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Human T-lymphotropic virus type 1 infection is frequent in rural communities of the southern Andes of Peru

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SUMMARY

Objectives: To evaluate the presence of human T-lymphotropic virus type 1 (HTLV-1) infection in isolated rural communities in the southern Andes of Peru.
Methods: We conducted a cross-sectional study in five communities located in three provinces in Ayacucho, Peru. The five communities are located at >3000 meters above sea level and are mainly rural, and more than 85% of the population speaks Quechua. Volunteers aged 12 years and older were included. Clinical and epidemiological data were collected, along with a blood sample for serological testing.
Results: We included 397 participants; their median age was 41 years (interquartile range 31–57 years) and 69% were women. According to our definitions, 98% were of Quechua origin. HTLV-1 was diagnosed in 11 people: 0/164 in Cangallo, 3/154 (2%) in Vilcashuaman, and 8/79 (10%) in Parinacochas. There were no cases of HTLV-2. All the HTLV-1-positive participants were born in Ayacucho and were of Quechua origin; they ranged in age from 29 to 87 years (median 56 years) and 10/11 were women. Ten were apparently healthy, and one woman was diagnosed with HTLV-1-associated myelopathy/tropical spastic paraparesis (HAM/TSP). Three out of 11 had a family member with a lower limb impairment compatible with HAM/TSP.
Conclusion: The fact that HTLV-1 infection was present in two out of three provinces suggests that HTLV-1 could be highly endemic in the southern Andes in the Quechua population.

1. Introduction

Human T-cell lymphotropic virus type 1 (HTLV-1) is the causative agent of adult T-cell lymphoma/leukemia (ATLL), HTLV-1-associated myelopathy/tropical spastic paraparesis (HAM/TSP), and HTLV-1-associated uveitis, and it increases the risk of several other inflammatory and infectious diseases.[1] The virus can be transmitted through blood transfusions or shared needles, through sexual contact, and from mother to child mainly through breastfeeding.[2] There is no treatment to cure the infection or a satisfactory treatment for ATLL and HAM/TSP, the two more severe consequences of HTLV-1 infection. However, there are prevention strategies that have proven to decrease the prevalence in a population, such as blood bank screening and avoiding breastfeeding from infected mothers.[3]

HTLV-1 is clustered among different population groups around the world: in Japan, the Caribbean basin, Central Africa, parts of Melanesia, and in Amerindians of Central and South America. The Quechuas are the major Amerindian ethnic group in Hispanic South America.[2,4–6] They are spread across the continent through the Andes highlands and the majority live in Peru and Bolivia. In Peru, they represent 13% of the total population;[7] in Bolivia, 30%.[8] There are many HTLV-1 prevalence studies in different indigenous groups in South America, but only a few reports in Quechuas from Peru[9–11] and Bolivia.[4,12]

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In Peru, no national survey has been conducted to determine the prevalence of HTLV-1 infection. However there is strong evidence suggesting that HTLV-1 is frequent and could affect 1–2% of the total population. A study conducted among 528 healthy women of three cities in Peru, reported an overall HTLV-1 prevalence of 2.5%.[10] In the largest study done in Peru among pregnant women, the authors found a prevalence of 1.7% at the largest maternity hospital in Lima.[13] Recently, a study in blood banks in Arequipa, a city in the southern Andes of Peru, showed a prevalence of HTLV-1 infection of 0.9%.[14]

Since 1991, a cohort of people living with HTLV-1 has been followed by the Institute of Tropical Medicine "Alexander von Humboldt" in Lima, Peru. By March 2007, this cohort included 1452 Peruvians with HTLV-1 infection, of whom 749 (51.5%) were born outside Lima.[15] Among the latter, the South Andean regions, which are mainly inhabited by Quechua and Aymara people, stand out because of the high number of persons infected. Also, Lima and the central and southern Andes account for most of the cases with HAM/TSP in the cohort. This observation was also described in a case series of 61 patients with HAM/TSP done in Lima, where more than 50% of the patients were born in an Andean region.[16,17] Of note, data from the 1993 National Census[18] indicated that the highest rate of lower-limb disability, which can be observed in HAM/TSP cases, occurred in the southern Andean regions of Peru, and, as also described for HAM/TSP, was more frequent in women than in men.

Because of the scarce information on HTLV-1 prevalence in Quechua populations and the indirect evidence suggesting a significant presence of HTLV-1 in the southern Andes of Peru, we explored the infection frequency and risk factors among people of this ethnic group living in the area and hypothesized that the HTLV-1 frequency is above the values reported for other Peruvian populations.

2. Materials and methods

2.1. Location

The study was focused on Ayacucho because this region is one of the predominant birth places among the participants of the HTLV-1 cohort at the Institute of Tropical Medicine "Alexander von Humboldt".

Based on data from the National Census of 1993 – the last survey in which disability of the lower limbs was recorded – we selected the three provinces with the highest rates of lower-limb disability that was not related to polio (data also provided by the census): Cangallo, Vilcashuaman, and Parinacochas. We used the same criteria to choose the five study towns from these provinces (Figure 1, Table 1). We contacted the local health centers and provided them with information about our study prior to commencing work in those towns that were willing to collaborate with the researchers.

Ayacucho is a mainly mountainous region in the south of Peru. The five towns we visited are located between 3200 and 3500 meters above sea level. The weather is cold and dry, with temperatures ranging between 15 and 20 °C during the day and close to 0 °C during the night. The rainy season is from December to March. According to the National Institute of Statistics, 80% of the population is considered poor and 30% live in conditions of extreme poverty.[7] Forty-two percent of the population live in rural areas, and there is an illiteracy rate of 17.9% among inhabitants aged 15 years and older, much higher than the national average of 7.1%. Sixty-three percent of the population in this region speaks Quechua. Ayacucho can be divided into three parts: the northern part, which is the most developed one, with a good road network that connects it with larger cities, including Lima; the central part, more isolated but still connected to the northern part and the capital of the region; and the southern part, which is the least densely populated area, with a separated road system and poor communication with the other parts of Ayacucho (Table 1, Figure 1).

2.2. Study population

We recruited volunteers aged 12 years and older. Since no previous data were available regarding the number of people affected, and because the remoteness of the communities precluded random sampling, we chose arbitrarily to study 5–10% of the population, approximately 400 participants in total. Volunteers were included until this number was reached.

2.3. Laboratory testing

We collected 6 ml of blood from each participant, separated the plasma by centrifugation, and stored it in cryovials. These samples were frozen and transported to Lima. For each sample, other than in one case, we performed two ELISAs.[19] In that one sample, insufficient for additional tests, we performed an ELISA just once. We used two commercial ELISA kits: Murex® HTLVI+II (Murex Biotech Ltd, Dartford, UK) and Ortho® HTLV-I/HTLV/-II Ab-capture ELISA test system (Ortho Clinical Diagnostic, Amersham, UK). The two different brands of ELISA were used for each sample until restrictions with the local availability of Ortho determined that we performed the Murex test twice.

If at least one of the ELISA tests had a positive result, we performed a confirmatory test either with INNO-LIA® HTLV-I/II Score (Innogenetics, Ghent, Belgium) or Western blot HTLV Blot 2.4® (MP Diagnostics, Singapore). Whenever performed, the result of the confirmatory testing, carried out in accordance with the manufacturer's specifications, defined the final HTLV-1 status category of the participant; there were four possible categories: HTLV-1-positive, HTLV-2-positive, HTLV-indeterminate, and HTLV-negative. All cases that had consistent negative results on the ELISA tests, and thus did not require confirmatory testing, were also classified as HTLV-negative.

2.4. Data collection

The questionnaire was filled out by a health worker during a face-to-face interview. We asked questions about the participant's demographics, risk factors for HTLV-1, diagnosed HTLV-1 complications, and symptoms potentially indicative of a complication. Ethnicity was defined according to the parents' place of birth and parents' mother tongue. People were classified as Quechua if both parents were born in an Andean region and both of them spoke Quechua. If at least one parent did not fulfill both of these criteria, the participant was considered mestizo. We explored risky sexual behaviors and looked for risk factors for acquiring infection through blood and syringes, such as transfusion and surgery history. We gathered information regarding breastfeeding practices: how long people were breastfed and how long women breastfed their infants. We included questions about surrogate breastfeeding practices. We asked for symptoms and diseases that could be related to HTLV-1 infection, such as ATLL, HAM/TSP, infective dermatitis, strongyloidiasis, crusted scabies, and tuberculosis. We actively searched for HAM/TSP symptoms and screened patients for trouble walking, trouble getting up from a chair, and urinary incontinence. If HAM/TSP symptoms were found, a detailed physical examination was done. The diagnosis of HAM/TSP was made using the diagnostic criteria proposed by De Castro-Costa et al.[20] We also enquired about HAM/TSP-like symptoms in direct relatives.

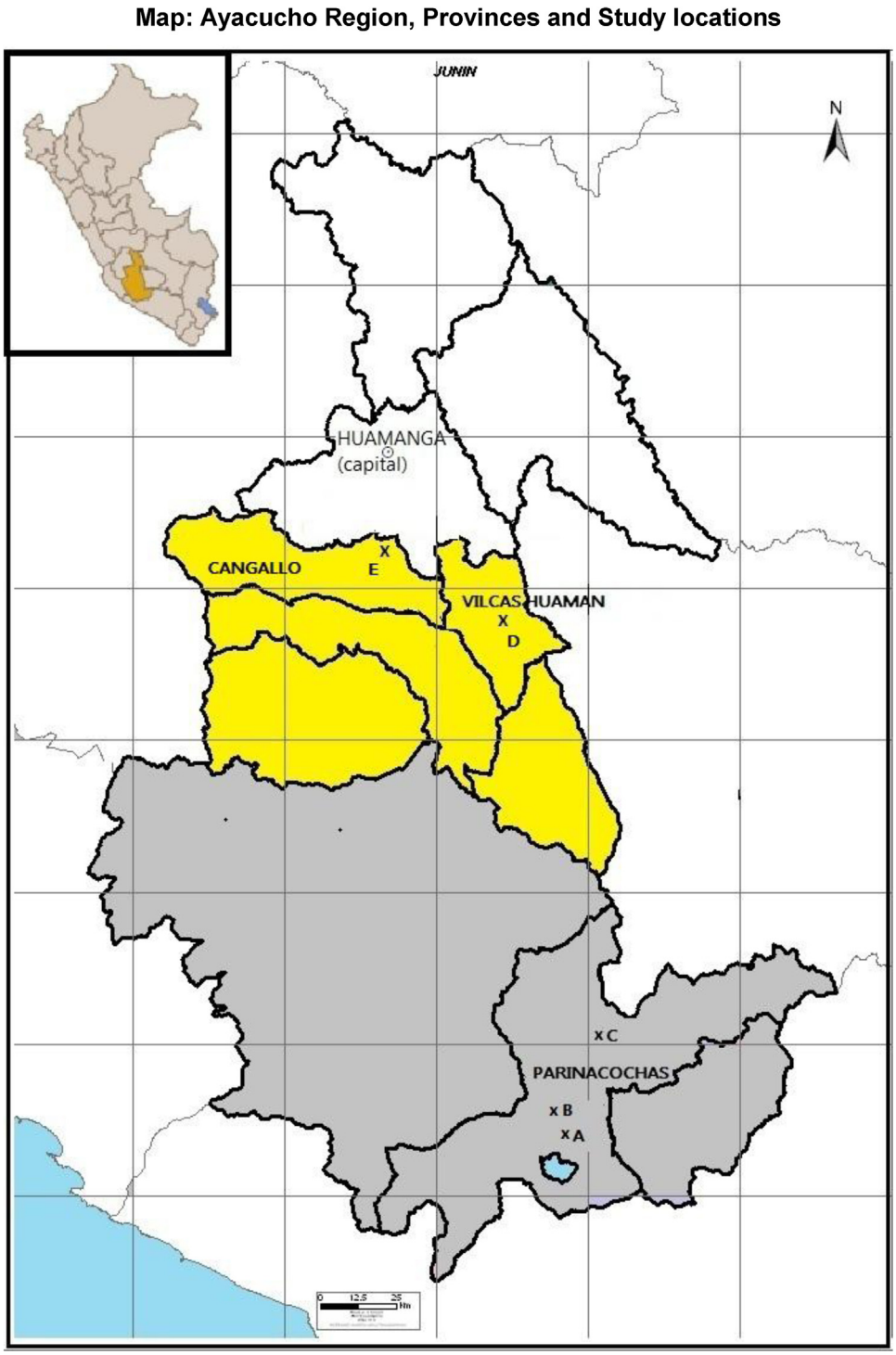

Figure 1. Map of Ayacucho region, provinces, and study locations.

2.5. Statistical analysis

Chi-square, Mann–Whitney, and Kruskal–Wallis tests were used to compare the characteristics of the participants from different provinces and to compare the people with and without HTLV-1 infection. The statistical package used for the analysis was STATA version 10 (Stata Corp., College Station, TX, USA).

2.6. Ethical aspects

This study was conducted in accordance with the principles of the Declaration of Helsinki. The Ethics Committee of the Universidad Peruana Cayetano Heredia and the Ayacucho's Regional Department of Health reviewed and approved the project. The informed consent document was translated into Quechua by a professor of linguistics. The text was revised by health workers whose first language is Quechua. Each study participant chose whether they wanted to go through the informed consent process in Spanish or Quechua. One of the field investigators was from the area and was a native speaker of Quechua and he explained the study to the Quechua speakers.

Because of a high rate of analphabetism, oral informed consent was also used. This consent required the signature of a witness and the fingerprint of the participant. The investigator explained the

Table 1
Socio-demographic characteristics of the studied populations

Province	District	% Rural population[a]	% Illiteracy[a]	% Quechua speakers[b,c]	% Poverty[d]	% Extreme poverty[d]	Study towns	Accessibility		Population[d]	Study participants (population %)
								Road type/travel time in hours[e]	Public transportation frequency		
Parinacochas	District a	35.4	18.3	85.4	76.1	36.7	Town A	Unpaved road/2 h	2/week	375	28 (8%)
							Town B	Unpaved road/3 h	2/week	255	14 (5%)
	District b	92.8	19.4	91.6	80.8	29.5	Town C	Unpaved road/5 h	3/week	348	37 (10%)
Vilcashuaman	District c	67.7	17	93.1	82.1	31.4	Town D	Unpaved road	Multiple times a day	2927	154 (5%)
Cangallo	District d	77	16.1	93.3	82.5	36.7	Town E	Paved road and small portion unpaved road/3 h	Multiple times a day	2239	164 (7%)

INEI, National Institute of Statistics.
[a] 2005 INEI Census.
[b] 1993 INEI Census.
[c] People who learned Quechua during childhood.
[d] 2007 INEI Census.
[e] Travel time from the Province Capital.

study to the participant and the witness in his or her first language, Spanish or Quechua. After the explanation, the participant was asked to repeat the main points of the study to ensure that they had understood it. Each participant kept a copy of the informed consent form, which included an explanation of the study and an explanation of HTLV-1 infection. For participants younger than 18 years of age, we requested his/her authorization and the authorization of one of the parents.

All volunteers were counseled before the test. Participants with HTLV-1 infection also received post-test counseling to explain the consequences of the infection. We offered medical attention at the Institute of Tropical Medicine "Alexander von Humboldt" for those participants with HTLV-1. Local health workers were informed about HTLV-1 infection and its consequences, and were trained in the management and monitoring of the patients with the infection. In this way, we ensured that people diagnosed with HTLV-1 infection could approach their local center as well.

3. Results

We recruited 397 participants from three provinces: 154 from Vilcashuaman, 164 from Cangallo, and 79 from Parinacochas. We recruited participants from one town in Vilcashuaman, one town in Cangallo, and three towns in Parinacochas. Some of the characteristics of the participants are shown in Table 2. The median age was different among provinces (Kruskal–Wallis, $p < 0.001$). Three hundred and ninety participants had complete information about their parents' origin. Of these, 98% were of Andean origin and 2% were mestizo. No black or white people participated. Eighty-four percent of the participants were born in the province where they were enrolled and 94% were born in Ayacucho. However, the number of people born outside the province where they were enrolled appeared higher in Vilcashuaman (16%) and Cangallo (19%) than in Parinacochas (9%). Seventy-one percent were married or were in a stable monogamous relationship; 18% were single, 3% were separated or divorced, and 8% were widowed. Ninety-nine percent were born via vaginal delivery.

None of the participants reported being a sex worker. None of the men for whom the information was available had sex with other men. There was no difference in the median age at first sexual intercourse between men and women, or among provinces. The median number of sex partners was different by gender (Mann–Whitney, $p < 0.001$): one for women (interquartile range (IQR) 1–2) and two for men (IQR 1–5). The number of sexual partners was different among provinces (Kruskal–Wallis, $p = 0.01$). The median number of partners in Parinacochas was two (IQR 1–2) and in Vilcashuaman and Cangallo was one (IQR 1–6). Of the 322 sexually active participants, 42% reported the use of a contraceptive method, with 34% of them saying that they used condoms. The rate of condom use was not different among provinces. None of the participants used intravenous drugs. One percent had a tattoo. Eighteen out of 394 (5%) had received a blood transfusion, and 83% of them were women. Indications for transfusion were mostly gynecological (cesarean section, post-partum or post-abortion, hysterectomy, vaginal prolapse, or molar pregnancy). Eighty-six out of 394 (22%) participants had a history of surgery, and 81% of them were women. Twenty-four out of 346 (7%) knew that they had been breastfed by someone other than their mother. Out of

Table 2
Characteristics of the study populations by province

Province	Participants	HTLV-1-positive	Median age,[a] years	Median age at first sexual intercourse	Females (%)	Number lifetime sexual partners[a]	History of transfusion (%)	History of surgery (%)	Number of participants who breastfed[b]	% Participants by breastfeeding time[b]		
										>2 years	1–2 years	<1 year
Parinacochas	79	8 (10%)	49	18	60 (76%)	2	3 (4%)	15 (19%)	76/77 (99%)	39%	56%	5%
Vilcashuaman	154	3 (2%)	39	18	100 (65%)	1	6(4%)	30 (19%)	146/149 (98%)	57%	36%	7%
Cangallo	164	0	38	18	113 (69%)	1	9 (5.5%)	41 (25%)	159/160 (99%)	57%	36%	7%
Total	397	11	41	18	273 (69%)	1	18 (5%)	86 (22%)	381/386 (99%)	53%	40%	6%

HTLV-1, human T-lymphotropic virus type 1.
[a] Significant.
[b] Where information was available.

Table 3
HTLV-1 frequency by town

Province	Town	Participants	HTLV-1-positive
Parinacochas	A	28	1 (4%)
	B	14	3 (21%)
	C	35	4 (11%)
Vilcashuaman	D	154	3 (2%)[a]
Cangallo	E	164	0
Total		397	11

HTLV-1, human T-lymphotropic virus type 1.
[a] One of them was the only male HTLV-1-positive.

249 women, 49 (20%) had breastfed a child that was not their own. Of these women, 72% (26/36) were related to the infant. The main reasons for breastfeeding another woman's child were the absence of the biological mother because of work, disease, or death, 'insufficient milk' in the biological mother, and because they were taking care of the child.

Two ELISAs were done in 99% of the participants. Three hundred eleven samples were tested with both commercial kits: Murex ELISA and Ortho ELISA. Eighty-five samples were tested twice with the Murex ELISA. Only one sample was tested once with the Ortho ELISA, because it was of insufficient size for further testing. Results were discordant for four samples (one ELISA positive and the other one negative). None of these samples was positive by confirmatory test. Only samples with two positive ELISA results were positive by the confirmatory tests.

Eleven participants (2.8%) were found to have HTLV-1. The frequencies of HTLV-1-positive results by province were: 0% (0/164) in Cangallo, 2% (3/154) in Vilcashuaman, and 10% (8/79) overall in Parinacochas (Table 3). All cases were found in participants older than 18 years of age. In Parinacochas, the frequencies of HTLV-1 by town were 4% (1/28), 21% (3/14), and 11% (4/35). No cases of HTLV-2 were found. One result was indeterminate using INNO-LIA but HTLV-negative using Western blot. We found no significant associations between HTLV-1 infection and demographic characteristics or possible risk factors (Table 4).

Two women with HTLV-1 infection had problems walking and one was diagnosed with HAM/TSP. She was 87 years old and had been born in Parinacochas. Six of the 11 participants with HTLV-1 infection had a relative with problems walking. Three of them had a description compatible with spastic paraparesis. HTLV-1 was associated with a higher probability of having a relative with walking difficulties (Chi-square, $p = 0.007$).

4. Discussion

In this study we investigated the frequency of HTLV-1 infection and searched for possible risk factors in a Quechua rural population of Ayacucho, a region in the southern Andes of Peru. Our results showed HTLV-1 infection frequencies of at least 2% in four out of five communities, which indicates that a high prevalence is very likely to occur in most of this area.

We observed differences in the frequencies of HTLV-1 among the five communities studied: whereas it exceeded 2% in the three communities in Parinacochas, no cases of HTLV-1 infection were found in Cangallo. Four characteristics among the studied communities could account for a real difference in the frequencies of HTLV-1 infection: age, sex, relative isolation, and percentage of participants born elsewhere. The communities with higher frequencies of HTLV-1 infection were the smaller ones (less than 500 inhabitants), with limited access by public transportation services and a poor road network. This relative isolation may account for the limited population admixture and a certain degree of endogamy, which, combined with other factors, may contribute to the perpetuation of HTLV-1. The participants in Parinacochas tended to be older than those in Cangallo by almost 10 years. HTLV-1 prevalence increases with age, which has been reported consistently in different countries, including Peru.[9,10,13] This observation can be explained by the birth cohort effect[21,22] and by a lifetime cumulative effect of the risk of transmission through sexual intercourse or blood/needle exchange. The frequency of women was also higher among the participants enrolled in Parinacochas. HTLV-1 is more prevalent in women worldwide, as a result of more effective sexual transmission from men to women, and, before the implementation of HTLV-1 screening of candidate blood donors, by a potentially higher exposure to transfusion-transmitted HTLV-1 in women for obstetric reasons. It is likely that exposure to transfusion-transmitted HTLV-1 will be higher in women with a high parity index; in fact, in this study we observed that most episodes of blood transfusion were secondary to gynecological and obstetric reasons. Parinacochas also had the lowest number of participants born elsewhere. Immigration of people from non-endemic HTLV-1 areas could account for a decrease in the rate of carriers[22,23] and in the number of horizontal sexual transmissions in these populations.

In contrast, the conditions of poverty (around 80%) and the rate of illiteracy (twice the national average) were similar in all the studied communities. Epidemiological studies in other countries

Table 4
Factors associated with HTLV-1 infection

Risk factors	Status		*p*-Value
	HTLV-1-positive	HTLV-1-negative	
Female gender[a]	10/11	263/386	0.11
Age, years, median (IQR)[b]	56 (31–68)	40 (30–57)	0.06
Age at first sexual intercourse, years, median (IQR)[b]	17 (15.5–19)	18 (16–20)	0.33
Number of sexual partners, median (IQR)	1 (1–2)	1 (1–2)	0.55
Breastfeeding[a]	11/11	370/375	0.7
Tattoos[a]	0/11	4/370	0.73
Transfusion[a]	1/11	17/383	0.47
Surgeries[a]	3/11	83/383	0.66
IV use[a]	2/11	51/377	0.66
Vaginal delivery[a]	11/11	377/379	0.81
Hepatitis/jaundice history	0/10	9/369	0.61
HIV-positive	0	0	
History of STDs	4/10	116/360	0.6
Family member with walking difficulties	6/11	77/376	0.007

HTLV-1, human T-lymphotropic virus type 1; IQR, interquartile range; IV, intravenous; STD, sexually transmitted disease.
[a] Chi-square test.
[b] Rank sum test.

have described the association of HTLV-1 infection with low socioeconomic status and low educational level.[24–26] We also need to consider that differences in HTLV-1 frequencies could have been obscured by aspects of the study design. With regard to the absence of cases with HTLV-1 infection in Cangallo, the health center also provided care to people from the surrounding rural communities; therefore, the proportion of the local population included could have been lower than the one we intended, and could potentially have resulted in an insufficient sample size for a low prevalence rate.

This is the first study done in small Andean rural communities in Ayacucho. Few studies have been done so far in the Quechua population of the southern Andes. One study in Quillabamba, Cuzco, found a 2.3% frequency of HTLV-1 among healthy low-risk pregnant women.[9] Quillabamba is a much larger city (26 000 inhabitants according to the 2007 National Census). In contrast to our study, in Quillabamba HTLV-1 was more frequent in sex workers, both homosexual and bisexual, and among people with a history of sexually transmitted diseases. In other investigations mainly conducted in more developed areas of large northern cities of Ayacucho (Figure 1), HTLV-1 was reported in 0.5% of healthy pregnant women.[10,11] These cities, the capitals of provinces, have larger populations, better socioeconomic conditions, and probably different population dynamics.

The assessment of risk factors for HTLV-1 infection was limited by the small number of HTLV-1-positive subjects and the fact that these factors were self-reported, which could introduce a social desirability bias (e.g., questions addressing sexual behavior). Nonetheless, some valuable information was collected that might explain the high HTLV-1 frequencies observed in some of the studied communities, particularly with regard to breastfeeding habits.

There is a clear association between the duration of breastfeeding and the risk of HTLV-1 transmission,[27] as has been reported in many countries including Peru.[27–29] In the present study, more than half of the participants reported having been breastfed for more than 2 years, which could have contributed to the endemicity of HTLV-1 infection. The efficacy of vertical transmission of HTLV-1 has also been associated with human leukocyte antigen (HLA) concordance between mother and infant.[30] HLA concordance may be more frequent in isolated populations, therefore increasing the risk of infection in communities like those reported here.

Surrogate breastfeeding has been associated with HIV infection[31] and might be a risk factor for HTLV-1 infection not yet reported in these communities. Surprisingly, 7% of the interviewees knew that they had been breastfed by another woman, most commonly by somebody else in the family. If HTLV-1 is present in a family, being breastfed by more than one family member may increase the infant's risk of acquiring HTLV-1. On the other hand, surrogate breastfeeding may also represent a way of introducing HTLV-1 into non-infected families, and thereby favor its persistence in the community.

No intravenous illegal drug users or sex workers were identified in the communities studied. In addition, no men reported having had sex with men. The number of lifetime sex partners was also low, especially among women. However, it is important to point out that the number of lifetime sex partners was higher in Parinacochas, which may also have contributed to an increased risk for the infection.

The association with HIV infection was not assessed in this study. This could be seen as a limitation. Nevertheless, HIV infection is relatively uncommon in Peru. A recent study[32] reported a prevalence of HIV infection of 0.5% among female sex workers, and 0.5% among men and 0.1% among women in the general population. The prevalence of HTLV-1 infection in that same study was 0.3%, but unfortunately the authors did not specify the rate of co-infection. Another study estimated that 84% of new cases were concentrated in higher risk populations, such as men who have sex with men and people who have casual heterosexual sex.[33] As previously discussed, the population that we studied did not report high-risk sexual behavior. Based on the latest report of the Ministry of Health of Peru,[34] 1243 new cases of HIV infection were reported in the country during the first half of 2013. Of these, 562 (45%) were reported in Lima and three (0.2%) in Ayacucho. Also, the cumulative incidence of HIV infection between 1983 and 2012 was 280 per 100 000 people for Lima and 16 per 100 000 people for Ayacucho.[34] This probably reflects a clustering of HIV infection in urban areas, although more studies are needed to determine the true prevalence of HIV infection in rural areas, where access to health services is more limited.

Taken together, our findings are compatible with the hypothesis that postnatal infection by breastfeeding may play a key role in the transmission of HTLV-1 in the studied Andean population. If proven, this would advocate for the adoption of prevention strategies. The prevention policies in place in Japan, based on prenatal screening of HTLV-1, along with counseling of the mother and bottle feeding, have successfully reduced the prevalence of HTLV-1 and related diseases in the population.[3] However, the implementation of policies with similar goals would face additional challenges in Andean communities. Here, malnutrition and infectious diseases remain the main causes of infant mortality and morbidity, not to mention that breastfeeding, particularly in rural areas, also impacts on birth spacing thus mitigating the rates of infant mortality, stunting, and malnutrition.[35–37] In view that in previous studies[3,27,28,38] most of the breastfeeding-related transmission occurred in infants who had been breastfed for 6 or more months, an alternative to consider would be a restriction of breastfeeding to 6 months to 1 year in women with HTLV-1. This measure should be actively linked with efforts to improve overall infant nutrition,[35] ensuring access to clean drinking water for these populations,[39] and promoting access to adequate birth control.

Interestingly, in this series the only factor associated with HTLV-1 infection was having a relative with walking problems. In the provinces where we found HTLV-1, we observed a case of HAM/TSP and another two of spastic paraparesis in men, among persons who declined to participate in the study. This observation raises the question of whether undiagnosed clusters of HAM/TSP could underlie the high rate of lower-limb disability not related to polio reported in this area in the 1993 National Census. Familial and ethnic clusters of HAM/TSP, described in other parts of the world, such as Zaire,[40] Brazil,[41] and Argentina,[42] suggest a genetic or environmental predisposition to this disease. Interestingly, in the report of 165 Peruvian cases of HAM/TSP, Andean origin, defined as we did, was associated with the disease.[16] No studies of HAM/TPS have been done in the Peruvian Andes; such studies could provide evidence of the natural history of the disease in the Quechua population.

This is the first study done in a Quechua rural general population in Peru that not only confirms the presence of HTLV-1 infection, but also suggests that it may be very frequent in some communities. However, we should state that the sample was small with regard to the number of enrolled individuals, and was also non-randomly selected. On one hand, the remoteness of the communities precluded random sampling, but, on the other, we selected provinces for this study amongst those with the highest rates of lower-limb disability according to the Peruvian National Census of 1993 (the last one that reported such information). Even if our findings support the initial hypothesis that such a situation could in fact be a harbinger of the potential presence of HTLV-1 in these areas, it also implies the need for additional studies to determine the prevalence of this infection in the region and the risk factors associated with it. Furthermore, HTLV-1 seems to manifest

itself directly according to the affected population and its location. The morbidity associated with HTLV-1 infection in the Quechua population has not yet been determined and further studies are needed to quantify the consequences of this disease.

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