

Situational Analysis of Selected NCDs—Type 2 Diabetes Mellitus and Hypertension among PLHIV Attending ART Center of Tertiary Care Hospital in India: A Mixed Methods Study

Blessy Wilson, J. K. Kosambiya, Mohamed Anas Patni¹

Department of Community Medicine, Government Medical College, Surat, Gujarat, India, ¹Department of Community Medicine, Ras Al Khaimah Medical and Health Science University, Ras Al Khaimah, UAE

Abstract

Background: Antiretroviral therapy (ART) has transformed the life of PLHIV with a longer life expectancy. The rising coexistence of non-communicable diseases (NCD)s especially type 2 diabetes mellitus (DM) and hypertension (HTN) among PLHIV (people living with HIV) is much more complicated and demanding for the health system, patients, and their families. To document the current status of type 2 DM and HTN among known diabetic/hypertensive PLHIV attending ART center, tertiary care hospital of South Gujarat. **Materials and Methods:** A mixed method study (cross-sectional survey followed by qualitative in-depth interview) was conducted among 184 PLHIV on ART with history of Type 2 DM and/or Hypertension who were registered and availing services from ART center, tertiary care hospital. Convenient sampling technique was used. All the participants were interviewed using pre-designed, semi-structured questionnaire, during their routine visits. In -depth interview (IDI) has been conducted to explore the delivery of NCD services at ART Centre. **Results:** Out of 184 PLHIV on ART, the most common co-morbidities were Type 2 DM (46.2%), HTN (39.13%), and 14.67% had both. Among total 184 participants, 64.1% were males and 35.9% were females. Only 22.3% of participants were availing treatment services for the above at tertiary care hospital. The study results showed a range of findings involving ART adherence, BMI, RBS, and BP measurements were included. IDI results described the NCD service delivery at ART Center. **Conclusions:** Study results suggest that the services received by PLHIV with NCD require an overhauling. Routine monitoring and strengthening of existing services should be focused to upgrade the quality and continuum of the care provided to PLHIV with NCD.

Keywords: ART, HIV with NCD, PLHIV

INTRODUCTION

HIV has scourged the world for more than two decades. More than 35 million people are infected with HIV globally, especially in resource-deprived settings. The treatment in the form of antiretroviral therapy (ART) has made an impact on morbidity and mortality. Access and eligibility to ART are increasing globally; however, only 46% of ART-eligible individuals receive it, exposing a vast treatment gap.^[1] UNAIDS has played a great role in encouraging countries to achieve 95–95–95 targets by 2025 in which 95% of PLHIV must know their status, of whom 95% should be started on ART and of whom 95% should achieve viral suppression to end AIDS epidemic. In spite of these efforts, it is noted that the global AIDS response that has been set up to address HIV

and common opportunistic infections has limited focus on other chronic illnesses which affects PLHIV as well as others. A significant gap in the care for NCDs was identified to meet the 95–95–95 targets.^[2]

The burden of NCDs especially type 2 diabetes mellitus (DM) and hypertension (HTN) is as common in PLHIV as well as non-HIV patients and is a roadblock to attaining Sustainable

Address for correspondence: Dr. J. K. Kosambiya,

A/6 B Poddar Residency, N/R GD Goenka International School, Canal Road, Vesu, Surat - 395 007, Gujarat, India.
E-mail: jkkosambiya@gmail.com

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

For reprints contact: WKHLRPMedknow_reprints@wolterskluwer.com

How to cite this article: Wilson B, Kosambiya JK, Patni MA. Situational analysis of selected NCDs—Type 2 diabetes mellitus and hypertension among PLHIV attending ART center of tertiary care hospital in India: A mixed methods study. Indian J Community Med 2024;49:681-6.

Received: 17-01-24, **Accepted:** 15-04-24, **Published:** 14-08-24

Access this article online

Quick Response Code:



Website:
www.ijcm.org.in

DOI:
10.4103/ijcm.ijcm_33_24

Development targets by 2030. These includes reducing the probability of death from any of the four main NCDs- diabetes, cardiovascular disease, cancer or chronic respiratory disease in the age group 30 to 70 years to one third by the year 2030.^[3] Tackling this threat has put focus on early screening and diagnosis.

NCDs mainly DM and HTN coexist in HIV-infected individuals increasing the risk of morbidity^[4] and mortality.^[5] Additionally, they have a negative impact on the quality of life and efficacy of ART.^[5]

India has a high prevalence of diabetes mellitus (16.5%), particularly in Gujarat notably the prevalence in men is 9% and that in women is 8.1%.^[6] While prevalence of HTN in Gujarat is also high with a prevalence in males is 13.1% and in women is 11.7%.^[6]

Therefore, in PLHIV with NCDs such as DM and HTN, it is expected that there is a dual burden of diseases, which increases in proportion as the PLHIV grows older and survives longer. In this regard, it should be explored whether the National AIDS Control Programme needs to address these issues in a holistic manner; so that the PLHIV with NCDs or risk factors for developing NCDs might receive comprehensive care and treatment.^[7]

The extortionate costs of NCDs, inclusive of treatment, are often lengthy and expensive, combined with income deprivation, force millions of people into poverty and suppress development. This holds that investing in better management of NCDs is critical.^[8] This threat exerted by NCDs is dealt with by detecting, screening and treating the diseases, and focusing on ART and NCD treatment adherence through proper service delivery.

METHODS

A mixed methods study (cross-sectional survey followed by qualitative in-depth interview) among PLHIV on ART with history of Type 2 DM and/or Hypertension who were registered and availing services from ART center, tertiary care hospital which was conducted between October 2021-March 2022. Convenient sampling technique was used. All the participants were interviewed during their routine visits; using a pre-designed, semi-structured questionnaire.

Out of the 3745 PLHIV aged above 30 years, availing services from the ART center as of data available in October 2021, only 196 (5.23%) participants meet the inclusion and exclusion criteria. After 6.1% of non-responsiveness and ongoing attrition (due to loss to follow-up, transferred out, and missed during the study period), finally a total of 184 participants were interviewed. Data collected was computed into MS Excel. Analysis of quantitative interview data was done using Microsoft Excel and IBM SPSS software ver. 24.^[9] Descriptive statistics of participant characteristics such as socio-demographic variables, baseline clinical profile, and treatment adherence were analyzed. This was followed by

tests of association to explore the association within these variables (Fischer's exact test).

Participants for in-depth interviews were selected from those among quantitative survey. Eighteen PLHIV having DM and/or HTN and the stakeholders of the ART center (1 senior medical officer and 2 counselors) were enrolled in the study, to explore the NCD service delivery at ART Center. The participants were approached by the ART counselors who explained the study to them before introducing them to the researcher. Patient identifiers were not collected from the participants. IDI was conducted after the study participants due consent for audio record. The audio records and field notes were translated from Hindi/Gujarati to English. Content analysis of the transcripts was done by coding and theme generation using N-Vivo software available to the department. The themes were compared and contrasted with the results from the quantitative study to summarize the findings.

Ethical Concerns: The permission was obtained from the Institution Human Research and Ethical Committee (No. GMCS/STU/ETHICS/Approval/27296/20, dated December 31, 2020 and GSACS (GSACS/SIMU/Research/2020-21/02/11014-17), dated December 28, 2020. All data were collected from the participants after informed consent and were kept under strict confidence. There was no physical or psychological harm to the participant.

RESULTS

A total of 184 participants were included in this study. The age of the participants ranged from 32 years to 74 years and the mean age was 52.34 years (SD \pm 7.97 years). Among total 184 participants, 64.1% were males and 35.9% were females. About 91.3 % participants were residing in urban area. The other socio-demographic characteristics of the study participants are given in Table 1.

The mean duration of HIV infection among 184 participants was 10.84 years (SD \pm 4.7 years) and median of 11.4 years. More than 95% of participants were found in WHO clinical stage I of HIV infection. Most of the participants (94%) were on the first line of ART. Only 6% of participants were on second-line ART. On assessment of ART adherence, 92.4% had good adherence and 7.1% had suboptimal adherence to ART whereas poor ART adherence was noted in one participant.

Out of 184 total participants with HIV, 46.2% had a known history of type 2 DM followed by 39.13% with HTN and less than 15% of the participants had both DM and HTN. The mean gap in the duration of diagnosis and initiation of medications among participants with DM and HTN was 1.5 months and 18.6 days, respectively. This gap might be taken for blood investigations and follow-up visits to confirm the diagnosis.

According to the WHO Asian-BMI classification,^[10] the mean BMI of total participants was 24.2 (SD \pm 4.45) kg/m². Among them, 41.8% of participants belonged to the obese category,

39.2% had normal BMI, and 13.6% were in the overweight category. About 5.4% were in the underweight category. The mean BMI of 27 participants with DM and HTN was 25.56 (SD \pm 4.67) kg/m² and of them, 51.9% were in obese category, 37% were having normal BMI, followed by 11.1% were in overweight category.

This study showed a statistically significant association between BMI and a history of having DM and HTN at a *P* value less than 0.05 [Table 2].

On the day of the interview, RBS and BP measurement was done for all the participants [Table 3]. Among those who have DM (n=85), 20% had high blood sugar and 24.7% had high

Table 1: Socio-demographic characteristics of the study participants (n=184)

Characteristics		Frequency (n=184)	Percentage (%)
Educational status	Primary school	89	48.4
	Illiterate	57	31
	Secondary school	33	17.9
	College and above	5	2.7
Occupational status	Laborer	55	29.9
	Housewife	50	27.2
	Unemployed	28	15.2
	Self-employed	19	10.3
	Retired	15	8.2
	Skilled worker	14	7.6
	Professional	3	1.6
Socio-economic class*	Upper (I) >8493	8	4.34
	Upper middle (II) 4246–8493	23	12.5
	Lower middle (III) 2547–4245	56	30.43
	Upper lower (IV) 1273–2546	62	33.7
	Lower (V) <1273	35	19.03
Marital status	Married	139	75.5
	Widowed/widower	38	20.7
	Single	7	3.8
Migration status	Migration	83	45.1
	Inter-state migration	63	75.9
	Intra-state migration	20	24.1
	No migration	101	54.9

*Modified B G Prasad classification (July 2022) of socioeconomic status

Table 2: BMI with diabetes mellitus and hypertension

Disease	BMI (kg/m ²)	Present	Absent	Test statistic, <i>P</i>
Type 2 diabetes mellitus		<i>n</i> =112	<i>n</i> =72	Fischer's Exact=13.37, <i>P</i> =0.003
	Underweight (<18.5)	3 (2.7%)	8 (11.1%)	
	Normal (18.5–22.9)	54 (48.2%)	18 (25%)	
	Overweight (23–24.9)	15 (13.4%)	10 (13.9%)	
	Obese (\geq 25)	40 (35.7%)	36 (50%)	
Hypertension		<i>n</i> =99	<i>n</i> =85	Fischer's Exact=12.35, <i>P</i> =0.006
	Underweight (<18.5)	8 (8.1%)	3 (3.5%)	
	Normal (18.5–22.9)	28 (28.3%)	44 (51.8%)	
	Overweight (23–24.9)	13 (13.1%)	12 (14.1%)	
	Obese (\geq 25)	50 (50.5%)	26 (30.6%)	

Table 3: Random blood sugar and Blood pressure measurements of the study participants

Characteristics		Total (n=184)	Type 2 DM (n=85)	Hypertension (n=72)	Both (n=27)
Random blood sugar (RBS)	High (\geq 200 mg/dL)	22 (11.9%)	17 (20%)	2 (2.8%)	3 (11.1%)
	Normal	162 (88.1%)	68 (80%)	70 (97.2%)	24 (88.9%)
Blood pressure	High (SBP \geq 140 or DBP \geq 90 mmHg)	52 (28.3%)	21 (24.7%)	22 (30.6%)	9 (33.4%)
	Normal	132 (71.7%)	64 (75.3%)	50 (69.4%)	18 (66.6%)

BP. Among those who have HTN (n=72), 30.6% had high BP and 2.8% had high blood sugar.

This study showed a statistically significant association between adherence to ART and the number of DM and HTN pills at *P* value less than 0.05 [Table 4].

It was noted that 52.7% had been continuing treatment for DM/HTN in private hospitals followed by 22.3% at tertiary care hospitals. Figure 1 shows DM/HTN service delivery among participants with HIV in tertiary care hospital.

IDI 4 reveals the easiness of availing medicines from nearby hospitals.

IDI 4: I can get all the medicines nearby private hospital. Its just 1 km away. I can walk to it. Besides walking is a good exercise.

NCD medicines were normally prescribed for one-month duration so that the physician can assess their DM and HTN control in their next visit. This helps in analyzing the patient's condition and deciding whether to continue the same drugs or not. The average distance between the participant's area of residence and the tertiary care hospital was 6 km and the travel cost required was Rs. 40. Therefore, the beneficiaries have to spend money only for travel for availing NCD services from the tertiary care hospital. IDI 3 was in support of this study result.

IDI 3: Earlier I thought of getting them from outside. But then I felt to try it out here. One person who comes to ART centre was going like that. Nowadays I get both ART and DM medicines from this hospital. This was a good idea now I have to pay only for travel.

Among the total participants, 78% said that they had received counseling from ART staff regarding the importance of controlling

blood sugar/blood pressure and regular exercise, the importance of regular NCD medications and smoking cessation. Among the total participants, 73.9% said that they had been informed by ART staff that NCD management was available in this hospital.

IDI 16: The ART staff here told me; when I come for check-up that I should try to go to NCD cell. There we have free provisions to give tablets for HTN and T2DM. It's a good thing I always maintain a rapport with them. I don't like taking unnecessary medicines. I don't have any symptoms now. I will take BP medicines only when i am feeling sick.

IDI 7: The ART staff here told me; when I come for check-up that I should try to go to NCD cell. There we have free provisions to give tablets for HTN and T2DM. It's a good thing I always maintain a rapport with them.

Counsellor 2: Yes, we give routine advice about nutrition and hygiene. For T2DM and HTN they advised to visit their physician for detailed check-up and treatment of complications.

DISCUSSION

In the study, majority of participants were aged above 50 years (121, 65.76%). According to the systematic review done by Shiraam *et al.*,^[11] the population above 50 years in India is at risk of co-morbidities like DM and HTN which is consistent with the results. Gender-wise, co-morbidity was found higher among males in comparison to females. NACO factsheet 2021 points out that the adult HIV prevalence among males was 0.23% and was 0.20% among females^[12] and in Gujarat, adult HIV prevalence was highest among males (0.21%) followed by 0.17% in females.^[13] The study setting also reflected that there was an influx of male PLHIV in daily outpatient services as they can collect ART for the rest of the family members too. This acted as a barrier to follow-up of DM and HTN.

Table 4: Association between adherence to ART and number of anti-diabetic pills and anti-hypertensive pills

Characteristics			Number of daily pills			Fisher's Exact	<i>P</i>
			1	2	≥3		
T2DM n=112	Adherence to ART (%)	Good (≥95%)	22 (78.6%)	56 (94.9%)	92 (94.8%)	7.06	0.02
		Poor (<95%)	6 (21.4%)	3 (5.1%)	5 (5.2%)		
HTN n=99	Adherence to ART (%)	Good (≥95%)	60 (92.3%)	27 (93.1%)	3 (60%)	3.3	0.19

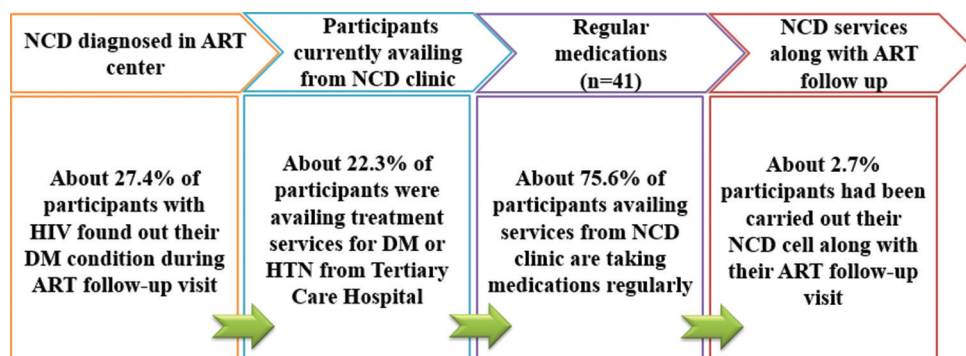


Figure 1: DM/HTN service delivery among participants with HIV in tertiary care hospital

The study setting (ART center of tertiary care hospital) was in an urban area and thus beneficiaries were mainly the urban population (91.3%). Prevalence of DM and HTN in urban areas of Gujarat were 20% and 17.6%, respectively according to NFHS 5 data.^[14] Being in an urban area was significantly associated with HTN in a study done by Chhoun *et al.*^[15] and Anchala *et al.*^[16]

Another major contributing factor to DM and HTN is education measured by the level of schooling received. Education plays a major role in adherence, retention to care, long-term follow-up of DM and HTN. About 48.4% completed their primary schooling while illiterates accounted for about 31%. Other closely associated factors involve migration and lifestyle. A study by Bello *et al.* and Li *et al.* concluded that increasing trend in migration and urbanization was related to poor health status and negative healthcare-seeking behaviour for DM/HTN control.^[17,18] Migrants living alone or without family support may have a higher chance of high-risk behavior as well as poor health-seeking behavior. Hence, migrants pose a greater risk of developing both HIV and NCD as well as low adherence and follow-up. Most of the participants were either unemployed or were laborers or daily wagers and thus affiliated with the upper lower and lower middle socioeconomic class. Many of the participants were intra or interstate migrants who migrated in the hope of a better job or livelihood and, in turn, had a lower socioeconomic status. Unhealthy dietary habits as well as a sedentary lifestyle and work-related stress might be a precursor for DM or HTN. Even with health services free of charge, inequalities along the socioeconomic gradient persist in preventive health-seeking behaviors and health outcomes.^[19]

This study furthermore provides a picture of the magnitude of HIV-NCD comorbidity. In this study, among 184 participants interviewed, about 46.2% of participants had type 2 DM and 39.13% were hypertensive. Mugerwa *et al.* observations collaborate with these findings with prevalence of hypertension being 12.4% and diabetes mellitus was 4.7%.^[20] Correspondingly, senior medical officer and counselors of the ART center reported that around 150 beneficiaries were availing services from the ART center as follows:

Counsellor 1: On our ART centre daily around 150-180 PLHIV patient visit from them we do reporting for hypertension and DM out of which 2-3 patient are diagnosed or had known case of it.

Counsellor 2: Per day around 150 to 170 patients visit ART centre. Don't know actual count of DM/HTN patients. It might be 5%. Co- morbidities/diseases other than HIV are not compulsory to enquire by counsellors as Doctor knew it. Patients tell might tell all these details to Doctor. Normally we don't ask every patient about history of DM/HTN but those who have symptoms we will ask details. According to me, 2-4% patients might have DM/HTN.

SMO: Per day around 150 patients visited ART centre, out of that 1-2 percent are known case of Type 2 DM and HTN.

HIV management and baseline clinical profile of study participants provide a varied picture. Among the 184 participants, the mean duration of HIV infection and ART initiation were 10.84 (SD \pm 4.7) years and 9.68 (SD \pm 4.6) years, respectively. In India, the test and treat policy was launched in April 2017.^[21] As per the policy, all PLHIV can be treated with ART regardless of CD₄ count, clinical stage, age, or population without any delay. In the present study, most of the participants were aged above 50 years who had been diagnosed HIV before the year 2017, hence the mean gap between HIV diagnosis and ART initiation was ranging from 1 to 1.6 years.

Among participants, 78.8% expressed that they had received counseling from ART staff regarding the importance of controlling blood sugar/blood pressure, regular exercise, and smoking cessation. Old age and a sedentary lifestyle is a leading cause of obesity among the study participants. The lack of indulgence in vigorous and recreational activity also highlights toward rising trends of overweight and obesity.

Increasing comorbidities are associated with an increase in the number of pills to be taken daily which may worsen medication adherence.^[22] This increased pill burden could reverse the improved quality of life of HIV patients with ART. It was observed that as the number of pills for DM and HTN increases, adherence to ART drugs decreases and the association was statistically significant. This collaborates with Sarna *et al.*^[23] where they noted that taking four or more medicines was associated with lower adherence (<90%).

CONCLUSION

As a success story of HIV, PLHIVs are nowadays living longer and fuller lives. They are living tantamount to HIV-negative individuals. All bliss has a downer. As they now are facing other morbidities similar to HIV-negative individuals. However, their challenges and barriers are bigger because of underlying HIV infection. Administration of life-long medication for both NCD and ART, pill burden, and financial burden can be easily foreseen. Added upon with lower adherence to ART and NCD medication can have a synergistic effect in downgrading either or both of the diseases.

As pre-assumed cachectic built of PLHIVs are not the current scenario, obesity is common nowadays among them, which plays a major role in the attainment of DM and HTN. Despite regular follow-up and treatment PLHIV continues to have raised blood sugar and blood pressure levels, this might bring to light the need to maintain good adherence and lifestyle modifications in both dietary and physical activity. This can be achieved by taking steps for the problems faced by PLHIVs after identifying each of them.

Acknowledgment

We would like to personally thank all the staff of the ART center and all the study participants who spent their precious time with us with a special mention to GSACS and HREC for their support and guidance for this study.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

- Kantor R, DeLong A, Schreier L, Reitsma M, Kemboi E, Orido M, *et al.* HIV-1 second-line failure and drug resistance at high-level and low-level viremia in Western Kenya. *AIDS* 2018;32:2485-96.
- Sando D, Kintu A, Okello S, Kawungezi PC, Guwatudde D, Mutungi G, *et al.* Cost-effectiveness analysis of integrating screening and treatment of selected non-communicable diseases into HIV/AIDS treatment in Uganda. *Int J AIDS Soc* 2020;23:e25507. doi: 10.1002/jia2.25507.
- Thakur JS, Nangia R, Singh S. Progress and challenges in achieving noncommunicable diseases targets for the sustainable development goals. *FASEB Bioadv* 2021;3:563-8.
- Duval X, Baron G, Garelik D, Villes V, Dupré T, Leport C, *et al.* Living with HIV antiretroviral treatment experience and tobacco smoking: Results from a multisite cross-sectional study. *Antivir Ther* 2008;13:389-97.
- Pérez-Matute P, Pérez-Martínez L, Blanco JR, Oteo JA. Role of mitochondria in HIV infection and associated metabolic disorders: Focus on nonalcoholic fatty liver disease and lipodystrophy syndrome. *Oxid Med Cell Longev* 2013;2013:1-4. doi: 10.1155/2013/493413.
- International Institute for Population Sciences. National Family Health Survey - 5(NFHS-5), 2019-21: State Fact Sheet Gujarat. 2021.
- International AIDS Society. IAS HIV Co- Infections and Co- morbidities. Available from: <https://www.iasociety.org/HIV-Programmes/Co-Infections>. [Last accessed on 2022 Apr].
- Han WM, Jiamsakul A, Kiertiburanakul S, Ng OT, Sim BLH, Sun LP, *et al.* Diabetes mellitus burden among people living with HIV from the Asia-Pacific region. *J Int AIDS Soc* 2019;22:e25236. doi: 10.1002/jia2.25236.
- IBM Corporation. Statistical Package for Social Sciences (SPSS), version 24.0. Armonk, NY: IBM Corporation; 2016.
- World Health Organization (WHO). International Association for the Study of Obesity (IASO) and International Obesity Task Force (IOTF). The Asia-Pacific Perspective: Redefining Obesity and its Treatment. Geneva: 2000;378-420.
- Shriraam V, Mahadevan S, Arumugam P. Prevalence and risk factors of diabetes, hypertension and other non-communicable diseases in a tribal population in South India. *Indian J Endocrinol Metab* 2021;25:313-9.
- National AIDS Control Organization (NACO). Status of National AIDS Response. Ministry of Health and Family Welfare. Government of India. New Delhi: Sankalak Booklet 2021 Third Edition. 2021. p. 24-5.
- National AIDS Control Organization (NACO). Status of National AIDS Response. Ministry of Health and Family Welfare. Government of India. New Delhi: Sankalak Booklet 2021 Third Edition. 2021. p. 149.
- International Institute for Population Sciences. National Family Health Survey - 5(NFHS-5), 2019-21: India Fact Sheet. 2021.
- Chhoun P, Tuot S, Harries AD, Kyaw NTT, Pal K, Mun P, *et al.* High prevalence of non-communicable diseases and associated risk factors amongst adults living with HIV in Cambodia. *PLoS One* 2017;12:e0187591. doi: 10.1371/journal.pone.0187591.
- Anchala R, Kannuri NK, Pant H, Khan H, Franco OH, Di Angelantonio E, *et al.* Hypertension in India: A systematic review and meta-analysis of prevalence, awareness, and control of hypertension. *J Hypertens* 2014;32:1170.
- Bello SI, Williams FE, Bello NO, Ajulo MA, Yusuf AA, Lawal HG. Diabetes mellitus and hypertension among patients on combination antiretroviral therapy in civil service hospital, Nigeria. *Bangladesh J Pharmacol* 2020;23:125-34.
- Li X, Deng L, Yang Id H, Wang H. Effect of socioeconomic status on the healthcare-seeking behavior of migrant workers in China. *PLoS One* 2020;15:e0237867. doi: 10.1371/journal.pone.0237867.
- Jacob R, Arnold LD, Hunleth J, Greiner KA, James AS. Daily Hassles' Role in Health Seeking Behavior among Low-income Populations NIH Public Access. 2014;38:297-306.
- Id SK, Id DM, Mugerwa H. Prevalence of non-communicable diseases among HIV positive patients on antiretroviral therapy at joint clinical research centre, Lubowa, Uganda. *PLoS One* 2019;14:e0221022. doi: 10.1371/journal.pone.0221022.
- National AIDS Control Organization(NACO). Strategy Document: National AIDS and STD Control Programme Phase-V (2021-26). NACO, Ministry of Health and Family Welfare, Government of India. New Delhi: 2022.
- Monroe AK, Rowe TL, Moore RD, Chander G. Medication adherence in HIV-positive patients with diabetes or hypertension: A focus group study. *BMC Health Serv Res* 2013;13:1-7. doi: 10.1186/1472-6963-13-488.
- Sarna A, Pujari S, Sengar AK, Garg R, Gupta I DJ. Adherence to antiretroviral therapy & its determinants amongst HIV patients in India. *Indian J Med Res* 2008;127:28-36.