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Determinants of the Demand for Cervical Cancer Secondary Prevention Services in Peru

Determinantes de la Demanda de Servicios de Prevención Secundaria del cáncer cervicouterino en Perú

César Sanabria-Montañez[1]

Abstract

Introduction. The preventive services of health are very important like investment in the health of the people. If the secondary preventive services are examined to face the cervical cancer (CCU) in Peru, its access and demands are not equitable. In this article, the determining factors of the demand of services of Pap smear screening (services PAP) are identified and measured. **Methods.** One studied to a population of women of 30 to 49 years, with data of the Demographic Survey and of Family Health (ENDES) of years 2016 to 2019. A logistic model was used to explore the relationship between demand of services PAP and variables of decision, socioeconomics and of health of the people. The predictability of the model based on the machine learning was examined. **Results.** The factors with the greatest probability of demand PAP services were having hypertension (OR = 4.76; 95% CI: 4.03 - 5.66) and belonging to the "richest" socioeconomic stratum (OR = 3.39, 95% CI: 2.96 - 3.87). On the contrary, with less probability of demand they were, living in small cities (OR = 0.27; 95% CI: 0.24-0.30), in Villages (OR = 0.26; 95% CI: 0.23-0.30) and in the High Andean Saw. (OR = 0.46, 95% CI: 0.41-0.51). **Conclusions.** The structural factors, living conditions and place of residence are the main determinants of the demand for PAP preventive services in Peru, which implies greater efforts in health policy and the need to coordinate with other sectors.

Keyword: demand for Pap smears, secondary prevention, cervical cancer, machine learning, Peru.

Resumen

Introducción. Los servicios de salud preventivos son muy importantes como inversión en la salud de las personas. Si se examinan los servicios preventivos secundarios para hacer frente al cáncer cérvico uterino (CCU) en el Perú, su acceso y demanda son inequitativos. En este artículo, se identifican y miden los factores determinantes de la demanda de servicios de Tamizaje de Papanicolaou (servicios PAP). **Métodos.** Se estudió a una población de mujeres de 30 a 49 años, con datos de la Encuesta Demográfica y de Salud Familiar (ENDES) de los años 2016 a 2019. Se utilizó un modelo logístico para explorar la relación entre demanda de servicios PAP y variables de decisión, socioeconómicas y de salud de las personas. Se examinó la predictibilidad del modelo en base al aprendizaje automático. **Resultados.** Los factores con mayor probabilidad de demandar los servicios PAP fueron, tener hipertensión (OR = 4.76; IC del 95%: 4.03 – 5.66) y pertenecer al estrato socioeconómico "más rico" (OR=3.39, IC del 95%: 2.96 – 3.87). Por el contrario, vivir en ciudades pequeñas (OR = 0.27; IC del 95%: 0.24–0.30), en Pueblos (OR = 0.26; IC del 95%: 0.23–0.30) y en la Sierra Altoandina (OR = 0.46; IC del 95%: 0.41–0.51) tenían menos probabilidades de demanda. **Conclusiones.** Los factores estructurales condiciones de vida y lugar de residencia son los principales determinantes de la demanda de servicios preventivos PAP en el Perú, lo cual implica mayores esfuerzos en la política de salud y la necesidad de articular con otros sectores.

Palabras clave: demanda de papanicolaou, prevención secundaria, cáncer cérvico uterino, aprendizaje automático, Perú.

[1]Principal Professor of the Faculty of Economic Sciences Economist and Master in Economics, Universidad Nacional Mayor de San Marcos, Lima, Perú.

ORCID:
[a]https://orcid.org/0000-0003-4059-378X

Corresponding author:
César Sanabria Montañez

Postal Address: Avenida De Los Precursores 981 – 502, San Miguel, Lima – Perú. Téléfono: 998 542 595

Email: csanabriam@unmsm.edu.pe

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Introducción

The CCU is a public health problem in the world, in developed countries it has receded, but it is still a disease more linked to less developed countries (1).

In Peru in 2020, 4,270 new cases of CCU were diagnosed (6.1% of all new cases of cancer). It is the second most common cancer in women and the fifth most common of all cancers in the country; mortality reached 2,288 women, it ranks fourth in number of deaths from cancer (2).

The CCU is a preventable disease; it can also be cured if caught early and treated properly (3), the primary care strategy is essential to prevent it (4). It was sought to answer the question, what factors associated with the characteristics of women determine the demand for preventive health services through Papanicolaou Screening (PAP services) in Peru?

Grossman's demand approach was used(5), who argues that health can be seen as a lasting social capital that produces a healthy time output. Thus, people inherit an initial stock of health that depreciates with age and can increase with investment.

The health is a consumer property that is desired because it makes people feel good (it gives satisfaction and usefulness), it gives rise to the primary demand for health services(6), (7). The health as a capital property increases the number of healthy days available to work and generate income, giving rise to the demand for preventive health services.

Material and methods

The research design is non-experimental and

retrospective, national in scope; It has a multivariate analysis method based on a logistic regression model, it seeks to explain what characteristics of women help to have a better probability of demanding PAP preventive services. The research has been conducted respecting ethics, with respect for people, information and readers.

The population of study has been women between 30 and 49 years of age, the Demographic and Family Health Survey (ENDES) was used from 2016 to 2019 (8). The sample includes only women who answered having or not been examined by means of the papanicolaou test, reaching 6,580, 6,704, 7,262 and 9,224 women for the years 2016, 2017, 2018 and 2019, respectively.

The modeling of the demand for preventive services (PAP) was based on Rotarou & Sakellariou(9), who examine the barriers that affect the rates of use of preventive health services and organize the variables through the characteristics of the people.

Likewise, health as people's capital requires investment, this can be observed in the association between socioeconomic factors and the use of PAP Screening(10), but the investment decision is often overshadowed by other factors(11), and demand factors based on social conditions and knowledge prevail (12) and education (13).

The model is expressed in the following equation:

$$y = f(xi, xj, xk, xl, \ldots, xn) \quad (1)$$

Donde:
y: demand for preventive services through Pap Smear Screening (PAP)
xi: Vector of variables of consciousness and decision of people, i=1,2,3 …, n
xj: Vector of socioeconomic structural variables, j =1,2,3 …, n
xk: Vector of "intermediate" structural variables derived from people's health and risk conditions, k =1,2,3 …, n

In the binary Logit model, the demand for preventive screening services (PAP) will be the dependent variable (y) that can take two values (1 = demand, 0 = no demand).

The model establishes the following relationship between the probability of the event occurring, given that the person presents the values (characteristics)
$X1=x_1, X2=x_2, \ldots, Xp=x_p$

$$Pr(Y=1|x_1,x_2,\ldots,x_p)=1/(1+\exp(-\alpha-\beta_1x_1-\beta_2x_2-\ldots-\beta_px_p)) \quad (2)$$

Where is the conditional probability, that is, the probability that the person demands PAP services given the factors $Pr(Y=1|x)$ $Pr(Y=1|x_1,x_2,\ldots,x_p)$, $x_1,x_2,\ldots,x_p$.

The independent variables grouped into decision variables: knowledge of cancer and CCU prevention, and education; in structural variables, belonging to a socio-economic condition, ethnic group, region and zone, type of city or population where they live; and in risk variables and health condition, having diseases: obesity, hypertension and diabetes; age of initiation of sexual intercourse, number of children, age of the person, marital status and number of household members. Variables, given their characteristics, values or attributes, are categorical or numerical (See Supplementary Annex).

The Machine learning was used(14) in order to predict the result for a new case, a model is "trained" with a Data Set and then the results are "tested" with another. Thus, information from 2016, 2017 and 2018 was integrated, forming an enriched Data Set, and it was assumed that the people interviewed do not repeat themselves in some year; With this Data Set, the model was “trained” and the results were “tested” with the 2019 DB.

In an analysis with training and testing, the results identified only 2% of the “minority class” (who do not demand PAP services), and this “minority class” was oversampled to balance the BD(15). The statistical independence of the categorical variables and the correlation of the numerical variables were then examined. Finally, the “training” Logit model explains the determinants of PAP demand. The results of the "test" model are synthesized in a Confusion Matrix that in turn allows to identify the metrics of accuracy, precision, sensitivity and specificity, allowing to analyze if the model is predictive.

The R environment was used to run the model and oversampling was done with Python and R.

Results

The results found in the study (See Table 1) show that most of the variables are explanatory (they have statistical significance), they stand out in the vector of reasoning and awareness, more knowledge of the CCU and greater education; they have a positive meaning, that is, more probability of demand.

In the vector of structural variables, it is examined that being in depressed socioeconomic conditions, cultural barriers (belonging to a certain ethnic group) and the fact of living in regions and zones of less development, define lower probabilities of demand for PAP services.

In the vector of variables related to the health condition or risk of women, they indicate that having hypertension or diabetes would lead to a greater probability of demand; the same would happen if they are older or have a greater number of children.

Among the findings of the marginal probability of demanding PAP preventive services (Table 2), the variables with the greatest marginal effect stand out, with the other variables remaining constant, the fact of living in a town or in a small city decreases the probability of PAP demand in 32.2% and 31.7% respectively.

The health condition of women such as hypertension and diabetes, lead to an increase in the probability of demand for PAP services.

Table 1. Results of the Papanicolaou Screening Preventive Health Services Demand Model

	Estimate	Pr(>|z|)
(Intercept)	10.1	0.8833
Knowledge of the CCU	0.3116	< 2e-16 ***
Higher education	0.5115	< 2e-16 ***
Postgraduate education	0.8446	< 2e-16 ***
Wealth Index: Poor	0.6908	< 2e-16 ***
Wealth Index: Medium	0.9408	< 2e-16 ***
Wealth Index: Rich	1.1475	< 2e-16 ***
Wealth Index: Richest	1.2206	< 2e-16 ***
Mother tongue: Quechua / Aymara	0.0099	0.7006
Mother tongue: Other native languages other than Quechua and Aymara	-0.716	2.94e-05 ***
Mother tongue: Other foreign languages	1.549	0.0163 *
Place of Residence: Urban	-10.19	0.8822
Natural Region- Ceja de Selva	-0.4701	1.69e-06 ***
Natural Region: Jungle - Amazonian Foothills and Low Jungle	-0.3484	< 2e-16 ***
Natural Region: High Forest	0.1343	0.0383 *
Natural Region: Sierra High Andean Zone	-0.7797	< 2e-16 ***
Natural Region: Sierra - Bajo Andean Zone	0.5073	2.03e-14 ***
Natural Region: Sierra - Mesoandina Zone	0.1858	1.33e-07 ***
Live in a small town	-1.315	< 2e-16 ***
Lives in a town	-1.338	< 2e-16 ***
Live in the field	-11.07	0.8722
Hypertension	1.561	< 2e-16 ***
Diabetes	1.148	6.15e-13 ***
Normal weight	-0.8616	0.0161 *
Overweight	-0.6844	0.0557 .
Obesity	-0.6132	0.0867 .
Age in years	0.0205	2.03e-15 ***
Number of children	0.1714	< 2e-16 ***
Age of First Sexual Relationship	-0.0175	1.67e-06 ***
Marital status: Widowed, divorced, separated	-0.121	9.82e-05 ***
Number of Household Members	-0.0005	0.9536

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
* Results of the model applied with ENDES Training Data 2016, 2017 and 2018 and with Oversampling.
** Pr(>|z|) is the so-called p-value, that is, the error probability of accepting H1 as true. It is obtained from the Wald statistic z = Estimate / Std E. The p-value corresponds to the z statistic. The smaller the p-value, the more significant the estimate.

There is a gradient of greater probability due to the fact of belonging to a greater segment of living condition (wealth), the person identified in the segment of "richest" increases their probability of demand for PAP services by 26.0%.

If the woman lives in the Sierra - High Andean Zone or in the Ceja de Selva, the probability of demand for PAP services decreases by 19.2% and 11.7% respectively. Likewise, having a native mother tongue different from Quechua and Aymara reduces their probability of requesting the services studied by 17.7%.

Having knowledge about the CCU or higher education or postgraduate education increases the probability of PAP demand, in 7.6%, 12.5% and 19.1%.

The Table 2 also shows the Odds Ratio, results of the regression analysis adjusted by the model, with constant variables, Peruvian women with postgraduate education have 2.33 (95% CI:2.09 -2.60) times the probability of demanding PAP than women with basic education.

In the structural variables, the population's living conditions stand out, thus the fact of belonging to the "richest" stratum implies an increase of 3.39 (95% CI: 2.97 -3.88) times in the probability of demanding PAP services compared to women from the very poor stratum.

Likewise, women belonging to an ethnic group whose mother tongue is different from Quechua and Aymara (OR = 0.49, 95% CI: 0.36 - 0.67) are 51% less likely to demand PAP services than women whose mother tongue is the

Table 2. Marginal Effects and Odds Ratio adjusted to the logistic regression model (with 95% CI) for the demand for preventive health services for Papanicolaou Screening *

	dF/dx **	Odds Ratio	IC (95%)
Knowledge of the CCU	7.70%	1.37	(1.30 -1.44)
Higher education	12.50%	1.67	(1.56 -1.78)
Postgraduate education	19.10%	2.33	(2.09 -2.60)
Wealth Index: Poor	16.30%	1.99	(1.83 -2.17)
Wealth Index: Medium	21.50%	2.56	(2.31 -2.84)
Wealth Index: Rich	25.10%	3.15	(2.81 -3.53)
Wealth Index: Richest	26.00%	3.39	(2.97 -3.88)
Mother tongue: Other native languages other than Quechua and Aymara	-17.70%	0.49	(0.35 -0.68)
Natural Region: Selva - Ceja de Selva	-11.70%	0.62	(0.51 -0.76)
Natural Region: Jungle - Amazonian Piedmont and Low Jungle	-8.60%	0.71	(0.66 -0.76)
Natural Region: Sierra - High Andean Zone	-19.20%	0.46	(0.41 -0.51)
Natural Region: Sierra - Bajo Andean Zone	11.80%	1.66	(1.46 -1.66)
Natural Region: Sierra - Mesoandina Zone	4.50%	1.2	(1.12 -1.20)
Live in a small town	-31.70%	0.27	(0.24 -0.30)
Lives in a town	-32.20%	0.26	(0.23 -0.30)
Hypertension	28.90%	4.76	(4.03 -5.66)
Diabetes	23.80%	3.15	(2.33 -4.35)
Age in years	0.50%	1.02	(1.02 -1.03)
Number of children	4.20%	1.19	(1.16 -1.21)
Age of First Sexual Relationship	-0.40%	0.98	(0.98 -0.99)
Marital status: Widowed, divorced, separated	-3.00%	0.89	(0.83 -0.94)

*Results from the ENDES Training Database 2016, 2017 and 2018 and with Oversampling.
** Expressed as a percentage of variation.

Spanish.

Women residing in a small city or in a town (OR = 0.27, 95% CI: 0.24 -0.30) and (OR = 0.26, 95% CI: 0.23 -0.30) have, respectively, 73% and 74% less probability of demand the PAP services that women residing in the capital of the Department.

Meanwhile, if a woman has hypertension or diabetes, the probability of demanding PAP services increases to 4.76 (95% CI: 4.03 - 5.66) and 3.15 (95% CI: 2.33 - 4.35) times the probability of demand of women who do not have hypertension or diabetes, respectively.

Finally, the results of the "training" model were "tested" with the BD ENDES 2019; the Confusion Matrix and the metrics (Table 3) show that the accuracy of the model is 66.1%, it refers to how close the result of a measurement is to the true value, it measures the frequency with which the classifier makes a correct prediction; After examining the precision (86.6%), it indicates that the model is reliable in terms of identifying the women who requested PAP services.

The sensitivity (69.3%) is the ability of the model to discriminate those who sue from those who do not. The specificity, the ability to detect a non-demanding woman, is moderate (51.7%); and having medium sensitivity and specificity, it will result in a balanced accuracy (average accuracy) of 60.52%; that is, the model manages to predict the cases correctly in 60.52%, confirming the moderate predictability that the model has.

Table 3. Confusion matrix and metrics. Result of the model "test" with BD ENDES 2019

Confusion Matrix		
	1	0
1	TP: 5229	FN: 811
0	FP: 2315	TN: 869
Metrics		
Orden	indicator	Test BD 2019
1	accuracy	0.6611
2	precision	0.86573
3	sensitivity	0.69313
4	specificity	0.51726
5	prevalence	0.81787
6	balanced accuracy	0.6052

Where TP = true positives, FN = false negatives, FN = false positives and TN = true negatives

Discusión

The results indicate that the proposed variables explain

being determining factors of the demand for PAP services in Peru; Certain characteristics such as knowledge, education, socioeconomic status, the place where the person lives, being of a certain ethnic group, having hypertension or obesity, define the demand.

They show the inequality that exists in Peru and in the demand for PAP services, belonging to the "richest" segment has the advantage of increasing the probability of demanding PAP services by 3.4 times the probability of women belonging to the " very poor"; and those who reside in a town have a probability of demand 74% less than women who live in the capital city of the Department; inequality that is also observed in relation to educational levels.

Examining the explanatory variables, with respect to knowledge, the results coincide with what was found by the study on the detection of CCU in Australia(12), which indicates awareness as a determining factor that is related to knowledge of cervical screening and other factors such as culture and language; and consistent with studies on the knowledge and use of preventive services in the United States(16), and in Ethiopia (17), thus denoting the importance of knowing the health problem to demand services and the role of information and communication to improve demand.

The Education, is important in the theory of human capital and in the demand for health and health services(18), (5), it plays a relevant role in the demand for preventive health that implies investing in health to achieve gains on healthy days. According to the results found, higher education leads to a greater probability of demand in Peru, this is consistent with the findings of various studies around the world(13), (19),(20) and particularly in Latin America (21).

Uniting education with structural variables, the results found in Italy are consistent with the results found in this study, it was found that the lowest educational level and the occupational class are strongly associated with the underutilization of screening, and as in Peru , these preventive services are funded by the State(10).

The role of living conditions (being richer) leads to a greater demand, coincides with what was found in India(22), and Latin America on determinants of health(23), although in Chile the probabilities are slightly higher to carry out preventive examinations than the poorest people(9); It already implies an important challenge to face, since it is a structural variable that implies solutions that go beyond health policies, and an opportunity to integrate it with other types of public actions. Likewise, belonging to a social group (ethnic group) with a Peruvian native language other than Quechua or Aymara - in Peru there are 47 native languages including Quechua and Aymara(24)-, implies being in a population group with more barriers and little integration to the benefits achieved by society; thus this population, according to the estimated results, has a higher probability of no demand.

The results of the study regarding ethnicity are consistent with what was found in Great Britain (12), where Asian women were much less likely to be aware of Pap smears relative to all other ethnic groups, due to not speaking English, resulting in very low chances of detection. Ethnic minorities also found low participation in the detection of CCU in the United States(25) and the same in Australia (12). Also in Kenya(26), they conclude with respect to ethnic groups, which have certain behaviors and culture that lead to not demanding health services. Which implies the need to improve health actions in terms of interculturality and social inclusion.

The variables referring to the place where Peruvian women live indicate that living in economically depressed areas, more geographically complex and further from the city leads to lower demand, coinciding with regional and territorial integration inequalities, with limited access to markets, including health services. The results of rurality and less development associated with lower PAP demand are consistent with those found in Zimbabwe(27) , USA (25) and Cameroon (28). And in them, subjective criteria for non-demand should not be set aside.

Having chronic diseases such as hypertension or diabetes, coincides with what was found in Great Britain, where a greater probability of demanding PAP services would be associated with the fact that the visits they make to the doctor for their health problems, who would play a role in referring to a demand PAP services(29).

The research found that the probability of demand increases with age, which is consistent with that found in Great Britain (29), where the demand increases when the population is in the age groups recommended for the PAP test. On the other hand, the fact that women are divorced or widowed or separated implies a high probability of not requesting PAP services, a result similar to that found in India(30), that being married and with more years of marriage leads to greater use of the PAP service.

Examined the application of machine learning. Regarding the results of the model “test” with the 2019 DB, they are very limited to predict the PAP demand, despite the increase in specificity with the Oversampling from 2% to 51.7%, that is, the inclusion in the DB of more women not demanding PAP services; The model has a moderate predictability, this means that the model is limited in building a machine learning process that allows forecasting PAP demand in the future.

However, the methodology made it possible to explain and measure the specific weight of the determinants of the demand for PAP services; the precision indicator refers to the existence of security of the variables incorporated in the study (the determinants factors) and their theoretical confirmation.

The limitations of the research are related to not having additional information to the ENDES, a survey that has a wealth of information on the population, and there is no more information on the context; such as the health system (the capabilities of the health facility, the proximity or distance in which the facility is located, the limitations and quality of the offer, among others), the working and cultural conditions and subjective perceptions (fears, shame, myths and beliefs) of women in Peruvian diversity.

Finally, in methodological terms, all the studies examined proposed a series of econometric models to identify the associations and relationships that exist between the population and the demand for preventive health services, including PAP services; the innovation of this research has been in the use of machine learning.

Conclusions

The structural variables are the most important in shaping the demand for secondary preventive services such as PAP screening, having more education and living conditions determine a greater probability of demand, and the opposite occurs with the population living in less integrated places and regions. to economic well-being. This implies a greater effort by health policies to integrate and articulate with other sectors.

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Authors contribution

Cesar Sanabria Montañez, is the sole author.

Interest conflict

I declare that I have no conflict of interest.

References

1. Small W, Bacon MA, Bajaj A, Chuang LT, Fisher BJ, Harkenrider MM, et al. Cervical cancer: A global health crisis. Cancer [Internet]. 2017 Jul 1;123(13):2404–12. Available from: https://acsjournals.onlinelibrary.wiley.com/doi/epdf/10.1002/cncr.30667
2. Ferlay J, Ervik M, Lam F, Colombet M, Mery L, Piñeros M, et al. Global Cancer Observatory: Cancer Today. Int Agency Res Cancer [Internet]. 2020;68(6). Available from: https://gco.iarc.fr/today
3. OPS. Control integral del cáncer cervicouterino. Guía de prácticas esenciales [Internet]. Vol. 53, Journal of Chemical Information and Modeling. 2016. 1–432 p. Available from: https://www.who.int/reproductivehealth/publications/cancers/cervical-cancer-guide/es/
4. Almonte M, Murillo R, Sánchez GI, Jerónimo J, Salmerón J, Ferreccio C, et al. Nuevos paradigmas y desafíos en la prevención y control del cáncer de cuello uterino en América Latina. Salud Publica Mex [Internet]. 2010 [cited 2021 Mar 6];52(6):544–59. Available from: http://www.scielo.org.mx/scielo.php?script=sci_arttext&pid=S0036-36342010000600010&lng=es&nrm=iso&tlng=es
5. Grossman M. On the Concept of Health Capital and Demand for Health. J Polit Econ [Internet]. 1972;80(2):223–55. Available from: https: // www. jstor .org / stable / 1830580
6. González Álvarez M, Clavero Barranquero A. Una revisión de modelos econométricos aplicados al análisis de demanda y utilización de servicios sanitarios. Hacienda Pública Española [Internet]. 2005;(173):129–62. Available from: https://core.ac.uk/download/pdf/6835983.pdf
7. Temporelli K. Análisis de la demanda de asistencia sanitaria: La utilidad del médico como terminante. In: Anales de Economia [Internet]. Bahia Blanca, Argentina; 2004 [cited 2017 Jun 4]. p. 1–25. Available from: http://www.aaep.org.ar/anales/works/works2004/Temporelli.pdf
8. Instituto Nacional de Estadística Informática. Microdatos Base de Datos [Internet]. INEI. 2020 [cited 2020 Dec 12]. Available from: http://iinei.inei.gob.pe/microdatos/
9. Rotarou ES, Sakellariou D. Determinants of utilisation rates of preventive health services: Evidence from Chile. BMC Public Health. 2018;18(1):1–11.
10. Damiani G, Federico B, Basso D, Ronconi A, Bianchi CBNA, Anzellotti GM, et al. Socioeconomic disparities in the uptake of breast and cervical cancer screening in Italy: A cross sectional study. BMC Public Health [Internet]. 2012;12(1):99. Available from: http://www.biomedcentral.com/1471-2458/12/99
11. Kenkel DS. The demand for preventive medical care. Appl Econ [Internet]. 1994;26(4):313–25. Available from: http://dx.doi.org/10.1080/00036849400000078
12. Belkar R, Fiebig DG, Haas M, Viney R. Why worry about awareness in choice problems? Econometric analysis of screening for cervical cancer. Health Econ [Internet]. 2006;15(1):33–47. Available from: https://onlinelibrary.wiley.com/doi/epdf/10.1002/hec.1013
13. Sabates R, Feinstein L. The role of education in the uptake of preventative health care: The case of cervical screening in Britain. Soc Sci Med [Internet]. 2006 Jun 1 [cited 2021 Mar 2];62(12):2998–3010. Available from: https://doi.org/10.1016/j.socscimed.2005.11.032
14. Silcox C. La inteligencia artificial en el sector salud: Promesas y desafíos [Internet]. La inteligencia artificial en el sector salud: Promesas y desafíos. Washington D.C.; 2020. Available from: https://publications.iadb.org/publications/spanish/document/La-inteligencia-artificial-en-el-sector-salud-Promesas-y-desafios.pdf
15. Ramentol E, Herrera F, Bello R, Caballero Y, Sanchez Y. Edición de Conjuntos de Entrenamiento no Balanceados, haciendo uso de Operadores Genéticos y la Teoría de los Conjuntos Aproximados. In: Congreso Español sobre Metaheuristicas y Algoritmos Bioinspirados. 2009. p. 277–84.
16. Parente ST, Salkever DS, DaVanzo J. The role of consumer knowledge of insurance benefits in the demand for preventive health care among the elderly [Internet]. Vol. 14, Health Economics Review. 2005. Available from: https://onlinelibrary.wiley.com/doi/epdf/10.1002/hec.907
17. Getachew Id S, Id G, Gizaw M, Ayele W, Addissie A, Kantelhardt EJ. Cervical cancer screening knowledge and barriers among women in Addis Ababa, Ethiopia. 2019; Available from: https://doi.org/10.1371/journal.pone.0216522
18. Grossman M. The human capital model of the demand

for health. NBER Work Pap No 7078 [Internet]. 1999;1(1):1–102. Available from: http://www.nber.org/papers/w7078.pdf
19. Jusot F, Or Z, Sirven N. Variations in preventive care utilisation in Europe. Eur J Ageing [Internet]. 2012;9(1):15–25. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5547316/
20. Ishii K, Tabuchi T, Iso H. Combined patterns of participation in cervical, breast, and colorectal cancer screenings and factors for non-participation in each screening among women in Japan. Prev Med (Baltim) [Internet]. 2021 Sep 1 [cited 2021 Jul 28];150:106627. Available from: https://www.sciencedirect.com/science/article/abs/pii/S0091743521002115?via%3Dihub
21. Guerrero Victoria JJ. Demanda de la consulta médica preventiva en Colombia: De terminantes y evidencia de inducción por oferta [Internet]. Pontificia Universidad Javeriana; 2014. Available from: https://repository.javeriana.edu.co/handle/10554/18506
22. Nilima, Puranik A, Shreenidhi SM, Rai SN. Spatial evaluation of prevalence, pattern and predictors of cervical cancer screening in India. Public Health [Internet]. 2020;178:124–36. Available from: https://doi.org/10.1016/j.puhe.2019.09.008
23. Odorico Monteiro de Andrade L, Pellegrini Filho A, Solar O, Rígoli F, Malagon de Salazar L, Castell-Florit Serrate P, et al. Universal health coverage in Latin America 3 Social determinants of health, universal health coverage, and sustainable development: case studies from Latin American countries. Lancet [Internet]. 2015;385:1343–51. Available from: https://data.undp.
24. Ministerio de Educación. En el Perú hay 47 lenguas originarias que son habladas por cuatro millones de personas [Internet]. MINEDU. 2017. Available from: http://www.minedu.gob.pe/n/noticia.php?id=42914#:~:text=Las lenguas con alfabetos oficiales,madija%2C kukama kukamiria%2C maijiki%2C
25. Fuzzell LN, Perkins RB, Christy SM, Lake PW, Vadaparampil ST. Cervical cancer screening in the United States: Challenges and potential solutions for underscreened groups. Prev Med (Baltim) [Internet]. 2021;144(January):106400. Available from: https://doi.org/10.1016/j.ypmed.2020.106400
26. Frings M, Lakes T, Müller D, Khan MMH, Epprecht M, Kipruto S, et al. Modeling and mapping the burden of disease in Kenya. Sci Rep [Internet]. 2018;8(1):1.9. Available from: https://www.nature.com/articles/s41598-018-28266-4.pdf
27. Mupepi SC, Sampselle CM, Johnson TRB. Knowledge, attitudes, and demographic factors influencing cervical cancer screening behavior of Zimbabwean women. J Women's Heal [Internet]. 2011;20(6):943–52. Available from: doi: 10.1089/jwh.2010.2062
28. Okyere J, Duodu PA, Aduse-Poku L, Agbadi P, Nutor JJ. Cervical cancer screening prevalence and its correlates in Cameroon: secondary data analysis of the 2018 demographic and health surveys. BMC Public Health [Internet]. 2021;21(1071):1–8. Available from: https://doi.org/10.1186/s12889-021-11024-z
29. Labeit AM, Peinemann F. Determinants of a GP visit and cervical cancer screening examination in Great Britain. PLoS One [Internet]. 2017;12(4):1–14. Available from: https://doi.org/10.1371/journal.pone.0174363%0AEditor:
30. George T J. Factors influencing utilization of cervical cancer screening services among women – A cross sectional survey. Clin Epidemiol Glob Heal [Internet]. 2021;11(February):100752. Available from: https://doi.org/10.1016/j.cegh.2021.100752