

## Vaccine coverage and factors associated with influenza vaccination in the elderly in the city of São Paulo, Brazil: SABE Study 2015

Cobertura vacinal e fatores associados à vacinação contra influenza em pessoas idosas do Município de São Paulo, Brasil: Estudo SABE 2015

Cobertura de vacunación y factores asociados a la vacunación contra la gripe en personas ancianas del municipio de São Paulo, Brasil: Estudio SABE 2015

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### Abstract

*This study evaluated influenza vaccine coverage among elderly individuals ( $\geq 60$  years) living in the city of São Paulo, Brazil, in 2015, and analyzed associated factors. This was a cross-sectional population-based study of data from the SABE Study (Health, Well-Being, and Aging). The dependent variable was influenza vaccination in the 12 months prior to the interview, and the independent variables were sociodemographic and behavioral characteristics, self-reported health status, and use of health services. Data analysis considered the complex study sample, respecting the sampling weight. Poisson's regression was used, with significance set at 5%. Vaccine coverage was 79.7% (95%CI: 76.8-82.5). Influenza vaccination was associated with marital status (PR single/without partner = 0.84; 95%CI: 0.77-0.93), physical activity (PR yes = 1.08; 95%CI: 1.01-1.17), and medical appointment in the previous 12 months (PR yes = 1.22; 95%CI: 1.07-1.39). There were no differences between sociodemographic strata. Influenza vaccination in the elderly had already reached the target for universal coverage in the city of São Paulo. The results are relevant for planning the immunization program, pointing to priority groups to motivate for vaccination and valuing interaction between the elderly and health services.*

*Influenza Vaccines; Aged; Immunization Programs; Vaccination Coverage*

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## Introduction

Influenza is an acute respiratory infection that affects millions of persons yearly, accounting for 290,000 to 650,000 deaths worldwide. Elderly persons constitute one of the highest risk groups for serious illness and complications<sup>1</sup>. Vaccination is the most effective way to prevent the disease and is recommended by the World Health Organization for the elderly, pregnant women, children 6 months to 5 years of age, individuals with chronic conditions/diseases, and health professionals<sup>1,2</sup>.

In Brazil, influenza vaccine has been supplied to the elderly by the National Immunization Program (PNI) since 1999. São Paulo pioneered this move with the city's first influenza vaccination campaign a year before, in 1998. The vaccine applied in the annual seasonal influenza vaccination campaigns is produced by the Butantan Institute and contains 3 viral strains, 2 of which are type A (H1N1/pdm09 e H3N2) and 1 is type B<sup>3</sup>.

The vaccine coverage target set by the Brazilian Ministry of Health was 80% until 2017, after which it was increased to 90%. In the city of São Paulo, administrative data estimate 82% coverage in 2015, with a steady increase in subsequent years, reaching 93.8% in 2019. However, administrative data based on number of doses applied are known to be less accurate than data from vaccination surveys<sup>4</sup>. Nationwide and São Paulo city surveys show vaccine coverage rates of 70%-75% in 2006-2016<sup>5,6,7,8</sup>.

Nationwide studies revealed a scenario in which vaccine coverage was lower among black Brazilians and those with less than 4 years of schooling in 2013<sup>7</sup>, and that the rates did not differ in 2015-2016<sup>8</sup>. Studies in the city of São Paulo showed that influenza vaccination was associated positively with older age, married/with partner marital status, chronic diseases, regular physical activity, and interaction with health services, especially public services, but that they did not differ between social strata<sup>5,6</sup>.

Although previous studies found that universal influenza vaccination was reached in the elderly, the vaccine coverage had not reached the national and international targets, making it necessary to constantly monitor these coverage rates and associated factors. The current study thus aimed to reassess influenza vaccine coverage among elderly residents of the city of São Paulo in 2015 and to verify whether the associated factors remain the same.

## Methods

This was a cross-sectional population-based study on influenza vaccination in elderly residents ( $\geq 60$  years) of the city of São Paulo in 2015.

The city of São Paulo had an estimated population of 11,811,516 in 2019, of which 15.18% belonged to the elderly population. The Municipal Human Development Index in 2010 was 0.805<sup>9</sup>.

The data source was the *Study on Health, Well-Being, and Aging* (SABE 2015), which is a longitudinal multiple cohort study that was started in 2000 and is repeated every five years (2006, 2010, and 2015). Each new wave includes a new cohort of individuals 60 to 64 years of age, aimed at maintaining the representativeness of the study's age brackets. The sample is complex, with a multistage sampling design to allow statistical inference to the non-institutionalized urban population 60 years or older in the city of São Paulo. The primary sampling units were the census tracts, with households as the secondary units. All residents 60 years or older in the selected households were invited to participate in the study.

All individuals who agreed to participate in the study were interviewed in their homes by a specifically trained team. On this occasion a questionnaire was applied that included sociodemographic and behavioral characteristics, quality of life, use of health services, and clinical information. Anthropometric measurements and blood and urine samples were taken. Detailed information on the SABE Study can be consulted in previous publications<sup>10</sup> and on the website (<http://hygeia3.fsp.usp.br/sabe/>).

The dependent variable was the combination of the answers to the questions "Have you ever gotten the flu vaccine?" and "When did you get the flu vaccine?", and the outcome was defined as influenza vaccination in the 12 months prior to the interview.

The independent variables were: sociodemographic characteristics (sex, color, age bracket, schooling, marital status, and whether the person was living alone and working at the time of the

interview); behavioral characteristics (alcohol consumption in the previous 3 months smoking, and physical activity at least 150 minutes a week); self-reported health status (self-rated health, number of chronic diseases, hypertension, diabetes mellitus, cardiovascular disease, chronic lung disease, falls in the previous 12 months, and depression); and use of health services (medical appointments and hospitalization in the 12 months prior to the interview and type of health service).

Data analysis considered the study design's complex sample, respecting the sampling weight, that is, the inverse of the sampling fraction, adjusted for the population's corresponding distribution by sex and age bracket. Analysis used the survey module of Stata 15 (<https://www.stata.com>).

Vaccine coverage rates were calculated (elderly vaccinated against influenza in the last 12 months divided by the total number of elderly) for the total sample and according to the independent variables, using Rao-Scott chi-square test to verify associations.

Crude and adjusted prevalence ratios (PR) were calculated with Poisson regression<sup>11</sup>. Independent variables with p-value less than 0.200 were included in the multivariate model. The modeling process followed a conceptual structure organized in blocks of covariables<sup>12</sup>. The model initially included the sociodemographic variables, adjusted to each other. Next, only sociodemographic variables with p-value less than 0.05 were kept in the model, which adjusted the behavioral variables and self-reported health status. Finally, the model included variables on the use of health services, which were adjusted by the sociodemographic and behavioral variables and self-reported health status with p-value less than 0.05.

The SABE Study 2015 was approved by the Institutional Review Board of the University of São Paulo School of Public Health (CAAE: 47683115.4.0000.5421, Review: 3.600.782). All participants signed the free and informed consent form, and the study followed the ethical procedures of *Resolução n. 466/2012*.

## Results

Of the total of 1,399 elderly individuals that were eligible for the study, 1,224 were interviewed in the SABE Study 2015, with 6.1% of refusals and 6.4% of losses. Among the interviewees, 1,043 (85.2%) had information on whether they had received the influenza vaccine in the previous 12 months, while one failed to answer the question "Have you gotten the flu vaccine?" and 180 did not know when they had been vaccinated. Vaccine coverage was 79.7% (95% confidence interval – 95%CI: 76.8-82.5).

Table 1 shows influenza vaccine coverage according to sociodemographic characteristics in the sample. Vaccine coverage was lower in individuals under 60-69 years of age (69.1%), compared to older elders, and in elders that were single or without a partner (singles, divorcees, and widows/widowers) (71.4%). An important finding was that vaccine coverage rates did not differ between schooling strata ( $p = 0.885$ ).

As for behavioral characteristics (Table 2), elderly who did not practice physical activity at least 150 minutes a week showed a lower proportion of influenza vaccination in the previous 12 months (78.5%), compared to their physically active peers (86%).

Table 3 shows vaccine coverage according to self-reported health status. Elderly individuals that reported depression showed lower vaccination rates (73%).

On use of health services (Table 4), the report of a medical appointment in the previous 12 months was associated positively with influenza vaccination (81.5%).

The multivariate analysis considered variables with p-value less than 0.200, that is: sex ( $p = 0.062$ ); age bracket ( $p = 0.002$ ); marital status ( $p < 0.001$ ); physical activity ( $p = 0.038$ ); diabetes ( $p = 0.159$ ); cardiovascular disease ( $p = 0.071$ ); depression ( $p = 0.031$ ); and medical appointment in the previous 12 months ( $p < 0.001$ ).

Table 5 shows the crude and adjusted prevalence ratios and respective 95%CI for the analysis of the association between such factors and influenza vaccination in the previous 12 months. Sex, age bracket, and self-reported diseases (diabetes, cardiovascular disease, and depression) did not remain in the multivariate model. Influenza vaccination was associated with marital status (PR single/without partner = 0.84; 95%CI: 0.77-0.93), physical activity (PR yes = 1.08; 95%CI: 1.01-1.17); and medical appointment in the previous 12 months (PR yes = 1.22; 95%CI: 1.07-1.39).

**Table 1**

Influenza vaccine coverage in a sample of elderly (N = 1,043) according to sociodemographic characteristics. City of São Paulo, Brazil, 2015.

Sociodemographic characteristics	n	Influenza vaccination	
		Yes (%)	p-value *
Sex			0.062
Male	394	82.5	
Female	649	77.4	
Color			0.505
White	547	79.0	
Non-white	482	80.9	
Age bracket (years)			0.002
60-69	236	69.1	
70-79	498	82.7	
80 or more	309	81.2	
Schooling (years)			0.885
0 - 3	358	78.7	
4 - 7	379	79.7	
8 - 11	198	80.9	
12 or more	105	81.6	
Marital status			< 0.001
Married/With partner	535	86.2	
Without partner	508	71.4	
Lives alone			0.606
Yes	183	78.1	
No	860	80.1	
Employed			0.497
Yes	315	81.1	
No	724	79.1	

Source: SABE Study 2015.

\* Rao-Scott chi-square test.

**Table 2**

Influenza vaccine coverage in a sample of elderly (N = 1,043) according to behavioral characteristics. City of São Paulo, Brazil, 2015.

Behavioral characteristics	n	Influenza vaccination	
		Yes (%)	p-value *
Alcohol consumption in the previous 3 months			0.301
No	726	78.9	
Yes	316	81.6	
Smoking			0.731
Never smoked	539	79.4	
Current or former smoker	501	80.4	
Physical activity (150 minutes/week)			0.038
No	811	78.5	
Yes	215	86.0	

Source: SABE Study 2015.

\* Rao-Scott chi-square test.

**Table 3**

Influenza vaccine coverage in a sample of elderly (N = 1,043) according to self-reported health status. City of São Paulo, Brazil, 2015.

Self-reported health	n	Influenza vaccination	
		Yes (%)	p-value *
Self-rated health			0.382
Good	499	81.3	
Bad	517	78.8	
Number of chronic diseases			0.642
0 - 1	564	80.3	
2 or more	479	79.1	
Hypertension			0.302
No	338	77.9	
Yes	704	80.8	
Diabetes mellitus			0.159
No	749	78.5	
Yes	291	82.6	
Cardiovascular disease			0.071
No	781	81.2	
Yes	259	75.6	
Chronic lung disease			0.240
No	954	78.8	
Yes	86	84.9	
Falls in previous 12 months			0.485
No	723	80.4	
Yes	319	78.5	
Depression			0.031
No	873	80.9	
Yes	164	73.0	

Source: SABE Study 2015.

\* Rao-Scott chi-square test.

**Table 4**

Influenza vaccine coverage in a sample of elderly (N = 1,043) according to health services use. City of São Paulo, Brazil, 2015.

Use of health services	n	Influenza vaccination	
		Yes (%)	p-value *
Medical appointment in previous 12 months			< 0.001
No	106	65.8	
Yes	923	81.5	
Hospitalization in previous 12 months			0.918
No	899	79.8	
Yes	143	79.4	
Type of health service			0.796
Private	306	80.3	
Public	737	79.6	

Source: SABE Study 2015.

\* Rao-Scott chi-square test.

**Table 5**

Crude and adjusted prevalence ratios (PR) for factors associated with influenza vaccination in the elderly (N = 1,043). City of São Paulo, Brazil, 2015.

	Crude PR (95%CI)	Adjusted PR (95%CI)
<b>Sociodemographic characteristics</b>		
Sex		
Male	1.06 (0.99-1.14)	
Female	Reference	
Age bracket (years)		
60   -   69	Reference	
70   -   79	1.19 (1.08-1.33)	
80 or more	1.17 (1.04-1.32)	
Marital status		
Married/with partner	Reference	Reference
Without partner	0.83 (0.76-0.90)	0.84 (0.77-0.93)
<b>Behavioral characteristics and health status</b>		
Physical activity (150 minutes/week) (a)		
No	Reference	Reference
Yes	1.09 (1.02-1.18)	1.08 (1.01-1.17)
Diabetes mellitus (b)		
No	Reference	
Yes	1.05 (0.98-1.12)	
Cardiovascular disease (c)		
No	Reference	
Yes	0.93 (0.86-1.01)	
Depression (d)		
No	Reference	
Yes	0.90 (0.81-1.00)	
<b>Use of health services</b>		
Medical appointment in previous 12 months		
No	Reference	Reference
Yes	1.24 (1.08-1.42)	1.22 (1.07-1.39)

95%CI: 95% confidence interval.

Source: SABE Study 2015.

Note: sociodemographic characteristics were adjusted for each other. Behavioral characteristics of health status were adjusted for sociodemographic characteristics with p-value < 0.05: (a) physical activity and marital status; (b) diabetes mellitus and marital status; (c) cardiovascular disease and marital status; (d) depression and marital status.

Characteristics of health services use were adjusted for sociodemographic and behavioral characteristics with p-value < 0.05: medical appointment in previous 12 months, marital status, and physical activity.

## Discussion

The study showed that influenza vaccine coverage among the elderly in the city of São Paulo in 2015 reached the national and international targets, which were 80% at the time. Factors associated with vaccination were marital status, physical activity, and interaction with health services. Importantly, the vaccination rates did not differ significantly between schooling strata. These were the study's most important results.

Administrative data from the PNI point to 82% coverage of the influenza vaccine in the elderly population in 2015<sup>13</sup>, or a rate quite similar to the current study. This proportion increased steadily, comparing previous assessments in the city by the SABE Study in 2006 (73.8%)<sup>5</sup> and 2010 (74.2%)<sup>6</sup> and compared to studies in other Brazilian cities<sup>14,15,16,17</sup>.

Marital status was associated with influenza vaccination, such that single elders or those without partners showed lower vaccine coverage. This association has been shown in previous studies <sup>15,17</sup>. This finding may express lack of conjugal support in health-related and financial issues <sup>18</sup>. A study that compared the use of health services showed that the odds of hospitalization were higher among unmarried individuals, while the odds of using outpatient services were higher among married individuals <sup>19</sup>. Another study found that persons are more likely to adopt positive health behaviors when spouses/partners also adopt them <sup>20</sup>.

Healthier behaviors are associated with positive health outcomes <sup>21</sup>. Regular physical activity is described as an important marker for the adoption of such behaviors. Many studies have shown that physical activity is positively associated with influenza vaccination <sup>6,7,22,23,24</sup>.

Various studies have identified individual interaction with health services as a predictor of influenza vaccination. Frequent use of health services may result in more access to information on vaccination campaigns and the importance of getting vaccinated, besides helping reduce inequality in access to health <sup>5,6,7,8,14,15,16</sup>.

In many studies, attendance at health service is linked to chronic diseases such as hypertension, diabetes, and cardiovascular and pulmonary diseases <sup>5,6,7,8,15,16</sup>. In the city of São Paulo in 2010, a positive association was seen between influenza vaccination and chronic diseases such as hypertension, diabetes, and cardiovascular disease <sup>6</sup>. Brazilian studies have shown an association between vaccination and the number of chronic diseases <sup>7,8</sup>. The current study did not find an association between vaccination and presence of chronic diseases, suggesting that vaccination activities are more effective, reaching the elderly population as a whole, without inequalities between social strata, and that health services are fulfilling their role in supplying information, without differences between individuals on the basis of whether they attend health units due to chronic conditions.

The persistent lack of inequalities in vaccination between educational strata is an important result of the study, suggesting that the program has already reached universal coverage, a result found in previous studies in the city of São Paulo <sup>6</sup> and in Brazil <sup>8</sup>. Influenza vaccination of the elderly is an important and effective strategy for reducing inequality between social strata in the burden of disease. A study that assessed the impact from influenza vaccination in the city of São Paulo from 1998 to 2002 pointed to a 26.3% drop in mortality from pneumonia and influenza, with the largest reduction in the city's more socially underprivileged areas <sup>25</sup>.

An important strength was that the study analyzed a representative sample of the elderly population in a large metropolis, allowing a more extensive assessment than the inference of vaccine coverage based on the number of doses administered. The use of data from the SABE Study is also a strength, since SABE's standardized methodology allows comparability over time, between the years 2006, 2010, and 2015. The samples' representativeness in all the years allows direct comparison of the studies' results in a ten-year period. The study's main limitation is self-report of information on influenza vaccination, which is subject to recall bias, without documental validation such as by consulting the individual's vaccination card. Self-reported information on vaccination showed high sensitivity (98%) and moderate specificity (71%) in a study of elderly <sup>26</sup>. Other more recent studies corroborate the validity of self-reported data on influenza vaccination in the elderly population <sup>27,28</sup>.

In conclusion, the study provides relevant findings for planning immunization programs, pointing to unmarried and physically inactive elders as a priority for targeting influenza vaccination. The study values the elderly's interaction with health services, noting that individuals who had not interacted even once in the previous year were less likely to be vaccinated. The lack of association with chronic diseases suggests that health services are fulfilling their role of providing information on the influenza vaccine, independently of attending health services for treatment of such conditions. All these results highlight the importance of continuously assessing vaccine coverage rates and associated factors.

## Contributors

A. P. S. Sato, F. B. Andrade and J. L. F. Antunes contributed to the study conception and design, data analysis and interpretation, writing and relevant critical revision of the manuscript's intellectual content, and approval of the version for publication. Y. A. O. Duarte contributed in the study conception and design, writing and relevant critical revision of the manuscript's intellectual content, and approval of the version for publication.

## Additional informations

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## Resumo

O presente estudo avaliou a cobertura da vacina contra influenza entre pessoas idosas (idade de 60 anos ou mais) residentes no Município de São Paulo, Brasil, em 2015, bem como verificou os fatores associados. Trata-se de um estudo transversal de base populacional com dados do Estudo Saúde, Bem-estar e Envelhecimento. A variável dependente foi a vacinação contra influenza nos últimos 12 meses anteriores à entrevista, e as variáveis independentes compreenderam características sociodemográficas, comportamentais, situação de saúde autorreferida e uso de serviços de saúde. Para a análise de dados, considerou-se a amostragem complexa do estudo, respeitando-se o peso amostral. Utilizou-se a regressão de Poisson, com nível de 5% de significância. A cobertura vacinal foi de 79,7% (IC95%: 76,8-82,5). A vacinação contra influenza foi associada a situação conjugal (RP sem companheiro = 0,84; IC95%: 0,77-0,93), prática de atividade física (RP sim = 1,08; IC95%: 1,01-1,17) e consulta médica nos últimos 12 meses (RP sim = 1,22; IC95%: 1,07-1,39). Não houve diferença entre os estratos sociodemográficos. A vacinação de idosos contra influenza já atingiu uma meta de universalidade no Município de São Paulo. Os resultados são relevantes para o planejamento do programa de imunizações, apontando grupos prioritários para motivar a vacinação, e valorizam a interação dos idosos com o serviço de saúde.

Vacinas contra Influenza; Idoso; Programas de Imunização; Cobertura Vacinal

## Resumen

Este estudio evaluó la cobertura de la vacuna de la gripe entre personas ancianas (edad de 60 años o más), residentes en el Municipio de São Paulo, Brasil, en 2015, así como verificó los factores asociados. Se trata de un estudio transversal de base poblacional con datos del Estudio Salud, Bienestar y Envejecimiento. La variable dependiente fue la vacunación contra la gripe en los últimos 12 meses anteriores a la entrevista y las variables independientes comprendieron características sociodemográficas, comportamentales, situación de salud autoinformada y uso de servicios de salud. Para el análisis de datos, se consideró la muestra compleja del estudio, respetando el peso de la muestra. Se utilizó la regresión de Poisson, con un nivel de significancia de un 5%. La cobertura de la vacunación fue de un 79,7% (IC95%: 76,8-82,5). La vacunación contra la gripe estuvo asociada a la situación conyugal (RP sin compañero = 0,84; IC95%: 0,77-0,93), práctica de actividad física (RP sí = 1,08; IC95%: 1,01-1,17) y consulta médica en los últimos 12 meses (RP sí = 1,22; IC95%: 1,07-1,39). No hubo diferencia entre los estratos sociodemográficos. La vacunación de ancianos contra la gripe ya alcanzó una meta de universalidad en el municipio de São Paulo. Los resultados son relevantes para la planificación del programa de inmunizaciones, apuntando grupos prioritarios para la motivación respecto a la vacunación, así como valora la interacción de los ancianos con el servicio de salud.

Vacunas contra la Influenza; Anciano; Programas de Inmunización; Cobertura de Vacunación

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