Journal of Taibah University Medical Sciences (2022) 17(5), 810–817

Taibah University

Journal of Taibah University Medical Sciences

www.sciencedirect.com

Original Article

Indigenous communities of Peru: Level of accessibility to health facilities

Akram Hernández-Vásquez, MD[a,*], Guido Bendezu-Quispe, MD[b] and Efrain Y. Turpo Cayo, MSc[c]

[a] *Centro de Excelencia en Investigaciones Económicas y Sociales en Salud, Vicerrectorado de Investigación, Universidad San Ignacio de Loyola, Lima, Peru*
[b] *Centro de Investigación Epidemiológica en Salud Global, Universidad Privada Norbert Wiener, Lima, Peru*
[c] *PhD Programme in Water Resources (PDRH), National Agrarian University – La Molina, Lima, Peru*

Received 16 December 2021; revised 5 February 2022; accepted 9 February 2022; Available online 25 February 2022

Abstract

Objectives: This study aimed to geospatially model the level of geographic accessibility to health facilities among Amazonian Indigenous communities in a region of Peru.

Methods: Spatial modeling of the physical accessibility of the Indigenous communities to the nearest health facility was performed through cost-distance analysis. The study area was Loreto, the region with the largest territorial area and number of Indigenous communities in Peru. The time required to reach a health facility was determined by cumulatively adding the time needed to cross the grids on the lowest cost route from the Indigenous communities' locations to the nearest health facility, by considering Amazonian geographical conditions and the main types of transport used.

Results: The median time to reach a health facility was 0.96 h (interquartile range: 0.45–2.41). Of the total communities (n = 1043), only 479 (45.93%) communities were within 1 h from the nearest health facility, and 161 (15.44%) were more than 8 h away. The Indigenous communities more than 8 h away from a health establishment were located in the border areas of the department of Loreto.

Conclusion: One in two Indigenous communities is more than 1 h from the nearest health facility.

Keywords: Geographic information systems; Native communities; Peru; South America; Spatial analysis; Spatial interaction model

الملخص

أهداف البحث: نمذجة مستوى الوصول الجغرافي إلى المرافق الصحية من قبل مجتمعات السكان الأصليين الأمازونيين في إحدى المناطق في دولة بيرو.

طرق البحث: تم تنفيذ النمذجة المكانية لمستوى الوصول للمجتمعات الأصلية إلى أقرب مرفق صحي باستخدام تحليل التكلفة والمسافة. كانت منطقة الدراسة هي "لوريتو"، وهي المنطقة ذات الامتداد الإقليمي الأكبر وعدد المجتمعات الأصلية في بيرو. تم تحديد الوقت اللازم للوصول إلى مرفق صحي من خلال الإضافة التراكمية للوقت اللازم لعبور الشبكات على الطريق الأقل تكلفة من موقع المجتمعات الأصلية إلى أقرب مرفق صحي مع مراعاة الظروف الجغرافية الأمازونية ونوع النقل المستخدم بشكل أساسي.

النتائج: بلغ متوسط الوقت اللازم للوصول إلى المرافق الصحية 0.96 ساعة (المدى الربيعي: 0.45-2.41). من إجمالي عدد المجتمعات (العدد = 1043)، يوجد فقط 479 (45.93٪) مجتمعا في نطاق ساعة واحدة للوصول إلى أقرب مرفق صحي و 161 (15.44٪) على بعد أكثر من ثماني ساعات. مجتمعات السكان الأصليين في نطاق أكثر من 8 ساعات بعدا عن المؤسسة الصحية كانت في المناطق الحدودية لمقاطعة لوريتو.

الاستنتاجات: واحد من كل مجتمعين من مجتمعات السكان الأصليين يقع في نطاق زمني أكبر من ساعة واحدة من أقرب مرفق صحي.

الكلمات المفتاحية: نظم المعلومات الجغرافية؛ نموذج التفاعل المكاني؛ التحليل المكاني؛ المجتمعات الأصلية؛ جنوب امريكا؛ بيرو

* Corresponding address: Universidad San Ignacio de Loyola, 550 La Fontana Avenue, La Molina, Lima, Peru.
E-mail: ahernandez@usil.edu.pe (A. Hernández-Vásquez)

Peer review under responsibility of Taibah University.

Production and hosting by Elsevier

1658-3612 https://doi.org/10.1016/j.jtumed.2022.02.006

Introduction

Access to health care is essential to preserve or improve the health of a population.[1] Within the framework of the Universal Health Coverage initiative and the Sustainable Development Goals seeking to "leave no one behind," a series of actions, established at the country level, aim to reduce inequalities in access to essential health care and increase the health care coverage in countries worldwide.[2,3] However, half the world's population still lacks access to essential health services.[2,3]

Geographical access to health services has been studied extensively in recent years, for medical conditions requiring rapid access to health facilities (e.g., maternal perinatal diseases or traffic accidents). Delays in arrival to health facilities are associated with worse health outcomes in populations.[4–6] Geographical difficulties in accessing a health service include factors such as the terrain, distance, or access to transport, and can result in delays in arrival or access to health services. Territorial areas may have few health care facilities, which are widely distributed; moreover, differences in access to health services may exist between urban and rural areas in developed and developing countries.[2]

In the Americas, 21% of the population lacks access to health services because of geographical barriers.[7] In this region, the Indigenous population has poorer health than the non-Indigenous population, including a greater proportion of people affected by conditions such as tuberculosis, HIV/AIDS, sexually transmitted diseases, and maternal and infant mortality.[8,9] Peru is the country with the second-largest Indigenous population and the third-largest number of Indigenous peoples in the Latin American region.[10] In Peru, 55 Indigenous peoples distributed in groups have settled in territories called Indigenous communities.[11] The Indigenous groups in Peru have less access to health care and poorer health than non-Indigenous groups.[12,13]

The Peruvian Amazon, one of the three natural regions of Peru, located east of the Andes mountain range, is characterized by lush vegetation, deep rivers, abundant rainfall, and a low population density. Rural communities have low access to medical care because of their geographical dispersion across the Amazon territory, distance to health facilities, and socio-cultural barriers to health care.[14,15] Within the Peruvian Amazon, the Loreto region, the department with the largest geographical area in Peru, includes 28 of the 55 Indigenous communities in the country.[11]

For the period between 2013 and 2014, half the Indigenous communities in Peru had no health facilities within their territorial areas.[16] These populations' displacement and ease of access to transport are barriers that must be addressed.[13,16] Because these Indigenous communities are usually located in rural and remote areas that are difficult to access, they face geographical, transport, and cultural barriers to receiving health care, which may be associated with higher mortality and serious complications. The objective of this study was to use geospatial modeling to explore the level of geographic accessibility to health facilities among Amazonian Indigenous communities in a region of Peru.

Materials and Methods

Study area

Peru is divided into 25 political-administrative units (24 departments and one constitutional province). The study area corresponded to the department of Loreto, which has the largest territorial area among the departments of Peru (368,852 km^2; 29% of the total area of Peru) and is located in the Peruvian Amazon in northeastern Peru. By 2017, it had a population of 883,510 inhabitants, 31.3% of whom lived in rural areas, and a population density of 2.4 inhabitants/km^2.[17] In Peru, there are 48 Indigenous languages, 44 of which are present in the Amazon region, and four of which are present in the Andean region.[18] These languages are grouped into 19 language families.[18] In the Loreto region, the use of 28 Indigenous languages has been reported, 20 of which are spoken only in this department.[18]

Data

Spatial modeling of physical accessibility to health facilities among Indigenous communities was performed through cost-time analysis.[19,20] The vector data were converted into an output raster format in which each cell was assigned the cumulative cost to the nearest source cell, to perform analysis operations and mathematical functions.[21]

The cost-time of traveling from an Indigenous community to a health facility, in a raster data structure, behaved similarly to connection nodes, such that the cost of transport was affected by the spatial orientation and how the nodes were connected.[19,21]

Friction surfaces

A friction surface consists of a two-dimensional grid. Herein, each cell of the grid represented a form of transport that contained cost values expressing the resistance of a cell to be traversed.[21] Because of the geographical conditions of the Amazon and the type of transport mainly used in the area, roads and navigable rivers were used as friction variables, and areas for accessibility, such as slopes and vegetation cover, were limited.

Given that various types of transport infrastructure have different characteristics, the weighted valuation of the variables of each friction surface raster was determined, and the cost-time per cell (sec × cell) was calculated according to equations (1) and (2) below.[22]

$$\text{Cost} = \frac{\text{Time}}{\text{Distance}} \quad (1)$$

$$\text{Time}_{\text{Sec/cell}} = \text{Cell size} \times \left(\frac{1}{\left(\text{Speed}(\text{km/h}) * \left(\frac{1000}{3600}\right)\right)} \right) \quad (2)$$

Two important friction surfaces that favor accessibility in the field of study were identified—road and river navigation[23]—and the average speeds for each type were assessed.[24] Two main friction surfaces reduced accessibility: the slope of the land and the type of vegetation cover.[25,26] The calculation of the slope of the land was generated from a digital elevation model (DEM) that allows for the calculation of the specific slope of territory.[27,28]

Main variable

The main variable in the study was the travel time to health facilities, on the basis of a distance cost analysis. In the department of Loreto, 384 georeferenced health facilities are registered in the National Georeferenced System SAYHUITE (http://www.sayhuite.gob.pe/sayhuite/map.phtml). Likewise, the localization points of the Indigenous communities were obtained from the *Instituto del Bien Común* (http://www.ibcperu.org/mapas/sicna/).

Processing

A cost-distance analysis was performed to model the accessibility of Indigenous communities to the nearest health facility. The analysis was performed with ArcGIS Desktop software version 10.4 (ESRI Inc., Redlands, CA, USA). First, the conversion to raster format with 30-m spatial resolution grids was performed by using the "Feature to Raster" tool. In the case of the DEM Shuttle Radar Topography Mission (SRTM), data were converted to a slope map with the "Slope" function. The reclassification of the input variables was performed according to Table 1. The data were then processed with the "Mosaic to new Raster," "Raster calculator," and "Cost distance" tools, for raster joining, friction surface calculation, and distance cost calculation, respectively. The time required to reach a health facility was determined by cumulatively adding the time needed to cross the grids on the lowest cost route from the location of the Indigenous communities to the health facility, thus resulting in a distance raster that was converted to units of time in hours in the ranges 0 to <2, 2 to <4, 4 to <8, or 8 or more hours.

Results

Table 1 shows the inputs included in the analysis. The study included a total of 1043 Indigenous communities, 35,838 families, and a total population of 185,349 people. Most of the Indigenous communities did not have a health

Table 1: Speeds and costs according to friction surfaces.

Type of friction surfaces	Average speed (km/h)	Cost (min/10 km)	Cost (sec × cell)
Surfaces favoring accessibility			
Road[23]			
Asphalt	60	10	5
Affirmed	50	12	6.48
Not affirmed/gauged	40	15	8.1
Navigation[23]			
Amazonian rivers	10	60	32
Amazon rivers with cargo transit	18	33	18
Surfaces decreasing accessibility[a]			
Slopes (%)[25]			
0−10 (walking)	5	120	65
10−30 (walking)	4	150	81
30−50 (walking)	2	300	162
>50 (walking)	1.5	400	216
Land cover[26]			
Non-Amazon forest areas	5	120	65
High hill forest	2.5	240	130
Splitter high hill forest	2.3	261	141
Low hill forest	2.5	240	130
Woodland plain forest	3	200	108
Mountain forest	1.5	400	216
Basimontane mountain forest	1.2	500	270
Mountain forest	1.2	500	270
High terrace forest	2.9	207	112
Low terrace forest	3.1	194	105
Blackwater flooded terrace forest	3.5	171	93
Flooded palm forest	3	200	108
Hydrophilic grassland	4.5	133	72
Lagoons, lakes, and swamps	1	600	324
River	10	60	32
Island vegetation	3	200	108
Sclerophyllous vegetation of white sand	4.2	143	77

[a] The DEM used for the analysis was the 30 m SRTM.

Table 2: Characteristics of Indigenous communities in the Loreto region, Peru.

Characteristics	Communities (n = 1043)	
	n	%
Population (median and interquartile range)	121 (70–220)[a]	
Linguistic family		
Quechua	207	19.85
Cahuapana	181	17.35
Tupi-Guarani	175	16.78
Jibaro	156	14.96
Others	324	31.06
Presence of health establishment		
Yes	130	12.46
No	913	87.54

[a] Population size data were available for 997 of 1043 communities.

Table 3: Time to access health facilities among Indigenous communities.

Characteristics	Communities (n = 1043)	
	n	%
Time to health facility (h)	0.96 (0.45–2.41)[a]	
Less than 2 h	654	62.70
2 to <4 h	142	13.61
4 to <8 h	86	8.25
8 h or more	161	15.44
"Golden hour" (less than 1 h)	479	45.93
Population with access by time ranges[b]		
Less than 2 h	136635	73.72
2 to <4 h	21960	11.85
4 to <8 h	17708	9.55
8 h or more	9046	4.88
"Golden hour" (less than 1 h)	107258	57.87

[a] Median and interquartile range.
[b] The population was calculated within the time categories for access of 997 of 1043 communities, because population data were available for these communities.

facility (87.54%). Of the 130 health facilities in Indigenous communities (with one health facility per community), 127 were health posts (118 public; nine private). Among the health centers, four were public, and three were private. The Quechua linguistic family was the most common language spoken by the Indigenous communities studied (19.85%), followed by Cahuapana (17.35%) (Table 2).

Among the communities, 479 (45.93%) communities were within 1 h, 654 (62.70%) were within 2 h, 142 (13.61%) were within 2–4 h, 86 (8.25%) were within 4–8 h, and 161 (15.44%) were within more than 8 h of the nearest health facility (Table 3). The median time to health facilities from the Indigenous communities was 0.96 h (interquartile range: 0.45–2.41).

Regarding the geographical distribution, most Indigenous communities more than 8 h away from the nearest health establishment were in border areas of the department of Loreto (Figure 1).

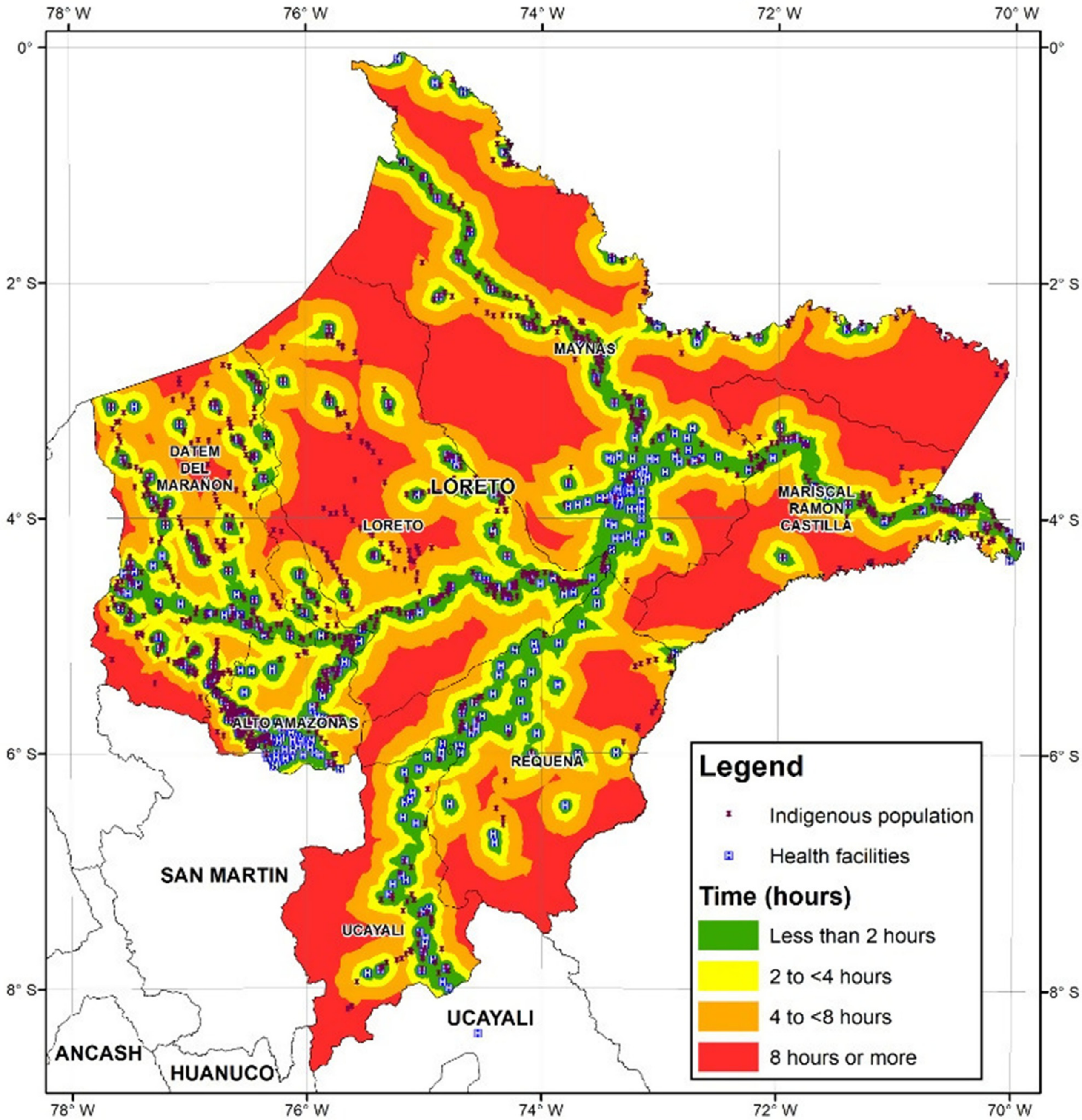

Figure 1: Estimated travel time to the closest health facility.

Discussion

This study sought to model and estimate the level of geographic accessibility to health facilities among the Indigenous Amazonian communities of the Loreto region of Peru. Most of the Indigenous communities were located more than 1 h from the nearest health facility, and one-third of these communities were more than 2 h away. Additionally, the Indigenous communities located in border areas of the Loreto region were mostly more than 4 h from the nearest health facility. Hence, We found that nearly half of the indigenous communities are in a time range greater than one hour ("golden hour") for access to health facilities through any means of transport available in the Loreto region.

More than half the Indigenous communities were more than 1 h away from a health facility. An increase in time or distance of 1 h or 1 km, respectively, from a health facility can decrease the likelihood of an institutional birth.[4] Additionally, in emergency medicine and related health sciences, a "golden hour" has been described, such that transport of patients with severe trauma to health facilities within the first hour after a traumatic event decreases both morbidity and mortality.[29] Although this concept is not completely accepted by the scientific community, and evidence both for and against it has been reported,[30,31] in Indigenous communities, where the use of health services is low,[32] and cultural barriers exist regarding language and expectations regarding the quality of care and waiting time,[32,33] access to health facilities in less time is likely to favor the use of health services by the residents of these communities.

According to the medical literature, the availability of transport also influences access to health services. Various Indigenous communities of Peru, including those located in Loreto, use river transportation, which is usually expensive and requires payment before each trip. In Peru, only one-quarter of the health facilities in Indigenous Amazonian villages have a means of transportation for visits, medical care, or the transfer of patients, and they experience budget constraints on the purchase of fuels and maintenance of transport vehicles.[13] Additionally, the high local costs of using private transport to transfer patients hinders access to medical care.[13] Strategies to improve physical accessibility to health facilities, such as ambulance systems, roads, or transport routes, can increase the use of health services in a complementary manner, thus improving the quality of care.[6] Therefore, strategies to improve accessibility to health facilities must be based on community interventions designed to facilitate access to operational transport in emergency situations. On the basis of previously reported experiences in the use of information technologies and health communication in Peru, access to these technologies must be greatly increased in remote areas of the country to improve health care access by identifying health care needs and providing access to transport and medical care.[34,35]

Although the distance that people must travel to receive health care depends on geographical conditions and transport availability, access to health facilities and health outcomes for the population of interest are dependent on accessibility factors, and financial or cultural considerations (language or local cultural practices), as previously described among Amazonian Indigenous peoples of Peru.[16,36] In general, the medical literature indicates disparities in access to health services, with less access for vulnerable populations.[5,37] Therefore, identifying the associated factors, assessing the effects of different programs at the local level, and developing or improving strategies are crucial. In Peru, in 2009, Law No. 29344, the Universal Health Insurance Framework Law, was adopted to ensure the full and progressive right of every person to social security in health, and to regulate access and functions of regulation, financing, provision, and supervision of insurance.[38] Although the scope of this law is at the local, regional, and national levels, progressive implementation of this law should lead to the development of strategies to facilitate increased access to health care among rural and remote communities, including vulnerable groups, such as Indigenous communities.

This study has several limitations, notably that the measures used to determine the distance to health facilities came from administrative data and therefore have the inherent deficiencies of secondary data analysis, data accuracy, and unavailability of some useful features for analysis. Similarly, seasonal factors were not considered, such as increased river flow or differences in transport speed according to the time of day (morning, afternoon, or night). These characteristics influence the transport time required to reach health facilities as well as the availability of transport in some locations. Despite the aforementioned limitations, the most recent and freely available data were used, and we believe that the study findings are useful as a first exploration of geographic accessibility to health facilities among Loreto's Indigenous communities through the use of tools of geospatial analysis.

Conclusions

One in two Indigenous communities are located more than 1 h from the nearest health facility. The communities with the longest times to access health facilities are located in the border areas of the Loreto region. These results indicate the necessity for decision-makers and authorities to develop or improve strategies to facilitate physical access to health facilities and increase their use. Such measures should be useful, given the low number of health facilities adjacent to or near Indigenous communities. Additionally, international agreements at the government level regarding the use of health facilities in border areas by foreigners (such as those from Colombia and Brazil, which border the Peruvian Amazon) could be an alternative to provide care to Indigenous communities in remote areas with limited geographic access to health facilities.

Source of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflict of interest

The authors have no conflict of interest to declare.

Ethical approval

The conduct of the study did not require the approval of an ethics committee, because it involved analysis of secondary data obtained from public domain sources and with free access, and did not analyze any human data.

Authors contributions

Conceptualization: AHV. Data curation: AHV and EYTC. Formal analysis: AHV and EYTC. Methods: AHV and EYTC. Writing original draft: AHV, EYTC, and GBQ. Writing review and editing: AHV, EYTC, and GBQ. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

Acknowledgments

We thank the *Instituto del Bien Común* and *Presidencia del Consejo de Ministros* for granting public access to the databases used in this study.

References

1. Evans DB, Hsua J, Boerma T. Universal health coverage and universal access. **Bull World Health Organ 2013**; 91. 546−546A.
2. World Health Organization. *Tracking universal health coverage: 2017 global monitoring report*; 2017 [cited 2022 Feb 28]. Available from: https://apps.who.int/iris/bitstream/handle/10665/259817/9789241513555-eng.pdf8.
3. United Nations. *The Millennium Development Goals Report 2015 [Internet]*. New York: UN; 2015 [cited 01 April 2019]. Available from: http://www.un.org/millenniumgoals/015_MDG_Report/pdf/MDG%202015%20rev%20(July%201).pdf.
4. Tegegne TK, Chojenta C, Loxton D, et al. The impact of geographic access on institutional delivery care use in low and middle-income countries: systematic review and meta-analysis. **PLoS One 2018**; 13:e0203130.
5. Carr BG, Bowman AJ, Wolff CS, et al. Disparities in access to trauma care in the United States: a population-based analysis. **Injury 2017**; 48: 332−338.
6. Fisseha G, Berhane Y, Worku A, et al. Distance from health facility and mothers' perception of quality related to skilled delivery service utilization in northern Ethiopia. **Int J Womens Health 2017**; 9: 749.
7. Pan American Health Organization. Strategy for universal access to health and universal health coverage. 53rd Directing Council of PAHO, 66th Session of the Regional Committee of WHO for the Americas, Washington, D.C., 2014 Sept. 29−3 Oct. 2014 (CD53.R14), http://www.paho.org/uhexchange/index.php/en/uhexchange-documents/technical-information/26-strategy-for-universal-access-to-health-and-universal-health-coverage/file.
8. United Nations Children's Fund. *Health Equity Report 2016. Analysis of reproductive, maternal, newborn, child and adolescent health inequities in Latin America and the Caribbean to inform policymaking*; 2016 [cited 2022 Feb 28]. Available from: https://www.unicef.org/lac/media/386/file/Publication.pdf.
9. del Popolo F, Jaspers D, United Nations, Economic Commission for Latin America and the Caribbean, et al. *Guaranteeing indigenous people's rights in Latin America: progress in the past decade and remaining challenges. Summary*; 2014 https://books.google.com/books/about/Guaranteeing_Indigenous_People_s_Rights.html?hl=&id=yNN5rgEACAAJ.
10. Comisión Económica Para América Latina y el Caribe. *Los pueblos indígenas en América Latina*; 2014 [cited 2022 Feb 28]. Available from: https://www.cepal.org/es/infografias/los-pueblos-indigenas-en-america-latina.
11. Ministerio de Cultura. *Lista de pueblos indígenas u originarios*. Ministerio de Cultura; 2019. https://bdpi.cultura.gob.pe/sites/default/files/archivos/paginas_internas/descargas/Lista%20de%20pueblos%20indígenas%20u%20originarios.pdf.
12. Díaz A, Arana A, Vargas-Machuca R, et al. Situación de salud y nutrición de niños indígenas y niños no indígenas de la Amazonia peruana. **Rev Panam Salud Publica 2015**; 38: 49−56.
13. Defensoría del Pueblo. *La Salud de las Comunidades Nativas: Un reto para el Estado*. DP; 2008. http://www2.congreso.gob.pe/Sicr/ApoyComisiones/comision2011.nsf/021documentos/B09C92BC24B04BE305258154005BE738/$FILE/Informe_N_134.pdf.
14. Lazo-Gonzales O, Alcalde-Rabanal J, Espinosa-Henao O. *El sistema de salud en Perú: situación y desafíos*; 2016 https://books.google.com/books/about/El_sistema_de_salud_en_Per%C3%BA.html?hl=&id=RsvvswEACAAJ.
15. Contreras-Pulache H, Pérez-Campos P, Huapaya-Huertas O, et al. La salud en las comunidades nativas amazónicas del Perú. **Rev Peru Epidemiol 2014**; 18: 1−5.
16. Defensoría del Pueblo. *La defensa del derecho de los pueblos indígenas amazónicos a una salud intercultural*. DP; 2015. https://www.defensoria.gob.pe/modules/Downloads/informes/defensoriales/Informe-Defensorial-N-169.pdf.
17. Instituto Nacional de Esatdística e Informática. *Loreto: Resultados Definitivos de los Censos Nacionales*. INEI; 2017. https://www.inei.gob.pe/media/MenuRecursivo/publicaciones_digitales/Est/Lib1561/. [Accessed 18 November 2019].
18. Ministerio de Educación. *Documento nacional de Lenguas originarias del Perú*; 2022 [cited 2022 Feb]. Available from: https://centroderecursos.cultura.pe/es/registrobibliografico/documento-nacional-de-lenguas-originarias-del-per%C3%BA.
19. Environmental Systems Research Institute. *Cómo funcionan las herramientas de coste de distancia—Ayuda | ArcGIS for Desktop*; 2022 [cited 2022 Feb 28]. Available from: https://desktop.arcgis.com/es/arcmap/10.3/tools/spatial-analyst-toolbox/how-the-cost-distance-tools-work.htm.
20. Adriaensen F, Chardon JP, De Blust G, et al. The application of 'least-cost' modelling as a functional landscape model. **Landsc Urban Plan 2003**; 64: 233−247.
21. Etherington TR. Least-cost modelling and landscape ecology: concepts, applications, and opportunities. **Curr Landsc Ecol Rep 2016**; 1: 40−53.
22. Farrow A, Nelson A. *Modelación de la accesibilidad en ArcView 3: Una extensión para calcular el tiempo de viaje y obtener información sobre captación de mercados*; 2001 https://cgspace.cgiar.org/handle/10568/70576.
23. Ministerio de Transportes y Comunicaciones. *Mapas Viales*; 2019 [cited 2022 Feb 28]. Available from: https://portal.mtc.gob.pe/transportes/caminos/normas_carreteras/mapas_viales.html.
24. Glave M, Barrantes R. *Amazonía peruana y desarrollo económico*. Lima; 2014, http://repositorio.iep.org.pe/handle/IEP/601.
25. Consultative Group for International Agricultural Research − Consortium for Spatial Information. *RTM 90m DEM Digital Elevation Database*; 2009 [cited 2022 Feb 28]. Available from: https://srtm.csi.cgiar.org/.
26. Ministerio del Ambiente. *Mapa nacional de cobertura vegetal: memoria descriptiva*; 2015 [cited 2022 Feb 28]. Available from: https://www.minam.gob.pe/patrimonio-natural/wp-content/uploads/sites/6/2013/10/MAPA-NACIONAL-DE-COBERTURA-VEGETAL-FINAL.compressed.pdf.
27. Tang J, Pilesjö P, Persson A. Estimating slope from raster data—a test of eight algorithms at different resolutions in flat and steep terrain. **Geod Cartogr 2013**; 39: 41−52.
28. Farr TG, Rosen PA, Caro E, et al. The Shuttle Radar Topography Mission. **Rev Geophys 2007**; 45: 1485.
29. Rogers FB, Rittenhouse KJ, Gross BW. The golden hour in trauma: dogma or medical folklore? **Injury 2015**; 46: 525−527.
30. Newgard CD, Schmicker RH, Hedges JR, et al. Emergency medical services intervals and survival in trauma: assessment of the 'golden hour' in a North American prospective cohort. **Ann Emerg Med 2010**; 55: 235−246. e4.
31. Castrodale V, Rinehart S, Ikuta L. The golden hour. **Adv Neonatal Care 2014**; 14: 9−14.
32. Dirección General de Epidemiología. *Comunidades Indígenas: Caracterización de su Población, situación de salud y Factores determinantes de la Salud 2012*. DGE; 2013. http://bvs.minsa.gob.pe/local/minsa/2734.pdf.
33. Marsland H, Meza G, de Wildt G, et al. A qualitative exploration of women's experiences of antenatal and intrapartum

care: the need for a woman-centred approach in the Peruvian Amazon. **PLoS One 2019**; 14:e0209736.
34. Limaye NP, Rivas-Nieto AC, Carcamo CP, et al. Nuestras Historias-Designing a novel digital story intervention through participatory methods to improve maternal and child health in the Peruvian Amazon. **PLoS One 2018**; 13:e0205673.
35. Limaye NP, Blas MM, Alva IE, et al. The Amazon Hope: a qualitative and quantitative assessment of a mobile clinic ship in the Peruvian Amazon. **PLoS One 2018**; 13:e0196988.
36. Kelly C, Hulme C, Farragher T, et al. Are differences in travel time or distance to healthcare for adults in global north countries associated with an impact on health outcomes? A systematic review. **BMJ Open 2016**; 6:e013059.
37. Politzer RM, Yoon J, Shi L, et al. Inequality in America: the contribution of health centers in reducing and eliminating disparities in access to care. **Med Care Res Rev 2001**; 58: 234–248.
38. Congreso de la República. *Ley Marco de Aseguramiento Universal en Salud*; 2009 [cited 2022 Feb 28]. Available from: http://www.leyes.congreso.gob.pe/Documentos/Leyes/29344.pdf.

How to cite this article: Hernández-Vásquez A, Bendezu-Quispe G, Turpo Cayo EY. Indigenous communities of Peru: Level of accessibility to health facilities. J Taibah Univ Med Sc 2022;17(5):810–817.