-child transmission of HSV-2. Thus, this study aimed at determining the prevalence and factors associated with HSV-2 infection among women and their newborns

II. MATERIAL AND METHODS

A. *Study area*

The study took place at the District hospital of Deido (Littoral region, Douala, Cameroon) as depicted in Figure 1. This is health facility categorized as 4th category among public hospitals over the country and first reference hospital to surroundings sub-division medical centers. It is located at the core of Deido neighbor especially in Bonajinje, covers Douala 1 and 5 sub-divisions and consists of 12 health areas of total surface of 4600 square meters [9].

Figure 1: Study areas. a= Africa; b = Cameroon; c = Douala (District hospital of Deido = A)

B. *Study design and population*

This prospective cross-sectional study was focused on mothers attending the district hospital of Deido along with their babies. They attended this health facility for routine pediatric consultation and/or vaccination of their baby. A total of 90 mothers aged 17-42 years old and 91 babies aged 1-15 months were enrolled in a convenient way in the study between August and September 2013.

Using the prevalence of 81.8% in HIV-negative women reported by Koanga et al [7] in Douala, the sample size was determined using the Lorentz's formula $n = Z^2pq/d^2$ where n = the sample size required, Z = 1.96: confidence level test statistic at the desired level of significance, p = 81.8%: prevalence of HSV-2 in women, q = 1-p: proportion of HSV-2 negative participants and d = acceptable error willing to be committed. The minimum sample size was estimated as n = 229. Unfortunately, this sample size was not achieved for the study period. Thus, a total of 181 individuals made of 90 women and 91 babies were included in the study.

Investigative methods included a questionnaire approach, clinical and biological analyses. Before enrolment, a detailed explanation of the study and its potential benefits (using an information sheet) was given to parents/legal guardians of the children who were then invited to participate in the study.

Thereafter, blood samples and some study-tailored information were collected through venipuncture and face-to-face interview of respondents respectively. Blood samples were transported to the laboratory for analysis. In addition, mothers received counseling on prevention of mother-to-child transmission of *Herpes simplex* viruses types 1 and 2.

C. *Questionnaire*

Mothers were interviewed for 15-20 minutes upon obtaining informed consent forms. A structured questionnaire was used to document participants' information. The first part of questionnaire was designed to collect information on sociodemographic data of mothers and babies. The second part was focused on gynecological, obstetrical and sexual behavior-related information of mothers. Lastly, the third part was focused on sociodemographic and clinical information of babies.

D. *Blood collection*

About 2 to 5 mL of blood were collected by venipuncture and at the wrist area in mothers and their babies respectively in sterile vacutainer. Blood samples were then transferred to laboratory of the hospital and centrifuged at 3000 rpm for 5-10 minutes. Supernatant (serum) was collected, aliquoted (2 mL) and stored at -20°C until analysis meanwhile pellet was discarded.

E. *Detection of HSV-2*

Sera samples were retrieved from freezer, threw out and slightly moved at room temperature at the same time that detection kits. Thereafter, samples were screened for the presence of *Herpes simplex* virus type 2. To do so, a microtest-plate enzyme-linked immunosorbent assay (ELISA) kit (Teco Diagnostics Laboratory, reference IGMH2G-96, USA) was used for targeting anti-HSV-2 immunoglobulin (IgG) antibodies in accordance to manufacturer's instructions. The test has a sensitivity of 94% and a specificity of 100%. The cut-off value used to determine a positive test on the kit was > 1.00. Any value below this value was considered as negative result with regard to the kit instruction manual.

F. *Ethical considerations*

The study was carried out in conformance with the guidelines for human experimental models in clinical research as stated by the Cameroon Ministry of Public Health and the Helsinki declaration. Besides, the ethical and administrative clearances for this study were issued by the

regional delegation of public health in the Littoral region (N°1817/L/MINSANTE/DRSPL/CSSE). The aim and objectives of the study were explained to them in the language they understood best (French or English), and their questions were answered. Only women who signed an informed consent form for their participation were enrolled. Participation in the study was strictly voluntary and women were free to decline answering any question or totally withdraw if they so wished at any time.

G. *Statistical analysis*

All data were keyed, verified for consistency and coded, in an Excel sheet and statistical analyses performed with Graphpad Prism version 5.0 for Windows (San Diego, California, USA). Data were summarized in table as percentages or mean ± standard deviation (SD) for qualitative and quantitative variables respectively where appropriated. Association between dependent and independent variables was tested using Pearson's independence Chi-square test (χ^2) and multivariate logistic regression method. Significant levels were measured at 95% CI with significant differences recorded at *p-value* < 0.05.

III. RESULTS

A. *Baseline sociodemographic characteristics of mothers*

Overall, 90 mothers aged 17 to 42 years old were enrolled in the study; most (35.6%) of whom were aged between 30 and 34 years old. The mean age of the mothers was 28.93 ± 3.53 years old. With regard to level of education, majority of the respondents had attended secondary (58, 645%). In addition, they were in the majority single (51.1%), Christians (87.8%), native from Littoral region (71.1%) and born in urban area (60.0%) as summarized in Table 1. Three women in six (60.0%) were doing jobs of informal sector such as trader, dressing-table or char-woman (Table 1).

B. *Baseline gynecological and toxicological characteristics of mothers*

Of the 90 respondents, 69 (76.7%) had had their first intercourse at age of more than 17 years old. A total of 34 (37.8) respondents gave birth for the first time when they were 25 years old and more (Table 2). Most of them have reported no history of abortion (62.2%), had one sexual partner only these last 2 years (77.8%), were always using condom during sexual intercourse (66.7%) and consuming liquors (51.1%).

C. *Baseline characteristics of babies*

A total of 91 babies were included in the study. This figure is different from number of mothers because one (01) mother gave birth to twins. The age of babies ranged between 1 and 15 months with a mean age of 5.21 ± 414 months. Females accounted for 52.7% against 47.3% for their male counterparts. Age groups of 1-3 months (54.9%) and 7-9 months (12.1%) were the most and the least represented categories respectively. With regard to birth weight, 46.1% of babies were weighing between 3000 and 3400 grams while that 33.0% and 20.9% were weighing more than 3500 grams and less than 3000 grams respectively (Table 3). Babies born at term (i.e. 37 weeks and more of gestation) accounted for 87.9% (54.9% + 33.0%) as depicted in Table 3. Lastly, 85.7% and 58.2% of babies are born by genital delivery and breastfed in mixed way respectively (Table 3).

D. *Prevalence of HSV-2 infection in mothers and babies*

Antibodies to HSV-2 were detected in 81 mothers and 68 babies giving a prevalence of 90.0% (81/90; 95%CI = 83.8% – 96.2%) and 74.7% (68/91; 95%CI = 65.7% – 83.7%) respectively. To be noted, seven babies of the 68 babies found being infected with HSV-2 were born to uninfected mothers as presented in Table 4. Thus, the rate of postnatal HSV-2 transmission in this study was recorded at 10.3% (95%CI = 82.4% – 97.0%).

E. *Factors associated with HSV-2 infection in mothers*

Multivariate logistic regression was used to any factor which could significantly influence the epidemiology of HSV-2 infection in mothers. None of variables included in the logistic model were found to be associated with HSV-2 infection even though the risk was higher in Secundigravidous (OR = 4.8; 95%CI = 0.5 - 44.1; P-value = 0.6347), were never using condom (OR = 1.8; 95%CI = 0.3 - 9.6; P-value = 0.3506) and consuming liquors (OR = 2.3; 95%CI = 0.5 - 9.7; P-value = 0.3999) for instance (Table 5).

F. *Factors associated with mother-to-child transmission of HSV-2*

Out of six variables included in logistic regression model, the age of babies was found to be significantly (P-value < 0.0001) associated with HSV-2 infection. Indeed, using the age group of babies aged 7-9 months as reference group, those aged of less than 3 months, between 4-6 months and at least 10 months had a risk of HSV-2 infection about 31-, 7- and 3-fold higher than their reference counterparts respectively (Table 6). In addition, a statistically significant negative association was found between age of babies and prevalence of HSV-2 infection (χ^2 = 24.959; df = 3; P-value < 0.0001) as presented in Figure 2.

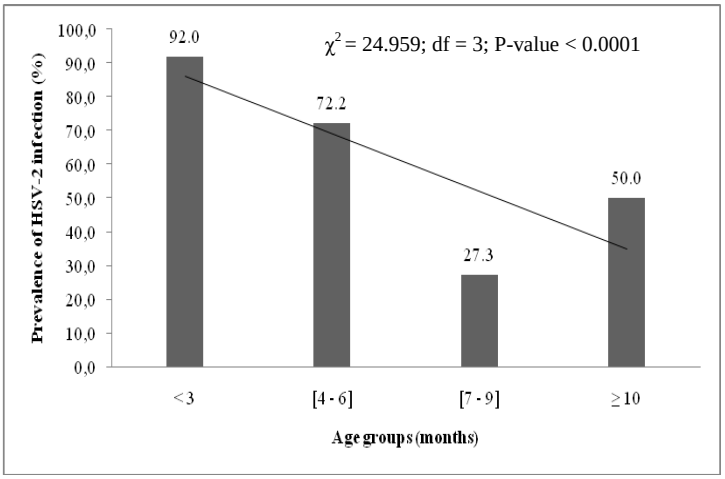

Figure 2: Prevalence of HSV-2 infection in babies with regard to age

Table 1: Sociodemographic characteristics of mothers

Variables	Categories	Frequency	Percentage (%)
Birthplace	Urban area	54	60,0
	Rural area	36	40,0
Age (years old)	< 25	22	24.4
	[25 - 29]	24	26.7
	[30 - 34]	32	35.6
	≥ 35	12	13.3
Level of education	Primary	4	4.4
	Secondary	58	64.5
	University	28	31.1
Marital status	Single	46	51.1
	Married	44	49.9
Occupation	Informal sector	54	60,0
	Employee	15	16.7
	Laborer	14	15.5
	Scholar/Student	7	7.8
Religion	Christians	79	87.8
	Others	11	12.2
Region of origin	Littoral region	64	17.8
	West region	16	71.1
	Other	10	11.1

Table 2: Gynaecological and toxicological characteristics of mothers

Variables	Categories	Frequency	Percentage (%)
Age at first intercourse (years old)	< 17	21	23.3
	≥ 17	69	76.7
Age at first pregnancy (years old)	< 20	24	26.7
	[20 - 24]	32	35.5
	≥ 25	34	37.8
Gestity	Primigravidous (1)	32	35.6
	Secundigravidous (2)	27	30,0
	Multigravidous (≥ 3)	31	34.4
Number of abortion	0	56	62.2
	≥ 1	34	37.8
Number of sexual partners	1	70	77.8
	≥ 2	20	22.2
Use of condom	Always	60	66.7
	Never	30	33.3
Alcohol consumption	No	44	48.9
	Yes	46	51.1

Table 3: Sociodemographic characteristics of babies

Variables	Categories	Frequency	Percentage (%)
Gender	Male	43	47.3
	Female	58	52.7
Age (months)	< 3	50	54.9
	[4 - 6]	18	19.8
	[7 - 9]	11	12.1
	≥ 10	12	13.2
Birth weight (g)	< 3000	19	20.9
	[3000 - 3400]	42	46.1
	≥ 3500	30	33,0
Number of months of gestation	< 9 months	11	12.1
	9 months	50	54.9
	> 9 months	30	33,0
Type of delivery	Genital delivery	78	85.7
	Caesarean delivery	13	14.3
Type of breastfeeding	Maternal	30	33,0
	Artificial	8	8.8
	Mixed	53	58.2

Table 4: Percentage of perinatally and postnatally HSV-2 infected babies

Mothers	N° of HSV-2 (+) babies	Prevalence (%)	95%CI	P-value
HSV-2 (+)	61	89.7	82.4 - 97.0	< 0.0001
HSV-2 (-)	7	10.3	3.0 - 17.6	
Total	**68**	**100**		

Data are presented as frequency (percentage). HSV-2 = Herpes simplex type 2; (+) = Infected; (-) = Uninfected; Pearson's chi square test was used to perform this association analysis. OR = Odds ratio, 95%CI = Confidence interval with 95%, P-value < 0.05 are considered statistically significant.

Table 5: Factors associated with HSV-2 infection

Variables	Categories	Total	N° of infected people (%)	Adjusted OR (95%CI)	P-value
Birthplace	Urban area	**54**	48 (88.9)	1	
	Rural area	**36**	33 (91.7)	1.4 (0.3 - 5.9)	0.7086
Age (years old)	< 25	**22**	20 (90.9)	1.4 (0.2 - 9.5)	0.7012
	[25 - 29]	**24**	21 (87.5)	1	
	[30 - 34]	**32**	28 (87.5)	1.1 (0.5 - 10.8)	0.7879
	≥ 35	**12**	12 (100.0)	3.1 (0.1 - 68.9)	0.8012
Level of education	Primary	**4**	4 (100.0)	1	
	Secondary	**58**	50 (86.2)	1.7 (0.1 - 35.9)	0.3845
	University	**28**	27 (96.0)	4.7 (0.5 - 42.5)	0.3712
Marital status	Single	**46**	40 (87.0)	1	
	Married	**44**	41 (93.2)	2.1 (0.4 - 8.8)	0.5012
Occupation	Employee	**15**	12 (80.0)	1	
	Informal sector	**54**	49 (90.7)	2.5 (0.5 - 11.8)	0.4879
	Laborer	**14**	13 (92.9)	3.3 (0.2 - 35.7)	0.6578
	Scholar/Student	**7**	7 (100.0)	4.2 (0.1 - 93.2)	0.5001
Religion	Others	**11**	12.2	1	
	Christians	**79**	87.8	2.3 (0.4 - 12.8)	0.3000
Region of origin	Littoral region	**64**	59 (92.2)	1	
	West region	**16**	13 (81.2)	2.7 (0.5 - 12.9)	0.4531
	Other	**10**	9 (90.0)	2.1 (0.1 - 23.4)	0.3879
Age at first intercourse (years old)	< 17	**21**	20 (95.2)	2.6 (0.3 - 22.3)	0.7112
	≥ 17	**69**	61 (88.4)	1	
Age at first pregnancy (years old)	< 20	**24**	24 (100.0)	12.0 (0.6 - 225.0)	0.068
	[20 - 24]	**32**	26 (81.3)	1	
	≥ 25	**34**	31 (91.2)	2.4 (0.5 - 10.5)	0.063
Gestity	Primigravidous (1)	**32**	27 (84.4)	1	
	Secundigravidous (2)	**27**	26 (96.3)	4.8 (0.5 - 44.1)	0.6347
	Multigravidous (≥ 3)	**31**	28 (90.3)	1.7 (0.3 - 8.0)	0.3121
Number of abortion	0	**56**	53 (94.6)	3.8 (0.8 - 16.3)	0.0777
	≥ 1	**34**	28 (82.3)	1	
Number of sexual partners these last 2 years	1	**70**	63 (90.0)	1	
	≥ 2	**20**	18 (90.0)	NA	1,000
Use of condom	Always	**60**	53 (88.3)	1	
	Never	**30**	28 (93.3)	1.8 (0.3 - 9.6)	0.3506
Alcohol consumption	No	**44**	38 (86.4)	1	
	Yes	**46**	43 (93.5)	2.3 (0.5 - 9.7)	0.3999

Data are presented as frequency (percentage). Multivariate regression models were used to perform this association analysis. OR = Odds ratio, 95%CI = Confidence interval with 95%, NA = Not applicable, P-value < 0.05 are considered statistically significant.

Table 6: Factors associated with mother-to-child transmission of HSV-2

Variables	Total	N° of infected people (%)	Adjusted OR (95%CI)	P-value
Gender				
Male	**43**	30 (69.8)	1	
Female	**58**	38 (79.2)	1.6 (0.6 - 4.3)	0.3013
Age (months)				
< 3	**50**	46 (92.0)	30.7 (5.7 - 163.7)	< 0.0001
[4 - 6]	**18**	13 (72.2)	6.9 (1.2 - 37.3)	< 0.0001
[7 - 9]	**11**	3 (27.3)	1	
≥ 10	**12**	6 (50.0)	2.7 (1.4 - 15.3)	< 0.0001
Birth weight (g)				
< 3000	**19**	15 (78.9)	1.8 (0.5 -6.8)	0.2127
[3000 - 3400]	**42**	28 (66.7)	1	
≥ 3500	**30**	25 (83.3)	2.5 (0.7 - 8.0)	0.4047
Number of months of gestation				
< 9 months	**11**	7 (63.6)	1	
9 months	**50**	36 (71.4)	1.4 (0.3 - 5.9)	0.3001
> 9 months	**30**	25 (83.3)	2.8 (0.6 - 13.6)	0.4963
Type of delivery				
Genital delivery	**78**	60 (76.9)	2.0 (0.6 - 7.2)	0.3331
Caesarean section	**13**	8 (61.5)	1	
Type of breastfeeding				
Mixed	**53**	36 (67.9)	1	
Maternal	**30**	26 (86.7)	3.0 (0.9 - 10.2)	0.1021
Artificial	**8**	6 (75.0)	1.4 (0.2 - 7.8)	0.3698

Data are presented as frequency (percentage). Multivariate regression models were used to perform this association analysis. OR = Odds ratio, 95%CI = Confidence interval with 95%, P-value < 0.05 are considered statistically significant.

IV. DISCUSSION

This study aimed at determining the prevalence of HSV-2 infections in Cameroonian women and their infants and identifying factors associated with infection and transmission of the virus in women and their neonates respectively.

The HSV-2 prevalence was 90.0 % in mothers included in this study. This does not match within the interval of 30%-80% reported previously by [10] in women from Sub-Saharan countries. Our prevalence value is higher than that previously reported by many authors in Cameroon [4], [5], [7], [8]. These authors found a HSV-2 prevalence of 71.6%, 75.5%, 81.8% and 64.7% respectively. Besides, this result is consistent with some studies carried out in others parts of Africa [11], [12] but however highly different from this of [13] and [14] outside Africa. The authors found prevalence of 86.4%, 96.5%, 0.5% and 18% respectively in Nigeria, Cote D'ivoire, The United States of America (USA) and Germany respectively. These differences may be mainly attributable to the small size of our study sample compared with these studies. In addition, differences in sample size of population, study design or study site have certainly accounted for an important part in discrepancies. For instance, Brown and colleagues used cell culture systems to isolate HSV-2 in patients of their study. This method is more specific and sensitive than ELISA method in detection of the virus. Besides, Suligoi et al [6] focused on the epidemiology of HSV-2 in overall population consisting of adults and adolescents from the Northern Cameroon irrespective of gender while we focused on women only.

Based on multivariate logistic regression, none of tested socio-demographic factors were found being associated with HSV-2 infection. This finding is line with that of Boni Cisse et al (2015) in Cote D'ivoire. In addition, some authors reported the same pattern in results on average although they found positive association between age and risk for HSV-2 infection [15] - [17].

Likewise, all factors related to sexual behavior, toxicological intoxication (i.e. liquors intake) and gynecological history have not significantly influenced prevalence of HSV-2 among women. Our findings partially agree with these of the abovementioned studies [15] - [17]. Indeed, [12], [16], [17] on the one hand and [15] on the other hand, we did not found any effect of number of sexual partners and age at first sexual intercourse on risk of HSV-2 infection respectively. Conversely, no association between abortion history and risk of HSV-2 infection was found as previously reported by [13]. Small size of our study sample likely limited the statistical power of statistical analysis and thus hindered its ability to identify some of factors tested in our study. This fact is all the more true that even usage of condom was not found associated with HSV-2 infection in

our study. The importance of this preventive instrumentation against sexually-transmitted diseases is well known [18], [19].

Out of 91 babies included in the study anti-HSV-2 antibodies were detected in 68 of them giving a prevalence of 74.7%. This result is higher than that reported by [14] in Germany and [20] in Tanzania who found 4.5% and 20% respectively. This may be explained by discrepancies in range of children included in these studies. Indeed, these authors focused on children aged between 0-12 months and 1-4 years old respectively.

Age of babies was found significantly (P-value < 0.0001) associated with an increased risk for HSV-2 infection. Indeed, the risk for HSV-2 transmission was observed to increase by 31-, 7- and 3-fold in babies aged < 3 months, 4-6 months and ≥ 10 months compared with those aged 7-9 months (reference group in multivariate logistic analysis) as depicted in Table 6. In addition, a negative association was found between the prevalence of HSV-2 infection decreased with age of babies. This finding is in line with literature which outlines risk of HSV-2 infection as a function of age [10], [15], [21]. Indeed, this explains by the gradual disappearance of maternal antibodies making them more and more at risk of HSV infections acquired within postnatal period.

Type of delivery and number of months of gestation were not found to be associated with risk of HSV-2 infection in this study. This is not consistent with others reports which outline that these both factors influenced the risk of HSV-2 infections [13] Indeed, Brown and coworkers showed that cesarean delivery significantly reduced the transmission of HSV infections from North American mothers to their babies at delivery. During delivery, mothers shedding viruses transmit them to their babies in 70% of cases at the time of delivery [22].

Nearly four fifth (89.7%; P-value < 0.0001) of HSV-2 infected babies were born to mothers infected with the virus as well. This is not surprisingly as the majority of neonatal HSV-2 infections are perinatally acquired with in utero exposure and peripartum period accounting for 5% and 85% respectively [22]- [24]. To be noted, 10.3% of the remaining HSV-2 infected babies were born to HSV-2 uninfected mothers. This finding confirms the fact that the transmission of HSV-2 can occur postnatally due to direct contact with a person shedding the virus, usually via an orolabial or other cutaneous lesion [21].

This study has some limitations although significant findings were recorded. The small sample size has reduced the power of statistical tools used in analysis limiting thus our ability to identify well-established risk factors for HSV-2 infection. In addition, whether the infection in mothers was either primary or recurrent was not sought in this study. Thus, it was impracticable to conclude if HSV-2 positive babies were born to mothers with primary or recurrent infection. However, findings from this study fill some gaps in the field of epidemiology of HSV-2 infection in mothers and neonates especially in Cameroon where data on the topic are scanty.

V. CONCLUSION

This study pointed out a high prevalence of Herpes simplex Virus type-2 in mothers and their babies in the town of Douala. Neonatal HSV infections may evolve to HSV disease and caused serious clinical signs and symptoms in neonates. Thus, clinicians should be aware of including HSV infections in the differential, how recognize and properly treat neonatal HSV infections with the ultimate aim to efficiently mitigate mother-to-child transmission.

ACKNOWLEDGMENT

The authors are grateful mothers who participated and accepted their babies are included in the study. We are also grateful to the staff of the District hospital of Deido for the technical assistance.

REFERENCES

[1] E. Anzivino, D. Fioritti, M, Mischitelli, A. Belliezi, V. Barucca, F. Chiarini, and Pietropaolo, V, "Herpes simplex infection in pregnancy and in neonate: status of art of epidemiology, diagnosis, therapy and prevention," *Virol J*, vol. 6: 40, 2009.

[2] S.J. Smith, and N.J Robinson, "Age-Specific Prevalence of Infection with *Herpes simplex* Virus Types 2 and 1: A Global Review," *J Infect Dis*, vol. 186 (Suppl1), 2002, pp. S3–28.

[3] WHO. Herpes simplex virus. World Health Organization, Factsheet. Available at www.who.int/mediacentre/fatsheet/fs400/en/ consulted on 14/03/2017.

[4] A.M. Eis-hubinger, E. Nyankiye, D. Mboua Bitoungui, and J Ndjomou, Prevalence of herpes simplex virus type 2 antibody in Cameroon. *Sex Transm Dis*, vol. 29 (11), 2002, pp. 637-642.

[5] N.R.R Dongang, M.M.L. Koanga, N.A.R. Ngono, M. Wakam, N.G. Djiakam, B Djimeli, et al, "Risk factors of cervical intraepithelial lesion in Douala-Cameroon: implications of Herpes simplex virus type 2, *Chlamydia trachomatis* and *Treponema pallidum*," *Afr J Cln Exper Microbiol*, vol. 12 (3), 2011, pp. 92-97.

[6] B. Suligoi, O. Tchamgmena, L. Sarmati, R. Bugarini, L. Toma, D.K. Bakary, *et al*, "Prevalence and Risk Factors for *Herpes Simplex* Virus Type 2 infection among adolescents and adults in Northern Cameroon," *Sex Transm Dis*, vol. 28 (12), 2001, pp. 690-693.

[7] M.L. Koanga Mogtomo, R.R. Dongang Nana, A.R. Ngono Ngane, J. Assam Assam, M. Wakam, E. Embolo, and P.H Amvam Zollo, "Seroprevalence and Factors Associated with Herpes Simplex Virus Type 2 and *Chlamydia trachomatis* among Women Attending AIDS Care Unit at the Bonassama District Hospital," *Bri J Med Med Res*, vol. 7(3), 2015, pp. 224-230.

[8] M.F.H. Njimbam, P.S. Nguwoh, and J Fokam, "Prévalence des infections à Herpes simplex virus 1 et 2 chez les personnes vivant avec le VIH à Yaoundé: une étude sérologique,'' *Health Sci Dis*, vol. 17 (3), 2016, pp. 1-5.

[9] F.R Kamdem, ''Evaluation des connaissances des femmes enceintes relatives aux consultations prénatales" Bachelor thesis, International School for Nurses and Technico-Sanitary Personnels (ISNTP), Douala, Cameroon, 2012, pp. 78.

[10] H Weiss, "Epidemiology of herpes Simplex Virus Type-2 infections in the developing world," *Herpes*, vol. 11, 2004, pp. 24A-35A.

[11] Y.A. Agabi, E.B. Banwat, J.D. Mawak, P.M., Lar, N., Dashe, M.M. Dashen, *et al*, "Seroprevalence of herpes simplex virus type-2 among patients attending the Sexually Transmitted Infections Clinic in Jos, Nigeria," *J Infect Dev Ctries*, Vol. 4(9), 2010, pp. 572-575.

[12] C. Boni Cisse, F. Zaba, S. Meite, A. Mlan, K. Inwoley, A. Kouassi M'Bengue, *et al*, "Seroprevalence of herpes simplex virus 2 infection among

pregnant women in urban health training Yopougon-Attie (Cote D'ivoire)," *J Med Lab Diagn*, vol. 6(3), 2015, pp. 17-21.

[13] Z.A. Brown, A. Wald, R.A. Morrow, S. Selke, J. Zeh, and L Corey, "Effect of serologic status and cesarean delivery on transmission rates of Herpes Simplex Virus from Mother to Infant," *JAMA*, vol. 289 (2), 2003, pp. 203-209.

[14] A. Sauerbrei, S. Schmitt, T. Scheper, A. Brandstadt, S. Saschenbrecker, M. Motz, *et al*, "Seroprevalence of herpes simplex virus type 1 and type 2 in Thuringia, Germany, 1999 to 2006," *Euro Surveill*, vol. 16 (44), 2011, pp. 1-7.

[15] H.A. Weiss, N.J. Robinson, E. Van Dyck, M. Kahindo, S. Anagonou, R. Musonda, *et al*, "The epidemiology of HSV-2 infection and its association with HIV infection in four urban African populations," *AIDS*, vol. 15 (Suppl 4), 2001, pp. S97-S108.

[16] D. Biswas, B. Borkakoty, and J Mahanta, "Seroprevalence and risk factors of Herpes simplex virus type-2 infection among pregnant women in north India," *BMC Infect Dis*, vol. 11:325, 2011.

[17] J.U. Nyiro E.J. Sanders, and C Ngetsa, "Seroprevalence, Predictors and Estimated Incidence of Maternal and Neonatal *Herpes Simplex* Virus Type 2 Infections in Semi-urban Women in Kilifi, Kenya,'' *BMC Infect Dis*, vol. 11: 155, 2011.

[18] K.K. Holmes, R. Levine, and M Weaver, "Effectiveness of condoms in preventing sexually transmitted infections," Bull World Health Org, vol. 82(6), 2004, pp.c454-461.

[19] P. Mayaud, and D Mabey, "Approaches to the control of sexually transmitted infections in developing countries: old problems and modern challenges," *Sex Transm Infec*, vol. 80, 2004, pp. 174–182.

[20] M.J. Kasubi, A. Nilsen, and S Howard, "Prevalence of Antibodies against Herpes Simplex Virus Types 1 and 2 in Children and Young People in an Urban Region in Tanzania," *J Clin Microbiol*, vol. 44 (8), 2006, pp. 2801–2807.

[21] S.G. Pinninti, and D.W. Kimberlin, 2014. "Management of neonatal herpes simplex virus infection and exposure," *Arch Dis Child Fetal Neonatal Ed*, vol. 99, 2014, pp. F240–F244.

[22] N. Duran, F. Yarkin, C. Evruke, and F Koksal, "Asymptomatic herpes simplex virus type 2 (HSV-2) infection among pregnant women in Turkey," Indian J Med Res, vol. 120, 2004, pp.106-110.

[23] T.L. Cherpes, D.B. Matthews, and S.A Maryak, "Neonatal Herpes simplex virus infection," Clin Obst Gynecol, vol. 55 (4), 2012, pp. 938-944.

[24] S.H. James, J.S. Sheffield, and D.W Kimberlin, "Mother-to-Child Transmission of Herpes Simplex Virus," *J Pediatr Infect Dis Soc*, vol. 3 (Suppl 1), 2014, pp. S19–S23.

Koanga Mogtomo Martin Luther (Ph.D) is senior lecturer at Department of Biochemistry, University of Douala, Cameroon. He is specialist of molecular biology and Epidemiology of virus-induced diseases. He is also competent in issues addressing public and animal health. He co-authored more than 40 publications in national and international scientific reviews.

Eloumou Elouki Landry is PhD student at Department of Biochemistry, University of Douala, Cameroon. He is specialist of molecular biology and Epidemiology of virus-induced diseases especially Herpes simplex infection. He co-authored 2 publications in international scientific reviews.

Ngono Ngane Annie Rosalie (Ph.D) is associate professor and the head of Department of Biochemistry, University of Douala, Cameroon. She is also the head of the laboratory of Biochemistry. She is specialist of microbiology and plant sciences. He is also competent in issues addressing public and animal health. She co-authored more than 60 publications in national and international scientific reviews.