Decline in locomotor functions over time in HIV-infected patients

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Objectives: To assess changes in locomotor function in HIV-infected patients and to evaluate the determinants of variations in lower limb muscle performance.

Design: Longitudinal study within the ANRS CO3 Aquitaine Cohort.

Methods: Standardized locomotor tests, including global functional capacity [6-min walk distance (6MWD)] and lower limb muscle performance tests [five times sit-to-stand (5STS) test], were performed in HIV-infected adults at baseline and 2-year follow-up. Evolution of performances and determinants of 5STS time were studied in linear mixed-effects models.

Results: At baseline (354 patients, 90% on antiretroviral treatment), median 5STS time was 9.8 s and 6MWD 549 m. Poorer performances were associated with falls, reported by 12% of 178 patients at follow-up. Estimated mean deterioration was +0.24 s/year ($P < 10^{-2}$) for 5STS time and −11 m/year ($P < 10^{-4}$) for 6MWD. In multivariable analyses, older age was associated with worse baseline 5STS time (+0.47 s/10-year age increase; $P = 10^{-3}$), but not with further deterioration. Deterioration was greater in prior injecting drug users compared to others (difference in slope +0.62 s/year; $P = 0.04$). 5STS time at any time point was worse in patients with history of cerebral AIDS conditions (+2.47 s; $P < 10^{-3}$) and diabetes (+0.95 s; $P = 0.02$) than in others. No significant associations were found for antiretroviral treatment type, viral load or $CD4^+$ cell count.

Conclusion: Compared to published data from healthy persons of similar age, baseline 5STS time and 6MWD were poorer in HIV-infected adults and associated with subsequent falls. Test performances deteriorated further over time. Age, diabetes, neurologic complications and injection drug use, rather than virologic factors, contribute to variations in lower limb muscle performance.

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Introduction

In the general population, locomotor functions deteriorate with age and are associated with risk of falls and with limitations in daily activities [1,2]. A decrease in skeletal muscle strength is considered a key element of frailty and loss of autonomy [3].

With an increasing life expectancy in HIV-infected patients [4,5], age-related changes and comorbidities have become a concern as they occur relatively early in this population [6]. In previous cross-sectional analyses, we have reported that poor locomotor performance was highly prevalent in a comprehensive sample of middle-aged ambulatory HIV-infected patients, the majority of whom were on antiretroviral treatment (ART) and had well controlled viral load. Poor lower limb muscle function was detected in approximately one out of two patients and more frequent than would have been expected in the general population of similar age [7]. In accordance with these findings based on functional locomotor assessments, body composition studies by other groups have shown a high prevalence of low appendicular skeletal muscle mass in HIV-infected patients, equivalent to the prevalence observed in the general population 10–25 years older [8,9]. Moreover, a frailty phenotype is associated with falls [10], and low muscle mass, limitations in physical function and frailty phenotype are determinants of poorer survival in HIV-infected patients [11–14]. Altogether, these results from recent clinical studies suggest that alterations of locomotor and muscle functions are of clinical relevance in the HIV-infected population in the era of combination ART. So far, no data are available in this population regarding the decline in locomotor function over time. Therefore, the objectives of the present study were to prospectively assess the changes in locomotor function in HIV-infected patients over time and to evaluate the determinants of variations in lower limb muscle performance.

Methods

Study population

We performed a longitudinal observational study nested in the ANRS CO3 Aquitaine Cohort. Details of the study procedures and baseline results of the majority of study participants have been reported previously [7]. Briefly, the ANRS CO3 Aquitaine Cohort is an open prospective cohort enrolling patients with confirmed HIV-1 infection, regardless of clinical stage, in south-western France. The locomotor study was conducted in five HIV clinics of the Bordeaux University Hospital. Cohort participants were eligible for enrolment if they were adults and had neither acute opportunistic infection nor cancer under treatment, and were able to stand and walk without assistance. Enrolment periods alternated per clinic, and the protocol defined that participation in the study be proposed to each eligible patient attending a visit during the enrolment period at a given clinic. The study was approved by the Ethics Committee of Bordeaux ('CPP du Sud-Ouest et Outre Mer III') and conducted in accordance with the Helsinki Declaration. The initial locomotor assessments were performed in 2007–2009, and participants were contacted again for a follow-up visit approximately 2 years later. Participants were considered lost to follow-up in the locomotor study if no contact for the follow-up visit could be achieved after at least eight phone calls at different week days and different times of the day.

Locomotor tests

Participants underwent functional locomotor tests at baseline and follow-up. The following locomotor assessments were performed by trained study staff according to standardized protocols:

The five times sit-to-stand (5STS) test measured the time (in seconds) required to complete five sit-to-stand-to-sit cycles from a chair and assessed lower limb muscle function and balance [1,15]. The participant was instructed to rise, stand fully up, and sit down again five times as fast as possible, without using his/her arms to push up from the chair.

The 6-min walk distance (6MWD) test measured the distance (in meters) covered in a 6-min walk and reflected global functional capacity and aerobic endurance [16]. Participants were instructed to walk the largest distance possible in 6 min without running.

In the 10-m walking speed (m/s), the time to walk 10 m was measured separately from the 6MWD test procedure.

The locomotor evaluation was completed with the timed-up-and-go test and one-leg standing test, which more specifically assessed balance.

Other patient characteristics

At the 2-year visit in the locomotor study, participants were asked whether they had experienced any falls during the 12 months prior to the visit. Self-reported physical activity levels were also recorded at this visit.

HIV-related and other clinical characteristics were extracted from the ANRS CO3 Aquitaine Cohort database.

Statistical analyses

Baseline was defined as the first nonmissing locomotor evaluation during the study period. For participants with missing locomotor results at the inclusion visit, the first available evaluation thereafter was considered the baseline evaluation. The data included in our previously published

cross-sectional analyses correspond to baseline data in the present analyses.

We performed descriptive analyses and compared subgroups of participants by tests for independent samples, using nonparametric methods as appropriate. Baseline locomotor test results in participants with and without incident falls reported at the follow-up visit were compared by Wilcoxon rank-sum tests.

We used a linear mixed-effects regression model per locomotor test, including a random intercept, to determine the change in test results over time (slope parameter of the model). This approach was preferred over direct calculation of a delta in test results, since mixed-effect models allow including all observations, even those of participants with missing follow-up evaluations [17]. The obtained estimates are unbiased under the assumption that follow-up data are missing at random. As the one-leg standing test was systematically terminated when the participant was still standing after 30 s, the right-censored nature of the observations was taken into account when modeling the performance in this test.

The following determinants of variation in 5STS test results were assessed in linear mixed-effect regression analyses, modeling the 5STS time at each locomotor evaluation as a time-updated dependent variable: sex, age, anthropometric data, intravenous drug use, smoking, alcohol consumption, HIV-1 RNA levels, $CD4^+$ cell counts and nadir, HIV transmission group, date of HIV diagnosis, disease stage [US Centers for Disease Control and Prevention (CDC) classification], hepatitis B and C status, history of lipodystrophy, medical history and comorbidities, and ART history and medication intake. Explanatory variables were time-updated whenever clinically plausible. Time-constant variables were modeled together with an interaction term with time. Variables with P less than 0.2 in univariable analyses were included in a multivariable full model, and the final multivariable model was obtained by backward stepwise modeling. P-values less than 0.05 were considered statistically significant in the final model. We kept time, sex and BMI in the model as adjustment variables regardless of their significance level. Confounding variables detected during the modeling procedure were also retained. Model adequation was assessed by examining the distributions of residuals and the influence diagnostics (likelihood distance and Cook's D, reflecting the impact of individual observations on the model). One observation was deleted from the final model due to high impact of this single outlier on the estimated model parameters.

In ancillary analyses, we stratified the final model by baseline age (<48 vs. ≥ 48 years) to explore the hypothesis put forward in our previous cross-sectional analyses that the effect of BMI on 5STS performance could be modified by age [7].

All statistical analyses were performed with SAS software, version 9.2 (SAS Institute, Cary, North Carolina, USA).

Results

Participant characteristics

Among the 354 participants of the locomotor baseline assessment, 81% were men and 14% were known for prior injection drug use (IDU). Median age was 48 years [interquartile range (IQR) 42, 54], 90% were on ART, and 84% had HIV RNA below 500 copies/ml. Median baseline $CD4^+$ cell count was 534/μl (IQR 355, 715), and 24% of participants had a history of an AIDS-defining disease. Baseline data of 324 participants out of the 354 were included in the previously published cross-sectional analyses [7]. The 30 additional participants included in the present analyses had a delayed baseline assessment. Their baseline characteristics did not statistically differ from the initial 324 participants (data not shown).

One hundred and seventy-eight participants had a locomotor follow-up visit in median 2.1 years (IQR 1.9, 2.4) after the baseline visit. Participants' time constraints and refusal without specified reasons were

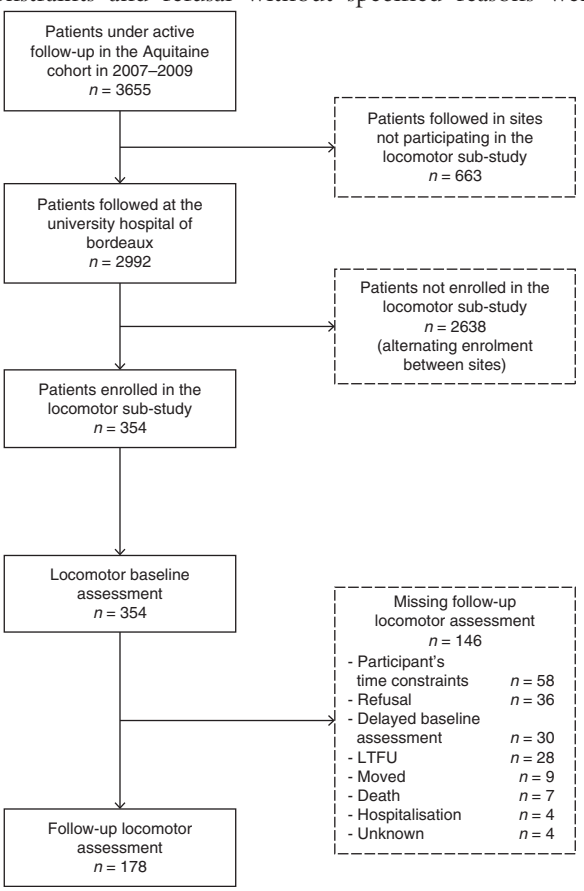

Fig. 1. Flow diagram of participant enrolment and follow-up in the locomotor study (ANRS CO3 Aquitaine Cohort, 2007–2011). Participant flow in the locomotor study

Table 1. Baseline characteristics of study participants with available longitudinal follow-up information compared with study participants with only baseline assessment in the locomotor study (ANRS CO3 Aquitaine Cohort, 2007–2011).

Baseline characteristics	Study participants with follow-up ($n=178$)	Study participants with baseline assessment only ($n=176$)	*P*
Median age (years, IQR)	48 (43, 56)	46 (41, 53)	0.03
Sex: men (%)	81	80	0.89
Median BMI (kg/m^2, IQR)	22.2 (20.5, 24.5)	22.4 (20.6, 24.7)	0.56
Transmission group (%):			0.54
Homosexual or bisexual	54	50	
Intravenous drug use	12	16	
Heterosexual	27	29	
Other	7	5	
Median time since HIV diagnosis (years, IQR)	12 (6, 18)	13 (8, 18)	0.89
CDC stage C (%)	24	24	1.00
History of cerebral CDC stage C condition (%)	3	7	0.10
Hepatitis B co-infection (%)	7	9	0.55
Hepatitis C co-infection (%)	20	18	0.79
Median CD4$^+$ nadir (/μl, IQR)	245 (151, 371)	274 (163, 396)	0.27
Median CD4$^+$ cell count (/μl, IQR)	506 (340, 715)	561 (366, 718)	0.30
HIV RNA level <500 copies/ml (%)	84	85	1.00
On antiretroviral treatment (%)	89	91	0.60
History of diabetes (%)	10	12	0.50
Median five times sit-to-stand test time (s, IQR)	9.7 (8.3, 11.3)	9.9 (8.2, 11.6)	0.93
Median 6-min walk distance (m, IQR)	548 (500, 613)	550 (500, 613)	0.84

CDC, Centers of Disease Control and Prevention; IQR, interquartile range. Wilcoxon rank-sum test for continuous variables and Fisher's exact test for proportions.

the main reasons for missing follow-up visits (Fig. 1). Participants with and without follow-up visits had similar baseline characteristics except for age (2 years older median age in those followed up; Table 1).

Evolution of locomotor test results between baseline and follow-up

The distributions of locomotor test results at baseline and follow-up are shown in Table 2.

Table 2. Distribution of locomotor test results at baseline and follow-up and estimated mean annual changes in the locomotor study (ANRS CO3 Aquitaine Cohort, 2007–2011).

Locomotor test result	Baseline ($n=354$) median (IQR)	Follow-up ($n=178$) median (IQR)	Estimated annual change mean (95% CI)	*P*
Five times sit-to-stand test time (s)	9.8 (8.3, 11.4)	10.3 (9.0, 12.2)	0.24 (0.07, 0.42)	$<10^{-2}$
Six-minute walk distance (m)	549 (500, 613)	520 (480, 575)	−11 (−16, −6)	$<10^{-4}$
10-m walking speed (m/s)	1.9 (1.7, 2.1)	1.9 (1.8, 2.2)	0.04 (0.02, 0.05)	$<10^{-4}$
Timed-up-and-go time (s)	5.6 (5.0, 6.3)	5.1 (4.7, 5.7)	−0.27 (−0.34, −0.20)	$<10^{-4}$
Time standing on one leg with eyes closed (s)	12.7 (7.0, 25.0)	16.0 (7.2, 30.0)	1.49 (0.75, 2.23)	$<10^{-4}$

CI, confidence interval; IQR, interquartile range. Locomotor test interpretation: five times sit-to-stand test, timed-up-and-go test: the shorter the time, the better the test performance. Six-minute walk distance, 10-m walking speed, time standing on one leg with eyes closed: the higher the result, the better the test performance. Median time between baseline and follow-up visit was 2.1 years (IQR 1.9–2.4) Mean annual change and *P* values for change derived from linear mixed models. Right-censoring of time standing on one leg with eyes closed taken into account in the model.

Estimated mean deterioration was +0.24 s/year [95% confidence interval (CI) 0.07, 0.42; $P < 10^{-2}$] for 5STS time and −11 m/year (95% CI −16, −6; $P < 10^{-4}$) for 6MWD (univariable mixed-effect models with $n = 353$ and 338 patients, respectively). No decline was detected in the other locomotor tests, which rather showed improvements over time.

Among the 178 participants with follow-up assessments, 31% had a worsening in 5STS time above an empirically defined threshold of 2 s. Thirty-four percentage had a decline in 6MWD of −54 m or less between the two visits, which corresponds to the minimal important difference in patients with cardiopulmonary disease [18].

Incident falls during follow-up and their association with baseline locomotor test results

At follow-up, 12% of participants reported at least one fall in the preceding year. Baseline 5STS time and 6MWD were significantly worse in participants with subsequent falls compared to those not reporting any falls at follow-up, whereas the association was of borderline significance for the timed-up-and-go test (Table 3).

Physical activity

Information on physical activity was available for 208 participants at baseline or follow-up. Sedentary or semi-sedentary lifestyles were frequent, with 47% of participants not performing regular physical activity during leisure time or work. Forty-one percentage of participants reported regular leisure physical activity, including endurance activities (22%), muscle-strengthening activities (3%), or both (16%). Absence of regular leisure physical activity other than walking was significantly associated with poorer 5STS time (11.0 vs. 10.0 s; $P = 0.03$), but not with the other test results.

Determinants of variation in five times sit-to-stand performance over time

Multivariable analyses focussed on the determinants of variations in 5STS test results since this test was most frequently altered in the cross-sectional analyses [7] and showed a significant deterioration over time.

In the final multivariable model, older age was significantly associated with worse baseline 5STS time (+0.47 s per 10-year age increase), but not with deterioration in this test over time (change in slope; Table 4). Deterioration was more pronounced in patients with prior IDU than in others (change in slope 0.62 s/year). Five times sit-to-stand performance at any time point was significantly worse in patients with time-updated history of cerebral CDC stage C conditions (+2.47 s) and of diabetes (+0.95 s), compared to other patients. No significant associations were found for sex. Neither time-updated viral load, $CD4^+$ cell count, type of ART nor cumulative exposures to ART drugs with potential muscle toxicity (raltegravir, zidovudine, and didanosine, stavudine or zalcitabine) were significantly associated with 5STS performance (data not shown).

In ancillary analyses, we stratified our final model by baseline age to explore whether an effect modification of age on BMI, reported in our previous cross-sectional analyses [7], was detectable in the longitudinal follow-up. Stratification resulted in a change in direction of effect of BMI on 5STS time, with a nonsignificant effect of −0.07 s/kg/m^2 (95% CI −0.17, 0.02; $P = 0.14$) in participants with baseline age below 48 years in contrast to a significant effect of +0.11 s/kg/m^2 (95% CI 0.004, 0.21; $P = 0.04$) in those aged at least 48 years.

Discussion

We report the evolution of locomotor performances over a 2-year follow-up, assessed by a comprehensive spectrum of functional tests in 354 ambulatory HIV-infected patients. Our results show that lower limb performance and global functional capacity, reflected by the 5STS and 6MWD tests, respectively, are impaired and further decline over time in this population.

Table 3. Comparisons of baseline locomotor results in participants with and without subsequent falls during follow-up in the locomotor study (ANRS CO3 Aquitaine Cohort, 2007–2011).

Baseline locomotor test result	Participants without subsequent falls ($n = 22$)	Participants with at least one subsequent fall ($n = 156$)	P
	9.6 (8.1, 11.2)	10.6 (9.7, 12.1)	0.01
Median 6-min walk distance (m, IQR)	557 (511, 615)	492 (447, 565)	$<10^{-2}$
Median 10-m walking speed (m/s, IQR)	1.9 (1.7, 2.0)	1.8 (1.5, 2.0)	0.11
Median timed-up-and-go time (s, IQR)	5.7 (5.1, 6.4)	6.0 (5.5, 7.4)	0.05
Median time standing on one leg with eyes closed (s, IQR)	12.2 (7.5, 26.6)	11.3 (5.7, 15.0)	0.12

IQR: interquartile range. Falls were defined by at least one participant-reported fall in the 12-month period prior to the locomotor follow-up evaluation. Analysis performed on 178 participants with available locomotor follow-up. Wilcoxon rank-sum tests.

Table 4. Factors associated with five times sit-to-stand time, final multivariable linear mixed-effects model ($n = 352$), locomotor study (ANRS CO3 Aquitaine Cohort, 2007–2011).

Variable	Beta (s)	95% CI (s)	*P*
Intercept	6.97	(4.98, 8.95)	
Time (years)	−0.26	(−1.11, 0.59)	0.83
Baseline age (per 10 years)	0.47	(0.18, 0.75)	10^{-3}
Change in slope for time (years) according to baseline age (per 10 years)	0.11	(−0.06, 0.28)	0.21
Baseline history of drug use (yes vs. no)	0.42	(−0.44, 1.27)	0.34
Change in slope for time (years) according to baseline history of drug use	0.62	(0.05, 1.20)	0.04
History of cerebral complications of AIDS[a,b] (yes vs. no)	2.47	(1.31, 3.63)	$<10^{-3}$
History of diabetes[b] (yes vs. no)	0.95	(0.13, 1.76)	0.02
Corticosteroids[b] (yes vs. no)	1.02	(−1.18, 3.22)	0.36
Baseline time since HIV diagnosis (years)	0.01	(−0.03, 0.06)	0.59
Change in slope for time (years) according to baseline time since HIV diagnosis (years)	−0.01	(−0.04, 0.01)	0.34
Sex (female vs. male)	0.56	(−0.16, 1.27)	0.13
Change in slope for time (years) according to sex	0.08	(−0.35, 0.51)	0.70
BMI[b] (kg/m^2)	0.02	(−0.05, 0.09)	0.63

CI, confidence interval.
[a]Cerebral complication of AIDS are defined by an CDC stage C illness with cerebral localization.
[b]Time-updated explanatory variables.
Estimates for fixed effects of multivariable linear mixed-effects model with random effect for intercept. Independent variable: five times sit-to-stand time in seconds. The shorter the time, the better the performance in the five times sit-to-stand test. The parameter beta is interpreted as the mean difference in five times sit-to-stand time per unit or category of the given explanatory variable, adjusted on all other explanatory variables in the table.

At baseline, the study participants with a median age of 48 years had an average 5STS time of 9.8 s and 6MWD of 549 m. In healthy persons of approximately the same age, 5STS performance of 7.1 s has been reported [19]. For the 6MWD, an average distance of approximately 640 m would have been expected according to a published reference formula for healthy individuals of the same age, sex, and BMI [20].

During follow-up, performances in 5STS time and 6MWD declined further. We were unable to compare the average annual deterioration in 5STS performance in our study (+0.24 s/year) to equivalent data in healthy individuals, since published longitudinal data are restricted to selected older populations [21,22]. For the 6MWD, a mean annual decline of approximately −5 m could have been expected in the general population [20], whereas we estimated a decline of −11 m/year. We found no deterioration in the other locomotor tests, and the more specific balance assessments appeared to improve over time. However, we cannot exclude that the observed ameliorations are due to learning effects from one study phase to the other.

The present results corroborate our previously published cross-sectional analyses, in which locomotor test results were treated as binary variables to reflect the presence or absence of poor performance compared to reference data from the general population. In these cross-sectional analyses, 5STS and 6MWD were the two most frequently altered tests with 53 and 24% poor performance, respectively, and the more specific balance tests were only rarely affected [7]. In the present analyses, to avoid the potential limitations related to the quality of available reference data, we examined the evolution of raw test results as continuous variables. Both analyses consistently indicate that lower limb performance and global functional capacity are two functions of potential concern in HIV-infected patients.

To assess the clinical relevance of poor locomotor function, we evaluated the associations between baseline locomotor results and subsequent falls. We found that fallers had significantly worse performance than nonfallers in the 5STS and 6MWD tests assessed approximately 2 years earlier. Together with longitudinal studies in the general elderly population [2,23] and cross-sectional data in HIV-infected patients [10], our results substantiate the association between poor locomotor performance and risk of falls. Results from a recent cross-sectional study in 78 HIV-infected patients further suggest that reduced physical function may be associated with low bone mineral density [9]. To what extent poor locomotor performance contributes to increased fracture risk in HIV-infected patients requires additional studies.

In our final multivariable model, age, diabetes, cerebral complications of AIDS and IDU were independent determinants of variations in 5STS time. We found no signal for associations with virologic factors or with ART, in particular, with potentially myotoxic drugs such as zidovudine, d-drugs (didanosine, stavudine or zalcitabine) or raltegravir. These results indicate that low 5STS performance in our population is mainly due to non-HIV-related determinants, as the association with cerebral complications of AIDS may reflect the impact of neurologic sequelae rather than of AIDS itself.

Although our stratified analyses should be interpreted with caution due to multiplicity issues related to subgroup analyses, the results corroborate the finding from our previous cross-sectional analysis that the effect of BMI on 5STS performance may vary with age. Albeit highly speculative, our hypothesis remains that this may be due to decreasing muscle mass and increasing fat mass in older age [7].

Additional determinants, which we could not include in our analyses, may contribute to poor lower limb performance. In particular, associations between muscle function and 25-hydroxy vitamin D level and inflammation markers have been described in the general population [24,25] and could also play a role in HIV-infected patients [26].

As the more specific balance tests did not decline, we speculate that the underlying mechanisms of 5STS performance in our study are primarily muscular. Although low appendicular muscle mass is frequent in HIV-infected patients and associated with functional impairment [9], it is probably not the only mechanism. In elderly persons, dynapenia (i.e. a decline in muscle ability to produce strength and power), rather than decline in muscle mass, seems to contribute to functional decline [27], and leg muscle strength and power are correlated with performance in activities of daily living and with chair rise time [28–30]. In HIV-infected patients, an exploratory study assessing contractile properties of knee extensors indicated potential intra-muscular impairments [31]. Moreover, gene expression analyses in the muscle tissue of HIV-infected patients suggest alterations similar to those observed with aging [32]. Nevertheless, central sensorimotor components may also play a role.

As poor physical function is associated with risk of falls and predicts disability [1], appropriate interventions to improve locomotor performance in HIV-infected patients are needed. For routine use, a simple and rapid locomotor test procedure would be optimal. Our longitudinal results support the recommendation that the 5STS test should be used to assess lower limb muscle performance and to screen for poor locomotor function in HIV-infected patients [7,33]. We noted that a large proportion of our study participants did not regularly engage in regular physical activity, and that lack of such activity was associated with poorer 5STS performance. Physical exercise training should thus be considered in these patients. Exercise recommendations in HIV-infected patients have been proposed recently [34].

Furthermore, as incidence and prevalence of diabetes in HIV-infected patients are markedly higher than in HIV-uninfected populations [35,36], and given the potential consequences of diabetes not only on locomotor but also on neurocognitive, kidney and cardiovascular function [37–40], diabetes prevention and screening measures are of utmost importance in these patients.

We acknowledge that missing follow-up assessments in a fraction of participants are a potential limitation of our analyses. Among other reasons, time-consuming study assessments with expert staff may have lead to refusal or have resulted in incompatible schedules for these ambulatory participants, in particular, for the younger ones. We used appropriate statistical methods for differentially missing data to obtain unbiased estimates under the hypothesis of data missing at random. However, the possibility of informative missingness cannot be excluded.

Our study has the strengths of a prospective longitudinal design with standardized objective measures of locomotor function in a large sample of ambulatory HIV-infected patients. To our knowledge, this is the first study assessing longitudinal changes in locomotor functions in an HIV-infected population.

We suggest that future research directions on locomotor functions in HIV-infected individuals should focus on the following aspects: at one end of the clinical research spectrum, studies disentangling the underlying neuromuscular mechanisms of poor locomotor performance in this population would help to better understand the pathophysiological processes, for instance, by using neuromuscular and strength measurements of specific muscle groups. At the other end of the spectrum, operational research, directly aiming at improving patient care, should be implemented. A formal evaluation of the impact of physical exercise programs, involving kinesiology professionals or physiotherapists, as primary and secondary prevention measures in routine care of HIV-infected patients would be of relevance.

In conclusion, compared to the available literature on healthy persons of the same age, baseline 5STS time and 6MWD are poorer in adults with well controlled HIV infection, and performance in these tests deteriorates further over time. Age, diabetes, cerebral complications of AIDS and IDU may contribute to poor lower limb muscle function. We recommend the use of the 5STS test to screen HIV-infected patients for poor locomotor

performance. Diabetes screening and physical exercise training should also be systematically considered.

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Conflicts of interest

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