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Frailty in People Living with Human Immunodeficiency Virus Aged 50 Years and Older: Prevalence and Predictors

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Abstract

Introduction: Life expectancy improvement for people living with Human Immunodeficiency Virus (HIV) is coming up against the problems associated with aging and chronic diseases. Frailty is a concern affecting a growing number of patients, particularly the elderly in this population. Our study aimed to determine the prevalence of frailty and its predictors on people living with HIV aged 50 years and older followed at the Outpatient Treatment Clinic (CTA) in Dakar. **Methodology:** We conducted a cross-sectional study of descriptive and analytic purposes ranging from November 2022 to August 2023, in CTA, Dakar (Senegal). We included people living with HIV aged 50 years and older under antiretroviral therapy for at least 6 months (≥6 months). Frailty was considered according to Fried criteria with a score ≥3. To identify the predictors of frailty, we performed a multivariate logistic regression analysis using STATA software version 18. **Results:** We included 199 patients. The median age at the moment of the study was 58 years old [50 - 91] with a sex ratio (M/F) of 0.58. The most representative age group was that of [50 - 59] years (59.3%). HIV-1 profile was most common in 89.45%. The median duration under antiretroviral therapy was 180 months [6 - 284] and 94% of patients received a Tenofovir Disoproxil Fumarate (TDF)-containing regimen with 43% of them for at least 10 years. Viral load was undetectable (≤40 copies/ml) in 98% of cases. WHO Stage III was more common at inclusion and 55.78% had nadir TCD4+ Lymphocyte counts < 200 elements/mm^3. In our study, 80% of patients underwent at least one comorbidity (≥1) and 31%

of patients had polymedication (≥5). Nutritional disorder was found in 65 patients. Frailty and prefrailty appeared in 28% and 36% of cases respectively. In multivariate analysis, nutritional disorder [aOR = 3.8 (2.3 - 6.4)], length of TDF-containing regimen exposure ≥10 years [aOR = 29.03 (9.5 - 89.7)], and polypharmacy [aOR = 1.53 (1.1 - 2.12)] were associated with frailty. **Conclusion:** Our study confirms the high prevalence of frailty among older people living with HIV. Its prevention should consider the management of comorbidities and the implementation of non-pharmacological interventions such as nutrition.

Keywords

Frailty, HIV, Senior, Dakar

1. Introduction

The main therapeutic headways have greatly changed the epidemiology of Human Immunodeficiency Virus (HIV) infection that constitutes to date a chronic disease [1]. Therefore, the number of people living with HIV (PLWH) aged 50 years and older is increasing due to wide antiviral treatment coverage and a life expectancy close to that of the general population [2] [3] [4] [5]. In Sub-Saharan Africa, the most affected region by the HIV pandemic, this number is expected to three-fold in the next decades to reach 9.1 to 10 million by 2040 [6] [7]. If the life expectancy improves in this population, aging recalls the need to implement more suitable strategies. However, integrating geriatric management in HIV points-of-care remains challenging. Indeed, this aging process raises some issues, including frailty. Described as a witness of vulnerability, frailty is a syndrome characterized by a decrease in reserves and resistance to stressors, even minors, resulting from a combined decline of multiple physiological systems [8] [9]. It is a dynamic and potentially reversible process [10] [11] whose outcome can be poor with an increased risk of hospitalization, institutionalization, falls, and mortality [12] [13] [14] [15].

Many studies are in line with the early onset of frailty among PLWH compared to uninfected people, with a higher frequency [16] [17] [18] [19].

As per Pathai *et al.* [19], PLWH has a two-fold risk of becoming frail. Nonetheless, it remains underdiagnosed in Sub-Saharan Africa. To the best of our knowledge, few studies have investigated the question and they were conducted in South Africa [19], Senegal [18], Tanzania [20] [21], and Ethiopia [22].

Senegal is the first African French-speaking country that has made antiretroviral therapy (ART) available, since 1998. In 2022, PLWH aged 50 years and older accounted for more than one-third of the treated people [7]. In 2014, Cournil *et al.* [18] outlined a frailty prevalence of 3.5% on PLWH. To the best of our knowledge, it is so far the only reported study in the country. It's against this backdrop that we performed this work that aimed to determine the prevalence of

frailty in PLWH aged 50 years and older, under ART, followed at the Outpatient Treatment Clinic (CTA) in Dakar, and to identify its predictors.

2. Materials and Methods

2.1. Study Design

We conducted a cross-sectional cohort study with descriptive and analytical purposes over 10 months ranging from November 2022 to August 2023.

2.2. Study Framework and Population

This study was carried out at the Outpatient Treatment Clinic located at Fann National Teaching Hospital Center in Dakar, Senegal. It is the first outpatient clinic for PLWH follow-up created in Senegal in June 1998.

In this study, we included PLWH aged 50 years and older under ART for at least 6 months (≥6 months) and those who came for their routine visit.

We didn't include patients who experienced hospitalization in the last 6 months before their routine visits or who underwent any intercurrent pathology within that period and patients who either were lost of follow-up or who returned to care.

2.3. Data Collection

Only updated data on the patient's medical records were collected. They included the current age, age at ART initiation, sex, HIV profile, initial and current World Health Organization (WHO) clinical Stages, initial TCD4 lymphocyte counts, current viral load, duration under ART, Tenofovir Disoproxil Fumarate (TDF)-containing regimen duration, current ART regimen, number of drugs, associated diseases, nutritional state, and frailty.

2.4. Diagnostic Criteria

Frailty was assessed according to Fried [14] criteria. They comprised 5 items: unintentional weight loss ≥ 5 kg within the last year, low physical activity, chronic exhaustion and exertional, reduced walking speed < 0.6 m/s, and muscle weakness measured by the wrist force test. Each item stands for 1 point and patients were classified as robust (0), pre-frail (1 or 2), or frail (≥3).

Full Mini-Nutritional Assessment [23] (MNA) was used to evaluate the nutritional state of patients. It helped identify 3 categories of patients: normal (≥24), at risk of malnutrition (between 17 and 23.5), and malnourished (<17).

Comorbidity was defined as the presence of one or more chronic diseases and the Charlson index [24] was used to assess comorbidities.

Polypharmacy was considered as taking ≥ 5 (including ART) for at least three months.

2.5. Data Analysis

We performed a descriptive statistic to describe variables. Data was summarized

by median with the interquartile range or by percentages. The demographic and clinical characteristics were compared using the Pearson chi-square test ($\chi 2$) or Fisher exact test, if appropriate. Univariate logistic regression was done to estimate the Odds ratio (OR) with the Confidence Interval (CI) at 95% of frailty-associated factors. To identify the predictors of frailty in our patients, we built a multivariate model including variables with a p-value < 0.25 in univariate analysis, after adjusting on current age and sex. The difference was statistically significant if the p-value < 0.05. Data were processed using STATA Software version 18.

2.6. Ethical Considerations

The head of the department approved the protocol and authorized the survey. Confidentiality and anonymity were respected.

3. Results

3.1. Characteristics of Our Study Population

Among the 302 patients aged 50 years and more received during our study period, 214 (67.7%) underwent a frailty assessment of whom 199 (92%) had a complete examination (**Figure 1**). Frailty assessment was not conducted on 7 (6.9%) patients because they were transferred the same day to another HIV point-of-care. The median age of patients was 58 years [50 - 91]. The most representative age group was [50 - 59] years with 59.3%. We found a female predominance with a sex ratio (M/F) of 0.58. HIV-1 profile was mostly represented (89.45%). The WHO stage III was most common at inclusion and 55.78% had a nadir TCD4+ Lymphocyte count < 200 elements/mm^3. The median duration under ART was 180 months [6 - 284] and 82 have received ART for at least 120 mois. The current TDF-containing regimen was found in 94% of patients of whom 43% for at least 10 years. The viral load at the study inclusion was undetectable (≤40 copies/ml) in 98% of cases. **Table 1** summarizes the epidemiological, clinical, and therapeutic HIV characteristics of our patients. In our study, 80% underwent at least one comorbidity (≥1).

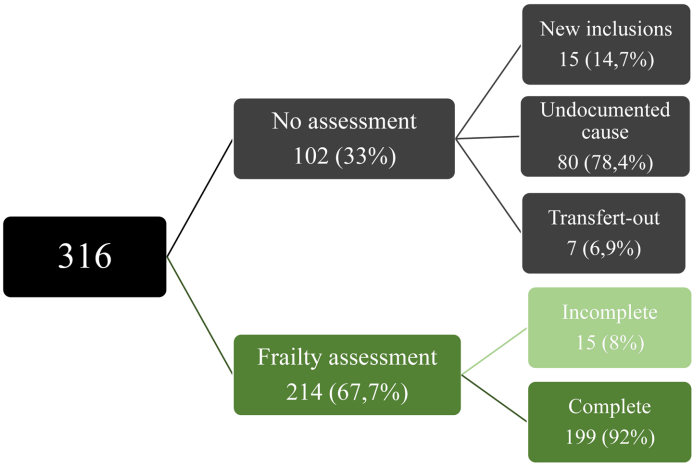

Figure 1. Flux diagram of our study population.

Table 1. Epidemiological, clinical, and therapeutic characteristics of PLWH in our study (N = 199).

Characteristics	Number (n/N)	Percentage (%)
Current age (years)		
[50 - 59]	118	59.30
[60 - 69]	59	29.65
≥70	22	11.06
Age at ART inclusion (years)		
<50	153	76.88
>50	46	13.12
Sex, n (%)		
Women	126	63.32
Men	73	36.68
HIV profile		
1	178	89.45
2	18	9.05
1 + 2	3	1.51
Line of treatment at the time of study		
First	190	95.48
Second	8	4.02
Third	1	0.50
WHO stage at inclusion		
I	52	26.13
II	53	26.63
III	74	37.19
IV	20	10.05
Nadir TCD4+ lymphocyte counts (elements/mm³)		
<200	111	55.78
≥200	88	44.22
Duration under ART(months)		
<120	35	17.59
120 - 240	142	71.36
>240	22	11.06
Current therapeutic regimen		
Without TDF	6	3.02
With TDF	193	96.08
Duration of TDF exposure		
<10years	114	57.29
≥10 years	85	42.71

Continued

Current WHO stage		0.50
I	194	97.49
II	3	1.51
III	1	0.50
IV	1	0.50
Current viral load (copies/ml)		
<40	196	98.49
>40	3	1.51

ART = Antiretroviral therapy; TDF = Tenofovir Disoproxil Fumarate.

Nearly half of patients (44.73%) have overweight/obesity. High blood pressure was found in 1/3 of patients (32.66%). It was followed by kidney failure (18.6%), diabetes (13.07%), Hepatitis B Virus (HBV) co-infection (10.05%), and dyslipidemia (6.53%). A Charlson comorbidity index ≥3 was outlined in 29 patients (14.57). We noted sensory disorders (vision and hearing) in 17 patients (8.54%). Polypharmacy (≥5) was revealed in 31% of patients. Nutritional disorder (risk of malnutrition and malnourished) was identified in 65 patients.

3.2. Frailty Prevalence and Predictors

Frailty and prefrailty were found in 28% and 36% of cases respectively. The characteristics of patients according to the Fried phenotype are presented in Table 2. Frailty was associated with a current age > 60 years (p = 0,001) and an age at ART initiation > 50 years (p = 0.002). It was more common in women (61.4%) without statistically significant difference (p = 0.15). More than one-third of the frail patients (40.53%) were polymedicated and a nutritional disorder was found in 71.93% of whom 10.53% were malnourished. Among frail patients, 38.59% presented at least one comorbidity (p = 0.65). High Blood Pressure (HBP) (40%), overweight/obesity (31.6%), diabetes (19.3%), chronic kidney disease (17.5%), neurologic disorders (12.3%), and dyslipidemia (8.8%) were the main reported comorbidities. We also found HBV co-infection in 87.7% of cases.

In univariate analysis, frailty was associated with nutritional disorders [aOR = 3.49 (2.36 - 5.16)], polypharmacy [aOR = 1.35 (1.08 - 1.71)], sensory disorders [aOR = 3.1 (1.04 - 9.2)], a long-term exposure to TDF-containing regimen ≥ 10 years [aOR = 20.9 (8.62 - 50.73)], WHO stage IV at ART initiation [aOR = 3.42 (1.08 - 10.82)]. It was also associated with the sex [aOR = 1.12 (0.52 - 2.42)] and duration under ART > 120 years [aOR = 1.5 (0.48 - 4.75)] but the difference was not statistically significant. Contrariwise, there was no association with comorbidities [aOR = 0.78 (0.36 - 1.71)] and Charlson comorbidity index [aOR = 0.98 (0.77 - 1.26)].

In multivariate analysis, only nutritional disorders [aOR = 3.8 (2.3 - 6.4)], long-term exposure to TDF-containing regimen≥ 10 years [aOR = 29.03 (9.5 - 89.7)], and polypharmacy [aOR = 1.53 (1.1 - 2.12)] were associated with frailty.

Table 2. Characteristics of patients according to Fried phenotype (N = 199).

	Robust (n = 71)	Prefrail (n = 71)	Frail (n = 57)	P-value*
Current age (years), n (%)				
[50 - 59]	53 (74.65)	40 (56.34)	25 (43.86)	**0.001***
[60 - 69]	17 (23.94)	23 (32.39)	19 (33.33)	
≥70	1 (1.41)	8 (11.27)	13 (22.81)	
Age at ART inclusion (years)				
<50	64 (90.14)	50 (70.42)	39 (68.42)	**0.002***
≥50	7 (9.86)	21 (29.58)	18 (31.58)	
Sex, n (%)				
Women	40 (56.34)	51 (71.83)	35 (61.4)	0.15
Men	31 (43.66)	20 (28.17)	22 (38.6)	
HIV profile, n (%)				
1	70 (98.6)	61 (85.9)	47 (82.46)	**0.007***
2	1 (1.41)	9 (12.7)	8 (14.04)	
1 + 2	-	1 (1.41)	2 (3.51)	
Line of traitement, n (%)				
First	68 (95.77)	68 (95.77)	54 (94.74)	0.93
Second	3 (4.23)	3 (4.23)	2 (3.51)	
Third	-	-	1 (1.75)	
WHO stage OMS at inclusion				
I	20 (28.17)	22 (30.99)	10 (17.54)	0.27
II	22 (30.99)	17 (23.94)	14 (24.56)	
III	24 (33.8)	27 (38.03)	23 (40.35)	
IV	5 (7.04)	5 (7.04)	10 (17.54)	
Nadir TCD4+ Lymphocyte counts (elements/mm³)				
<200	41 (57.75)	41 (57.75)	29 (50.88)	0.67
≥200	30 (42.25)	30 (42.25)	28 (4912)	
Duration under ART (months)				
<120	11 (15.49)	13 (18.31)	11 (19.3)	0.34
120 - 240	55 (77.46)	51 (71.83)	36 (63.16)	
>240	5 (7.04)	7 (9.86)	10 (17.54)	
Current therapeutic regimen				
Sans TDF	3 (4.23)	2 (2.82)	1 (1.75)	**0.04***
Avec TDF	68 (95.77)	69 (97.18)	56 (98.25)	
Duration of TDF exposure				
<10ans	52 (73.24)	55 (77.46)	7 (12.28)	**0.001***

Continued

>10ans	19 (26.76)	16 (22.54)	50 (87.72)	
Current WHO stage				
I	70 (98.59)	70 (98.59)	54 (94.74)	0.79
II	1 (1.41)	1 (1.41)	1 (1.75)	
III	-	-	1 (1.75)	
IV	-	-	1 (1.75)	
Current viral load (copies/ml)				
<40	71 (100)	70 (98.59)	55 (96.59)	
>40	-	1 (1.41)	2 (3.51)	
Body mass index				
Underweight	5 (7.04)	6 (8.45)	8 (14.04)	0.29
Normal	33 (46.48)	27 (38.03)	31 (54.39)	
Overweight/obesity	33 (46.48)	38 (53.53)	18 (31.58)	
Sensory disorders				
No	71 (100)	64 (90.14)	47 (82.46)	**0.001***
Yes	-	7 (9.86)	10 (17.54)	
Comorbidities				
<1	45 (63.38)	38 (53.52)	35 (61.4)	0.65
1 - 2	18 (25.35)	19 (26.76)	14 (24.55)	
≥3	8 (11.27)	14 (19.72)	8 (14.04)	
Charlson comorbidity Index				
<1	52 (73.24)	44 (61.97)	37 (64.91)	0.69
1 - 2	11 (15.49)	15 (21.13)	11 (19.3)	
≥3	8 (11.27)	12 (16.9)	9 (15.79)	
Polypharmacy				
≤4	58 (81.69)	45 (63.38)	34 (59.65)	**0.013***
≥5	13 (18.31)	26 (36.62)	23 (40.35)	
MNA				
Normal	63 (88.73)	55 (77.46)	16 (28.07)	
Risk of malnutrition	8 (11.27)	16 (22.54)	35 (61.40)	**0.001***
Malnourished	-	-	6 (10.53)	

ART = Antiretroviral therapy; TDF = Tenofovir Disoproxil Fumarate; MNA = Mini-Nutritional Assessment.
*P-value significant < 0.05.

Moreover, the risk of frailty was 5-fold at age ≥ 70 ans. Univariate and multivariate analyses are reported in Table 3.

Table 3. Univariate and multivariate analysis (N = 199).

Characteristics	Univariate	Multivariate
	aOR ($CI_{95\%}$)	aOR ($CI_{95\%}$)
Current age (years)		
[50 - 59]	Ref	
[60 - 69]	1.90 (0.95 - 3.82)	1.98 (0.67 - 5.87)
≥70	5.37 (2.06 - 14.00)	5.21 (1.44 - 18.88)
Age at ART initiation (years)		
<50	Ref	
≥50	0.62 (0.21 - 1.86)	
Sex		
Male	Ref	
Female	1.05 (0.54 - 2.03)	0.79 (0.31 - 2.04)
WHO stage at inclusion		
I	Ref	
II	1.14 (0.44 - 2.97)	1.2 (0.31 - 4.91)
III	1.59 (0.67 - 3.79)	1.95 (0.52 - 7.28)
IV	3.42 (1.08 - 10.83)	4.13 (0.62 - 27.55)
Nadir TCD4 lymphocyte counts (elements/mm^3)		
<200	Ref	
≥200	1.41 (0.73 - 2.72)	
Duration under ART (months)		
<120	Ref	
120 - 240	0.55 (0.23 - 1.28)	0.24 (0.06 - 1)
>240	1.50 (0.48 - 4.75)	0.34 (0.05 - 2.15)
Duration of TDF exposure		
<10ans	Ref	
≥10ans	20.91 (8.62 - 50.73)	29.21 (9.5 - 89.76)
Body mass index		
Normal	Ref	
Underweight	1.96 (0.69 - 5.53)	
Overweight/obesity	0.61 (0.29 - 1.28)	
Sensory disorders		
No	Ref	
Yes	1.18 (0.60 - 2.33)	3.07 (0.61 - 15.39)
MNA		
Normal	Ref	

Continued

Nutritional disorder	3.49 (2.36 - 5.16)	3.84 (2.30 - 6.41)
Comorbidities		
<1	Ref	
1 - 2	0.78 (0.35 - 1.71)	
≥2	0.90 (0.35 - 2.28)	
Charlson comorbidity index		
<1	Ref	
1 - 2	1.06 (0.46 - 2.44)	
≥3	1.08 (0.44 - 2.68)	
Polypharmacy		
≤4	Ref	
≥5	1.39 (1.12 - 1.74)	1.53 (1.10 - 2.12)

ART = Antiretroviral Therapy; TDF = Tenofovir Disoproxil Fumarate; MNA = Mini-Nutritionnal Assessment.
Adjusting factors: current age and sex.

4. Discussion

To the best of our knowledge, in Senegal, this is the first work to study frailty among PLWH aged 50 years and older, under antiretroviral treatment, and who were neither hospitalized nor in an advanced stage of the disease. It pointed out a high prevalence of frailty and prefrailty in this population. This clinical situation emerges from different factors including age, nutritional status, polypharmacy, and long-term TDF exposure. Frailty and prefrailty were found in 28% and 36% respectively. Unlike Cournil [18] in 2014 who estimated the prevalence at 3.5% in PLWH in Senegal, our results are higher than those reported by Pathai [19] in 2013 (19.4%), Yamada [16] in 2022 (10.9%), Branas [25] in 2017 (15.4%), Allavena [26] in 2023 (13.5%), and Blanco [27] in 2019 (4.4%). This could be explained, on one hand, by the difference in the ages of the study populations and mismatched social factors. In fact, in their series, Pathai [19], Cournil [18], and Blanco [27] included PLWH of less than 50 years. This witnesses the early onset of frailty suggesting the necessity of early and systematic screening in this population. On the other hand, aging under ART could play a role in the occurrence of frailty. In our study, more than ¾ (80%) of patients received ART for a duration of 240 months or more. These latters have therefore more odds of being exposed to ART molecules which, for a long time ago, was described to be able to have effects on muscle activity and poor distribution of adipose tissue [28] [29] [30].

However, our results are very close to those of Lorenz *et al.* [31] (24%) and overlap with the reports of Althoff *et al.* [32] (29%), both in the United States. Contrariwise, in Italy, Valentini, *et al.* [33] found a higher prevalence at 38%.

This could be explained by age > 65 years and the number of hospitalized patients in their study. Our study, conducted in a resource-constrained setting, brings additional results to the prior findings in other African countries namely South Africa [19], la Tanzanie [20] et l'Ethiopie [22]. Despite this variability in the prevalence between the different series published, frailty remains high in PLWH.

Most studies reported high proportions of comorbid patients and suggest the presence of a link between comorbidities and frailty [14] [19] [26] [34]. In our series, we didn't find this link. This is similar to the findings of Cleg *et al.* [35] who reported that 26% of frail patients didn't experience comorbidity or disability. However, comorbidities may play a role in the occurrence of frailty [14]. Indeed, chronic diseases have many effects on vulnerability and could modulate the decline in functional capacities [36].

In our series, one-third of patients (n = 65) underwent a nutritional disorder according to MNA with a prevalence of malnutrition and risk of malnutrition in frail patients at 10% and 60% respectively. A nutritional disorder was an important predictor of frailty [3.8 (2.3 - 6.4)]. Other authors have shown the same link [8] [33]. A poor nutritional status can lead to sarcopenia which itself can result in a decline in muscle weakness [8] [37], suggestive of frailty. Additionally, some authors described the beneficial impact of nutritional support on frailty improvement [38] [39]. However, in our study, we found a high prevalence (31.6%) of overweight/obesity in frail patients but the difference was not statistically significant [aOR = 0.61 (0.29 - 1.28)]. Our results were similar to the findings of Ferrioli [40] and Xu [41]. Reinders [42] suggested that an important adiposity is a risk factor of frailty. This discrepancy in the results lets us think that frailty may not only be the preserve of undernutrition. In fact, with the aging process, we observe both an increase in adiposity and a decrease in muscle mass defined as "sarcopenic obesity" or "paradoxical obesity" whose mechanisms are yet to be fully known [43].

A TDF-containing regimen duration of exposure ≥ 10 years was associated with frailty (aOR = 29.2 [9.5 - 89.7]). TDF is known to cause bone mineralization disorders [44] [45]. Therefore, in our study, this important prevalence of frailty could also be supported by osteoporosis which, as per the authors, is a clinical condition more frequent in PLWH and could increase this risk [46] [47] [48]. Nonetheless, our work didn't aim to study bone mineralization disorders. It would be necessary to set an approach integrating the particularities related to HIV and its treatment to better identify frailty predictors that will help design efficacious preventive strategies. McComsey [47] and Negredo [49] have also yielded a benefit to switching TDF with other reverse transcriptase nucleotide inhibitors such as Abacavir or Tenofovir Alafenamide. However, TDF remains the first-line recommendation for HIV infection [50].

Regarding polypharmacy, it was commonly found in our study population (31%), and nearly half of the frail patients (40.35%) were polymedicated. This association was statistically significant [aOR = 1.35 (1.08 - 1.71)]. Our findings

corroborate with the literature [1] [51] [52] [53] [54]. This could be explained by the fact that PLWH undergo more comorbidities which management requires multiple drugs co-administration. However, even if this association exists, it is hard to establish causality between polypharmacy and frailty and indicate what situation comes first [55]. Besides, some authors reported a high incidence of frailty in polymedicated patients regardless of the number of comorbidities or severity [51] [52].

Frailty is a multifactorial and complex geriatric syndrome of insidious evolution. It is often attributed to aging leading to a diagnosis delay.

Our study has some strengths. It is the first work that investigates this question in Senegal one of the oldest HIV local cohorts. Additionally, the authors underwent preliminary training in geriatrics and are continuously supported by a geriatrician for a multidisciplinary approach purpose. However, it has some limitations because of its cross-sectional design. It would be necessary to undertake a longitudinal looking-forward study to identify the chronology of the different events, the incidence of frailty, and patient outcomes.

5. Conclusion

Frailty is a clinical syndrome and constitutes a major public health concern due to its high prevalence. It is important to early identify people at risk to implement preventive approaches. This prevention should be directed to the management of comorbidities and the implementation of non-pharmacological interventions such as nutrition. It is necessary to add targeted strategic multidisciplinary to the available settings to reinforce the quality of care delivery for PLWH and successful aging with fewer complications that can impair the quality of life.

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Conflicts of Interest

The authors declare no competing interest. They didn't receive any specific financing to achieve this work. All participants included in this study gave their consent for their medical records to be registered in the anonymized recording system of the Clinic.

Authors Contributions

AN, AG, NFNG, NK: Conceptualization.
AN, AM: Data processing.
AN, DB: Methodology.
AN: Formal analysis.
AN: Manuscript-original draft.

AN, AbN, HS, BS, BF: Medical care.

AN, AG, NFNG, NK, DB, HS, BS, FMA: Manuscript-revision and editing.

List of Abbreviations

HIV = Human Immunodeficiency Virus.

PLWH = People Living with HIV.

CTA = Outpatient Treatment Clinic.

ART = Antiretroviral Therapy.

TDF = Tenofovir Disoproxyl Fumarate.

MNA = Mini-Nutritional Assessment.

HBV = Hepatitis B Virus.

OR = Odds Ratio.

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