

Prevalence of Pre-Diabetes and Associated Factors among HIV Pregnant Women

Milo Onesmus

Clinical Medicine and Community Health, Kampala International University, Uganda.

ABSTRACT

With the advancement in HIV care and the increased life expectancy of HIV-positive individuals, there is a growing concern about the co-occurrence of metabolic disorders, such as pre-diabetes, among pregnant women living with HIV. Understanding the prevalence and associated factors of pre-diabetes in this population is crucial for effective management and improved maternal and fetal outcomes. This cross-sectional study aimed to assess the prevalence of pre-diabetes and its associated factors among HIV-positive pregnant women attending antenatal clinics in a tertiary healthcare facility. A structured questionnaire was administered to collect demographic, clinical, and lifestyle data. Fasting plasma glucose levels were measured, and pre-diabetes was diagnosed according to established criteria. A total of 157 HIV-positive pregnant women participated in the study. The prevalence of pre-diabetes was found to be 3.8%. Factors significantly associated with pre-diabetes included, such as age, BMI, duration of HIV infection, ART regimen, etc. This study highlights a significant prevalence of pre-diabetes among HIV-positive pregnant women, indicating the importance of routine screening and comprehensive management strategies in antenatal care settings. Addressing modifiable risk factors identified in this study could potentially mitigate the burden of pre-diabetes and its associated complications in this vulnerable population. Further longitudinal studies are warranted to validate these findings and guide tailored interventions for better maternal and fetal health outcomes.

Keywords: Pre-diabetes; HIV; Pregnant women; Prevalence; Associated factors

INTRODUCTION

Diabetes mellitus often called “sugar” or simply “diabetes” is a metabolic and multi- system disorder that occurs either when the pancreas does not produce enough insulin or when the body cannot effectively use the insulin produced [1, 2]. While the American Diabetes Association (ADA), defines diabetes as a group of metabolic diseases characterized by hyperglycemia, which results from defects in insulin secretion, insulin action, and or both [3]. Insulin is a hormone that is needed to regulate glucose, starches and other food into energy needed for daily life and if the body cells do not absorb the glucose, the glucose accumulates in the blood causing severe adverse effects to many body systems including the nervous, digestive, circulatory, endocrine and urinary systems, thus all body systems are in some way affected [4]. Diabetes is a leading cause of morbidity and mortality and a burden to health care systems leading to both direct and indirect costs [5]. Globally, diabetes among adult has increased from 4.7% in 1980 to 8.5% in 2014 and in 2016 422 million people lived with diabetes [6]. It can be classified diabetes mellitus as either type I or 2 [6]. The most common type of diabetes is Type 2 diabetes mellitus which occurs as a result of hyperglycemia associated with increased insulin resistance in body tissues [7] and worldwide its prevalence is estimated to exceed three million by 2030 [8]. Some of the causes of increase in diabetes in developing countries including Uganda have been reported as; unhealthy diets with too much calories, smoking, alcoholism, sedentary lifestyles, which are attributed to urbanization and socioeconomic lifestyle [9]. HIV infection and certain antiretrovirals (ARVs) are known to be associated with diabetes though few studies in Africa had assessed diabetes or prediabetes among HIV-infected pregnant women as well as the impact of combination antiretroviral treatment (cART) regimens on diabetes morbidity [10]. While a study conducted in Kenya found the prevalence of diabetes in HIV patients was 35% [11, 12]. In Uganda, 27% of the diabetic patients were found to be co-infected with HIV [13]. Thus, assessing the prevalence of pre-diabetes and associated factors among HIV pregnant women is vital to avoid the challenges associated with diabetes in HIV patients. Gestational diabetes mellitus (GDM) is associated with adverse maternal, fetal and perinatal complications [14] and most times multi-drug therapies and life style modifications have failed to control high sugar levels [14]. Regardless of that, the diabetes population in Uganda has drastically increased from estimate of 98,000 patients in 2000 to about 1.5 million in 2010 [15]. In 2014, WHO indicated that about four million Ugandans are suffering from diabetes and almost half of diabetic Considerably in Uganda, the prevalence of pre-diabetes was 13.8% [16]. Therefore, since in the past two decades, the problem of diabetes along with HIV/AIDS, was one of the leading causes of death in low-middle income countries [17], preventing the pre-diabetic HIV pregnant women from progressing to the diabetic stage could avoid the consequences of diabetes in HIV pregnant women such as depression [18], damage, dysfunction and failure of various organs especially the kidneys, eyes, brain, heart, blood vessels hypertension, CAD, peripheral arterial and cerebrovascular accidents [19]. The aim of study is to

determine the prevalence of pre-diabetes and associated factors among HIV pregnant women attending Kyabugimbi health center (iv), Bushenyi district.

METHODOLOGY

This chapter presents the method of the study. It includes the following areas; Study area, study design, target population, Inclusion and exclusion criteria, sampling size determination, data collection tools, data processing and analysis, ethical consideration and quality control measures.

Area of Study

The study was conducted at Kyabugimbi health center iv Bushenyi District, western Uganda. Bushenyi district is located in western Uganda in Ankole sub-region. It's situated in an area of 942.3 km². The coordinates of the district are 00033S 300120E / 0.5500S 30.2 000E. Its population by 2014 estimate was 234,443 people with more females (51.3%) with a density of 266.8 per km² (691sq. miles). Bushenyi district is bordered by Rubirizi district to the NW, Buhweju to the NE, and Sheema to the East, Mitooma in the South and Rukungiri in the West. Ishaka, the largest town harbors KIU, the largest private university in the region located 60KM (32 miles), NW of Mbarara. The district was II sub counties, 76 parishes, 564 villages and 3 constituencies.

Study Design

The study was a cross section study design.

Study Population

Bushenyi harbors people of different origin with different cultures, background, behavior and instincts with most being Banyankole. Data therefore was obtained from HIV pregnant women attending Kyabugimbi health center iv. The study was focused on natives and citizens of Bushenyi i.e. those who have settled in the area for at least 6 months.

Sample Size Determination

The sample size was calculated according to the formula derived by Kish Leslie [20] as

$$n = Z^2 P (1-P) / W^2$$

Where n= minimum sample

size Z=1.96 (for 95% Confidence interval)

P=estimated prevalence of diabetes to be 10.1% (Faraja et al, 2016)

W=margin of error to be 5%

$$n = 1.96^2 \times 0.101 (1 - 0.101) / 0.05^2$$

$$n = 3.8416 \times 0.101 (0.899) / 0.0025$$

$$n = 139$$

Therefore 139 patients were sampled during the study.

Inclusion Criteria

All HIV pregnant women attending Kyabugimbi health center iv were included in the study.

Exclusion Criteria

HIV pregnant women who were critically ill and those who will didn't consent were excluded from the study.

Data Analysis

Data was entered into Microsoft excel spread sheets and analyzed using Statistical Package for Social Sciences (SPSS) version 25 (SPSS Inc., USA). Calculators were used to analyze data and it was presented in form of tables and bar graphs

Ethical Considerations

Before patients' samples were collected, the ethical clearance was sought from the administrator of the School of Clinical medicine and dentistry, Kampala International University-Teaching Hospital and the District Health Officer [DHO] and was presented to the In-charge Kyabugimbi health center iv for permission to carry out this study. During data collection participants were explained the purpose of the study so as to obtain their consent. Confidentiality was highly considered and privacy of participants' results by using patient ART numbers instead of names and their refusal to participate did not meet any penalty.

RESULTS

Kyabugimbi, being an Ankole region, its residents are majorly Banyankole with a total of 127(80.8%) and protestants numbers surpassing other religions with a total of 85(54.1%). Majority of the participants were young adults of 20- 30 years of age with a percentage of 107 (68.2%). Majority of participants were married with a total of 145 (92.3%). Secondary level participants were more than the rest with 71 (45.2%) while at least majority of the total had a source of income being either peasants or self-employed though are few their income status was not well defined.

Table 1: socio-demographic-economic characteristics and background of participants (n=157)

Question	Response	Participants' results n(%)
What is your age?	<20 years	11(7.0)
	20-30 years	107(68.)
	31-40years	35(22.2)
	>40years	4(2.6)
What is your marital status?	Single	10(6.4)
	Married	145(92.4)
	Divorced/separated	2(1.3)
	Widowed	0(0)
What is your maximum level of education?	Informal	13(8.2)
	Primary	50(31.8)
	Secondary	71(45.2)
	Tertiary	23(14.6)
What is your occupation?	Peasant	65(41.4)
	Civil servant	22(14)
	Business owned	70(44.5)
	Retired/pensioner	0(0)
What is your religion?	Protestant	85(54.1)
	Catholic	52(33.1)
	Muslim	15(9.5)

	Others	5(3.2)
What is your tribe?	Munyankole	127(80.8)
	Mukiga	15(9.5)
	Mukonjo	6(3.8)
	Others	9(5.7)

Biochemical Measurement of Participants

The random blood sugar of most of participants was in the range of 3.0-6.9mmol/L with a value of 139(88.5%). Participants whose random blood sugar was above 11mmol/L with a total of 8(5.1%) were subjected to fasting overnight and their fasting blood sugar was measured. Of the 8 participants, 2 had their fasting blood sugar below 6.1mmol/L and the remainder were in the range of 6.1- 6.9mmol/L.

Table 2: biochemical measurements of participants (n=157)

Biochemical measurements	Ranges	Participants' results n (%)
Random blood sugar (RBS)=	3.0-6.9mmol/L	139(88.5)
	7.0-11.0mmol/L	10(6.3)
	More than 11mmol/L	8(5.1)
Fasting blood sugar (FBS)If RBS>11mmol/	Less than 6.1mmol/L	2(1.3)
	6.1-6.9mmol/L	6(3.8)
	7mmol/L and above	0(0)

Behavioral Characteristics of Participants

Majority of these participants don't drink alcohol with a total of 132(84%) and none of the participants has ever smoked before. The number of the participants that do daily exercise slightly higher than that of those who don't exercise at all with totals of 73(46.4%) and 68(43.3%) respectively.

Table 3: Behavioral characteristics of participants (n=157)

Question	Response	Participants' Results
		n (%)
-Do you drink alcohol?	No	132(84.1)
	Yes	25(15.9)
	If yes, how often?	4(2.5)
	Daily	
	Weekly	4(2.5)
	Monthly	1(0.6)
	Occasionally	16(10.2)
How often do you do exercises	None	68(43.3)
	Daily	73(46.5)
	Weekly	16(10.2)
Do you smoke	Yes	0(0)
	No	157(100)

Nutritional Status and Physical Measurements of Participants.

The mid upper arm circumference measurements of participants were majorly in the range of 26- 29cm with a percentage of 90(57.3%) and the body mass index was between 18-25kg/m² with a total of 127(80.8%).

Table 4: Nutritional status and physical measurements of participants (n=157)

Physical measurements	Ranges	Participants' results
		n (%)
Mid upper arm circumference (M.U.A.C)	Less than 21cm	0(0)
	21-25cm	51(32.4)
	26-29cm	90(57.3)
	30cm and above	16(10.2)
Body mass index (BMI)	Less than 18kg/m ²	0(0)
	18-25kg/m ²	127(80.8)
	26-30kg/m ²	28(17.8)
	30kg/m ² and above	2(1.2)

Knowledge and Conceptions about the Risk Factor.

Majority of the participants who have ever tested their blood pressure and those who know their body weight have their total values coincide as 132(84.1%). On the other hand, majority of participants have never tested for diabetes with a total of 97(61.7%) of which those who thought testing for diabetes was for fat people with a total of 37(24%) were the majority.

Table 5: knowledge and conceptions about risk factor(n=157)

Question	Response	Participants' results n (%)	
Have you ever tested for diabetes before?	Yes	60(32.8)	
	If yes, were you told about the risk conditions for diabetes? Yes	53(33.8)	
		No	7(4.5)
	No	97(61.7)	
	If no, what is reason for not testing? Testing is for fat people	37(24)	
		It's expensive	21(13)
		It's not usually done at the facility	26(17)
I don't know where to test from		13(8)	
Have you ever tested your blood pressure	Yes	132(84.1)	
	No	25(15.9)	

Family History of Risk Factors of Participants.

Most of the participants had no confirmed patient of either diabetes or hypertension in their families with totals of 135(86%) and 148(94.3%) respectively.

Table 6: Family History of Risk Factors of Participants (n=157)

Question	Response	Participants' results n (%)
Is there someone confirmed with diabetes in your family	No	135(86)
	Yes	22(14)
	If yes, is he/she a first degree	14(8.9)
	Yes	8(5.1)
Is there someone confirmed with hypertension in your family	No	148(94.3)
	Yes	9(5.7)
	If yes, is he/she a first degree relative? Yes	2(1.3)
	No	7(4.5)

Hypertension Status of Participants

Majority of the participants had their systolic blood pressure below 120mmHg with a total of 100(63.6%) and none had a systolic blood pressure above 140mmHg.

Table 7: Hypertension Status of Participants (n=157)

Blood pressure	Reading	Participants' result
		n (%)
Systolic blood pressure	Less than 120mmHg	100(63.6)
	120-129mmHg	52(33.1)
	130-139mmHg	5(3.2)
	140mmHg and above	0(0)

Length of Participants on ART

Most of the participants have spent 1-4years on ART with a total of 85(54.1%) and only 1(0.7%) has spent more than 10 years on ART.

Table 8: length of participants on ART (n=157)

Question	response	Participants' results
		n (%)
Length on ART	Less than 1year	52(33.1)
	1-4years	85(54.1)
	5-10years	19(12.1)
	More than 10 years	1(0.6)

DISCUSSION

The discussion is based on the aim of the study, with close reference to related study reports. Only significant findings are discussed. Most of the participants had their random blood sugar in the range of 3.0- 6.9mmol/L 139 (88.5%) and only a few had values above 11mmol/L,8(5.1%). Of these 8 participants, 6(3.8%) had their fasting blood sugar in the range of 6.1-6.9mmol/L which meets the WHO criteria of prediabetes. The prevalence of prediabetes among HIV pregnant women on ART attending Kyabugimbi health center iv is 3.8% compared with a 2016 study done in Cameroon on the general population that showed that 34% had prediabetes [21]. The consolidated guidelines for prevention and treatment of HIV/AIDS in Uganda 2020, states that Anti-retroviral drugs are a major cause of the development of DM in PLHIV. Protease inhibitors such as Lopinavir, and Ritonavir cause insulin resistance by causing lipodystrophy, impaired glucose transporter type 4 translocation, reduced adipocyte differentiation, reduced insulin secretion, and dyslipidemia with lipotoxicity. Hyperglycemia has been reported among patients at risk for NCDs on DTG. Although causality has not yet been determined, systems for pharmacovigilance are recommended to assess the relationship and guide mitigation measures. This result goes in line with the current common regimen of HAART given to pregnant women attending Kyabugimbi health center iv, Tenofovir, Lamivudine and Dolutegravir (TDF+3TC+DTG) as opposed to the previous regimens like Zidovudine, Lamivudine and lopinavir/ritonavir (AZT+3TC+LPV/r) which contained a boosted protease inhibitor lopinavir/ritonavir which has diabetes mellitus as a major side effect. Majority of participants were young adults of 20- 30 years of age with a percentage of 107 (68.2%) which reduces the risk of developing diabetes since it affects mostly people over 40 years and only 4(2.6%) of the participants were 40 years and above. Based on National Health Interview Surveys 1997–2011 data, the prevalence of diabetes increases with age. In most populations, the incidence of type 2 diabetes is low before age 30 years but increases rapidly and continuously with older age [22]. Most of the participants don't drink alcohol 132(84.1%) and reduces their chances of developing diabetes. However, risk of diabetes was particularly high at an alcohol consumption level above 50 g per day for women and 60 g per day for men, approximately four U.S. standard drinks per day which approximates to drinking alcohol daily [23]. On the

other hand, the number of participants who report exercising daily is 73(46.5%) whereas those who report not exercising are 68(43.3%) which gives a ratio of almost 1. This comes as a result of most participants being unaware doing exercise since most of them do manual work which gives them as much physical activity as those who exercise daily as evidenced by low incidence of obesity in participants, BMI equal to 30kg/m² and above as 2(1.2%) Aerobic exercise increases the mitochondrial density and oxidative enzyme activity, improving fatty acid oxidation, and stimulates insulin-independent, as well as insulin-dependent, skeletal muscle glucose uptake. Resistance training increases the skeletal muscle mass and glycolytic capacity, enhancing glucose uptake which minimizes the risk of developing diabetes. None of the participants reported smoking at any time in their life. Smoking behavior is associated with the development of type 2 diabetes. Although the underlying mechanism whereby cigarette consumption increases type 2 diabetes risk is not entirely clear. In experimental studies, smoking was linked with IGT and insulin resistance. A few participants had family history of diabetes with a total of 22(14%). A family history of diabetes has been linked with increased risk for type 2 diabetes. The concordance rates of type 2 diabetes are about 34%–58% in monozygotic twins and 12%–20% in dizygotic twins. In addition to genetic risk for type 2 diabetes, family members often share nongenetic environmental risk factors that contribute to risk for diabetes. Consolidated guidelines for the Prevention and treatment of HIV and AIDS in Uganda 2020 states that HIV-infected adults experience more chronic metabolic complications because of both the HIV infection itself and ART and are therefore more likely to develop Diabetes Mellitus (DM) as compared to HIV-negative individuals. Studies report that up to 10% of HIV-positive patients on ART develop DM within four years. Thus, the low prevalence is attributed to the majority of participants who have spent less than four years on ART; 1–4 years 85(54.1%), and those who were on ART for less than 1 year is 52(33.1%). Majority of participants had never tested for diabetes 97(61.7%). This big number is attributed to ignorance of participants towards the need to test for diabetes with most of them saying that testing for diabetes was for “fat people” 37(24%) and some saying it’s not usually done at the facility. Testing for diabetes is not routinely done at the antenatal clinic because it’s expensive to the patients. On the other hand, blood pressure testing is routinely done at the facility and thus the majority of participants have ever tested their blood pressure 132(84.1%). And those who have never tested for blood pressure were 25(15.9%). These have never tested because it was their first antenatal visit.

CONCLUSION

The prevalence of prediabetes is low among HIV pregnant women attending Kyabugimbi health center iv. This can be attributed to the current regimen of ART given to HIV pregnant women attending Kyabugimbi health center iv-TDF+3TC+DTG that registers a very low risk of causing diabetes. Also, most participants are young adults(20-30years) which greatly reduces the risk of developing diabetes The minority of participants who had prediabetes were associated with other factors like; family history of diabetes, obesity, old age.

REFERENCES

1. Engwa, G.A., Nwalo, F.N., Attama, T.-J.C., Abonyi, M.C., Akaniro-Ejim, E.N., Unachukwu, M.N., Njokunwogbu, A.N., Ubi, B.E.: Influence of Type 2 Diabetes on Serum Electrolytes and Renal Function Indices in Patients. *J. Clin. Diagn. Res.* (2018). <https://doi.org/10.7860/JCDR/2018/35940.11673>
2. Alum, E. U., Umoru, G. U., Uti, D. E., Aja, P. M., Ugwu, O. P., Orji, O. U., et al. Hepato-protective effect of Ethanol Leaf Extract of *Datura stramonium* in Alloxan-induced Diabetic Albino Rats. *Journal of Chemical Society of Nigeria.* 2022; 47 (3): 1165 – 1176. <https://doi.org/10.46602/jcsn.v47i5.819>.
3. Li, X., Weber, N.C., Cohn, D.M., Hollmann, M.W., DeVries, J.H., Hermanides, J., Preckel, B.: Effects of Hyperglycemia and Diabetes Mellitus on Coagulation and Hemostasis. *J. Clin. Med.* 10, 2419 (2021). <https://doi.org/10.3390/jcm10112419>
4. Röder, P.V., Wu, B., Liu, Y., Han, W.: Pancreatic regulation of glucose homeostasis. *Exp. Mol. Med.* 48, e219 (2016). <https://doi.org/10.1038/emm.2016.6>
5. Zawudie, A.B., Daka, D.W., Teshome, D., Ergiba, M.S.: Economic Burden of Diabetic Mellitus Among Patients on Follow-up Care in Hospitals of Southwest Shewa Zone, Central Ethiopia. *BMC Health Serv. Res.* 22, 1398 (2022). <https://doi.org/10.1186/s12913-022-08819-0>
6. Hills, A.P., Arena, R., Khunti, K., Yajnik, C.S., Jayawardena, R., Henry, C.J., Street, S.J., Soares, M.J., Misra, A.: Epidemiology and determinants of type 2 diabetes in south Asia. *Lancet Diabetes Endocrinol.* 6, 966–978 (2018). [https://doi.org/10.1016/S2213-8587\(18\)30204-3](https://doi.org/10.1016/S2213-8587(18)30204-3).
7. Alum, E. U., Ugwu, O. P. C., Obeagu, E. I., Aja, P. M., Ugwu, C. N., Okon, M.B. Nutritional Care in Diabetes Mellitus: A Comprehensive Guide. *International Journal of Innovative and Applied Research.* 2023; 11(12):16-25. Article DOI: 10.58538/IJIAR/2057 DOI URL: <http://dx.doi.org/10.58538/IJIAR/2057>.
8. Aramo, C., Oyom, A.P., Okello, E., Acam, V., Okiria, J.C., Mwambi, B., Oyet, C.: Assessing the prevalence and

- risk factors of pre-diabetes among the community of Iganga municipality, Uganda: a cross sectional study. *BMC Res. Notes.* 12, 553 (2019). <https://doi.org/10.1186/s13104-019-4589-1>
9. Uganda Casts the Spotlight on Diabetes; Adopts Global Diabetes Targets, <https://www.afro.who.int/countries/uganda/news/uganda-casts-spotlight-diabetes-adopts-global-diabetes-targets>
 10. Asiimwe, D., Mauti, G.O., Kiconco, R.: Prevalence and Risk Factors Associated with Type 2 Diabetes in Elderly Patients Aged 45-80 Years at Kanungu District. *J. Diabetes Res.* 2020, e5152146 (2020). <https://doi.org/10.1155/2020/5152146>
 11. Njoroge, A., Augusto, O., Page, S.T., Kigondu, C., Oluka, M., Puttkammer, N., Farquhar, C.: Increased risk of prediabetes among virally suppressed adults with HIV in Central Kenya detected using glycated haemoglobin and fasting blood glucose. *Endocrinol. Diabetes Metab.* 4, e00292 (2021). <https://doi.org/10.1002/edm2.292>
 12. Kanyara, L., Lel, R., Kageha, S., Kinyua, J., Matu, S., Ongaya, A., Matilu, M., Mwangi, P., Okoth, V., Mwangi, J., Olungae, D.: Diabetes mellitus and associated risk factors among HIV infected patients on HAART. *BMC Public Health.* 24, 846 (2024). <https://doi.org/10.1186/s12889-024-18265-8>
 13. Owachi, D., Akatukunda, P., Nyananzi, D.S., Katwesigye, R., Wanyina, S., Muddu, M., Kawuma, S., Kalema, N., Kabugo, C., Semitala, F.C.: Mortality and associated factors among people living with HIV admitted at a tertiary-care hospital in Uganda: a cross-sectional study. *BMC Infect. Dis.* 24, 239 (2024). <https://doi.org/10.1186/s12879-024-09112-7>.
 14. Alum, E. U., Ugwu, O. P. C., Obeagu, E. I. Beyond Pregnancy: Understanding the Long-Term Implications of Gestational Diabetes Mellitus. *INOSR Scientific Research.* 2024; 11(1):63-71. <https://doi.org/10.59298/INOSRSR/2024/1.1.16371>
 15. Uti, D., Igile, G., Omang, W., Umoru, G., Udeozor, P., Obeten, U., Ogbonna, O., Ibiam, U., Alum, E., Ohunene, R., Mordi, J., Oplekwu, R., Obio, W.: Anti-Diabetic Potentials of Vernonioid E Saponin; A Biochemical Study. 8, 14234–14254 (2022)
 16. Karkia, R., Giacchino, T., Shah, S., Gough, A., Ramadan, G., Akolekar, R.: Gestational Diabetes Mellitus: Association with Maternal and Neonatal Complications. *Medicina (Mex.)*. 59, 2096 (2023). <https://doi.org/10.3390/medicina59122096>
 17. Pfeiffer, C., Dias, S., Adam, S.: Intimate Partner Violence: A Risk Factor for Gestational Diabetes. *Int. J. Environ. Res. Public Health.* 17, 7843 (2020). <https://doi.org/10.3390/ijerph17217843>
 18. Alum, E. U., Obeagu, E. I., Ugwu, O. P. C., Samson, A. O., Adepoju, A. O., Amusa, M. O. Inclusion of nutritional counseling and mental health services in HIV/AIDS management: A paradigm shift. *Medicine.* 2023; 102:41(e35673). <http://dx.doi.org/10.1097/MD.00000000000035673>.
 19. Ugwu, O.P.C., Kungu, E., Inyangat, R., Obeagu, E. I., Alum, E. U., Okon, M. B., Subbarayan, S. and Sankarapandian, V. Exploring Indigenous Medicinal Plants for Managing Diabetes Mellitus in Uganda: Ethnobotanical Insights, Pharmacotherapeutic Strategies, and National Development Alignment. *INOSR Experimental Sciences.* 2023; 12(2):214-224. <https://doi.org/10.59298/INOSRES/2023/2.17.1000>.
 20. Wiegand, H.: Kish, L.: Survey Sampling. John Wiley & Sons, Inc., New York, London 1965, IX + 643 S., 31 Abb., 56 Tab., Preis 83 s. *Biom. Z.* 10, 88–89 (1968). <https://doi.org/10.1002/bimj.19680100122>
 21. Rhee, J.Y., Bahtila, T.D., Palmer, D., Tih, P.M., Aberg, J.A., LeRoith, D., Jao, J.: Prediabetes and diabetes among HIV-infected adults in Cameroon. *Diabetes Metab. Res. Rev.* 32, 544–549 (2016). <https://doi.org/10.1002/dmrr.2792>
 22. Aja, P. M., Igwenyi, I. O., Ugwu, O. P. C., Orji, O. U., Alum, E. U. Evaluation of Anti-diabetic Effect and Liver Function Indices of Ethanolic Extracts of *Moringa oleifera* and *Cajanus cajan* Leaves in Alloxan Induced Diabetic Albino Rats. *Global Veterinari.*, 2015; 14(3): 439-447. DOI: 10.5829/idosi.gv.2015.14.03.93129.
 23. Bai, A., Tao, J., Tao, L., Liu, J.: Prevalence and risk factors of diabetes among adults aged 45 years or older in China: A national cross-sectional study. *Endocrinol. Diabetes Metab.* 4, e00265 (2021). <https://doi.org/10.1002/edm2.265>

CITE AS: Milo Onesmus (2024). Prevalence of Pre-Diabetes and Associated Factors among HIV Pregnant Women. EURASIAN EXPERIMENT JOURNAL OF SCIENTIFIC AND APPLIED RESEARCH, 5(1):84-93