

## Use of WhatsApp by older adults screened for depression in socioeconomically deprived areas of Guarulhos, São Paulo State, Brazil: challenges and possibilities for telehealth

Uso do WhatsApp por idosos depressivos em áreas socioeconomicamente carentes de Guarulhos, São Paulo, Brasil: desafios e possibilidades para a telessaúde

Uso de WhatsApp por ancianos deprimidos en áreas desfavorecidas socioeconomicamente en Guarulhos, São Paulo, Brasil: retos y posibilidades de la telesalud

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### Abstract

*This study aimed to investigate the relationship between sociodemographic characteristics, depressive symptomatology, mobile phone ownership, and different uses of WhatsApp among older adults enrolled in primary care clinics in Guarulhos, São Paulo State, Brazil. This is a secondary data analysis, using data collected in the screening of participants to be included in the PROACTIVE cluster randomized trial. Individuals aged  $\geq 60$  years, registered in primary care clinics in Guarulhos, were assessed for sociodemographic characteristics, depressive symptoms according to the PHQ-9, mobile phone ownership, and use of WhatsApp. We performed multiple logistic regression models to investigate characteristics of the potential users of digital interventions. Of 3,356 older adults screened for depression, 45.7% said they use WhatsApp to receive/send messages. In the subsample that presented depressive symptomatology ( $n = 1,020$ ), 41.9% stated using WhatsApp. Younger older adults and those with better socioeconomic status used more WhatsApp and were more likely to own a mobile phone. Participants with higher levels of symptoms of depression were less likely to use WhatsApp. Gender, age, schooling level, income, and depressive symptomatology are variables associated with the possession of a cell phone and with the use of WhatsApp by the older adults of the sample. These findings can help to implement digital health programs better suited to disadvantaged populations in Brazil and other low- and middle-income countries through mental telehealth interventions using WhatsApp and mobile health services to the older people.*

*Public Health Informatics; Health Services for the Aged; Depression; Medical Informatics Applications; Telemedicine*

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## Introduction

The high prevalence of depression in older adults <sup>1</sup> and unequal access to treatment leads to challenges in mental health service delivery <sup>2</sup>. The COVID-19 pandemic has created massive disruptions to in-person healthcare worldwide, compromising the treatments for the most vulnerable individuals. An unintended outcome of this is the opportunities of telehealth <sup>3</sup>.

Interactive Health Communication Applications (IHCA) allow individuals to use an electronic device to access or transmit health information or receive guidance. IHCA seem to have positive effects on behavioral and clinical outcomes of chronic patients <sup>4</sup>. The use of WhatsApp as a psycho-educational resource for older people with depression also seems to be a promising strategy <sup>5</sup>. However, further research is needed to determine the most feasible way to deliver IHCA among different groups of patients <sup>4</sup>, and to identify older adults who are most likely to be benefited by these programs <sup>6</sup>.

WhatsApp use is frequent among Brazilians <sup>7</sup>, and it is being increasingly used as a health communication tool in digital mental health programs <sup>4,7</sup>. The widespread of mobile phones in low- and middle-income countries (LMICs) has created an incentive for the use of WhatsApp in primary health care <sup>8</sup>. Thus, a better knowledge of sociodemographic characteristics that may prevent older adults with or without depression to use WhatsApp is needed, as well as the use of mobile phones as a crucial tool to offer better communication strategies to this audience.

This study aimed to investigate the relationship between sociodemographic characteristics, depressive symptomatology, mobile phone ownership, and different uses of WhatsApp among older adults enrolled in primary care clinics in Guarulhos, São Paulo State, Brazil.

## Methods

### Sample and procedure

This is a secondary data analysis using cross-sectional data collected during the recruitment phase of the PROACTIVE cluster randomized controlled trial <sup>9</sup>. The study was approved by the Research Ethics Committee of the School of Medicine, University of São Paulo (n. 2,836,569).

Recruitment and data collection occurred from May 2019 to February 2020 with individuals aged  $\geq 60$  years registered in 20 primary care clinics in Guarulhos. Participants provided verbal or written consent. The Guarulhos Municipal Health Department provided a list with the contacts of all older adults registered in these clinics (n = 37,218). The names in this list underwent a process of pre-check for eligibility, excluding outdated information, duplicated names, wrong age in database, and inconsistent information. After the pre-check for eligibility, the list was randomly ordered among a previously trained team of independent research assistants that were able to establish a first contact by phone or at home with 8,147 people, number sufficient to reach the sample size calculated for the clinical trial. Then, 4,791 were excluded due to problems including non-valid phone number, person not found, exclusion criteria, refusal, and dead individuals. Thus, 3,356 individuals were screened for depression by research assistants <sup>9</sup>.

### Measures

The study used the *Patient Health Questionnaire-9* (PHQ-9) <sup>10</sup> to assess depression, and a cut-off point of 10+ indicated depressive symptomatology, a threshold that has been reported to provide a 91% sensitivity and 88% specificity among individuals aged  $\geq 60$  years <sup>10</sup>. Information on mobile phone ownership and the use of WhatsApp was evaluated through the following questions: "Do you have an own mobile phone?", "Do you send or receive text or audio messages by WhatsApp?", and "Do you watch videos that you receive by WhatsApp?". Personal income was assessed based on Brazilian minimum wage in 2019.

## Statistical analyses

To explore sociodemographic and socioeconomic characteristics associated with the outcome measures (mobile phone ownership and WhatsApp use), multiple logistic regression models were used. Sociodemographic and socioeconomic characteristics collected as part of the pre-registered trial were included as predictors in the models, including age group (60-69, 70-79, and  $\geq 80$  years), gender, personal income ( $\leq 1$ , 1-2, 2-3, and  $> 3$  minimum wages), and schooling level in years (none, 1-4, 5-8, and  $\geq 8$ ). Models estimated in the overall sample also included whether the participant had depressive symptomatology above the threshold. The same set of models were estimated in the depressed subsample (PHQ-9  $\geq 10$ ).

The variance inflation factor (VIF) of the predictors were calculated to assess the existence of multicollinearity. None of the VIFs were greater than ten, suggesting that multicollinearity was not a problem.

Data management and analyses were performed in Stata/MP 16.1 (<https://www.stata.com>).

## Results

Among the 3,356 individuals screened for depression, 1,020 presented depressive symptomatology. Table 1 shows the characteristics of both samples.

Tables 2 and 3 show the results of the multiple logistic regression models. In the overall sample, non-depressive, younger, wealthier, and with more years of schooling older adults were more likely to possess a mobile phone (Table 2, upper section) and to use WhatsApp for messaging or to watch received videos (Table 3, upper section). Mobile phone ownership was similar for women and men, but women were more likely than men to use WhatsApp for sending and receiving messages as well as for watching videos.

Results with the subsample of participants with depressive symptomatology (Table 2 and 3, lower section) did not differ significantly from those with the overall sample, with the exception that, in the depressed subsample, women were more likely than men to possess a mobile phone. In the subsample, older adults with a personal income above 3 minimum wages had higher odds of having a mobile phone (odds ratio – OR = 4.40; 95% confidence interval – 95%CI: 1.57; 12.31), use WhatsApp for messaging (OR = 4.96; 95%CI: 2.08; 11.84), or watch videos received via WhatsApp (OR = 4.99; 95%CI: 2.12; 11.72), than their counterparts with a personal income up to 1 minimum wage. Regarding schooling years, older adults with more than eight years of schooling had higher odds of having a mobile phone than their counterparts with no education (OR = 2.96; 95%CI: 1.65; 5.31), with even larger odds for using WhatsApp for messaging (OR = 8.30; 95%CI: 4.48; 15.38) and watching videos (OR = 6.21; 95%CI: 3.39; 11.38). Regarding age, oldest adults ( $\geq 80$  years old) had lower odds of having a mobile phone (OR = 0.22; 95%CI: 0.13; 0.38), of using WhatsApp for messaging (OR = 0.17; 95%CI: 0.08; 0.35), and of watching videos received via WhatsApp (OR = 0.12; 95%CI: 0.05; 0.28) than their youngest (60-69 years old) counterparts. Finally, women were more likely to have a mobile phone (OR = 1.59; 95%CI: 1.15; 2.20), use WhatsApp for messaging (OR = 2.65; 95%CI: 1.58; 3.80) and watching received videos (OR = 2.36; 95%CI: 1.64; 3.41) than men.

## Discussion

WhatsApp is a widely used application software in the sample, however we found systematic differences in the mobile phone ownership and WhatsApp use among older adults in both samples. In both the overall sample and depressed subsample, lower schooling years, lower income, and higher age were associated with lower odds of having a mobile phone and using WhatsApp. These differences may interfere with equitable access to mental health treatments delivered via IHCA's such as WhatsApp. Women were also more likely to have a mobile phone and to use WhatsApp than men, hence this should be considered when implementing telehealth programs.

**Table 1**

Sample characteristics.

| Characteristics                    | Overall sample (n = 3,356)<br>n (%) | Depressive symptomatology subsample * (n = 1,020)<br>n (%) |
|------------------------------------|-------------------------------------|--|
| Age [mean (SD)]                    | 68.3 (6.7)                          | 68.6 (7.0)   |
| Gender                             |                                     |  |
| Men                                | 1,231 (36.7)                        | 270 (26.5)   |
| Women                              | 2,125 (63.3)                        | 750 (73.5)   |
| Schooling level (years)            |                                     |  |
| None                               | 535 (15.9)                          | 181 (17.7)   |
| 1-4                                | 1,556 (46.4)                        | 504 (49.4)   |
| 5-8                                | 754 (22.5)                          | 209 (20.5)   |
| ≥ 8                                | 491 (14.6)                          | 120 (11.8)   |
| Missing                            | 20 (0.6)                            | 6 (0.6)  |
| Personal income (minimum wages **) |                                     |  |
| ≤ 1                                | 2,100 (62.6)                        | 731 (71.7)   |
| 1-2                                | 648 (19.3)                          | 161 (15.8)   |
| 2-3                                | 233 (6.9)                           | 39 (3.8)   |
| > 3                                | 165 (4.9)                           | 32 (3.1)   |
| Missing                            | 210 (6.3)                           | 57 (5.6)   |
| Has a mobile phone                 |                                     |  |
| No                                 | 1,087 (32.4)                        | 373 (36.6)   |
| Yes                                | 2,251 (67.1)                        | 641 (62.8)   |
| Missing                            | 18 (0.5)                            | 6 (0.6)  |
| Sends/Receives WhatsApp messages   |                                     |  |
| No                                 | 1,801 (53.7)                        | 587 (57.5)   |
| Yes                                | 1,535 (45.7)                        | 427 (41.9)   |
| Missing                            | 20 (0.6)                            | 6 (0.6)  |
| Watches WhatsApp videos            |                                     |  |
| No                                 | 1,945 (58.0)                        | 629 (61.7)   |
| Yes                                | 1,370 (40.8)                        | 378 (37.1)   |
| Missing                            | 41 (1.2)                            | 13 (1.3)   |

SD: standard deviation.

\* Depressive symptomatology subsample included participants in the overall sample with PHQ-9 scores ≥ 10;

\*\* Minimum wage: BRL 998 (~ USD 197).

In the literature, age, education, and income are inversely associated with internet access and use of the internet for telehealth <sup>11,12</sup>. In this sense, research should be conducted in different contexts and cultures, focusing on identifying the groups most vulnerable to exclusion from telehealth-based interventions to address these inequalities <sup>12</sup>.

This study has limitations. First, the research was conducted with older adults registered in primary care clinics in Guarulhos, so it may not be generalizable to other cities in Brazil. Second, we collected information on personal income, which may not capture people's economic situation as adequately as family or household income measures. Due to the cross-sectional design of our study, no directionality can be inferred from these results. Also, as a secondary data analysis, we could only consider the sociodemographic and socioeconomic variables included in the original protocol. On the other hand, this study provided information on a socioeconomically deprived population within an upper-middle-income economy, which may help closing the treatment gap in the future, especially for the most vulnerable populations.

**Table 2**

Results of the multiple logistic regression models performed in the overall sample and depressive symptomatology subsample for the information regarding having a mobile phone.

|   | Outcome: has mobile phone |         |
|---|---------------------------|---------|
|   | OR (95%CI)                | p-value |
| <b>Overall sample (including PHQ-9 screening)</b>       |                           |         |
| PHQ-9 screening   |                           |         |
| ≥ 10  | 0.84 (0.71; 1.00)         | 0.044   |
| Gender (reference: men)                                 |                           |         |
| Women   | 1.15 (0.97; 1.37)         | 0.113   |
| Age in years (reference: 60-69)                         |                           |         |
| 70-79   | 0.52 (0.44; 0.62)         | < 0.001 |
| ≥ 80  | 0.26 (0.19; 0.35)         | < 0.001 |
| Personal income in minimum wages * (reference: ≤ 1)     |                           |         |
| 1-2   | 1.31 (1.06; 1.61)         | 0.012   |
| 2-3   | 2.02 (1.40; 2.92)         | < 0.001 |
| > 3   | 2.24 (1.44; 3.48)         | < 0.001 |
| Schooling level in years (reference: none)              |                           |         |
| 1-4   | 1.84 (1.49; 2.28)         | < 0.001 |
| 5-8   | 2.27 (1.76; 2.94)         | < 0.001 |
| ≥ 8   | 3.63 (2.62; 5.04)         | < 0.001 |
| Model fit: pseudo-R <sup>2</sup>                        | 0.081                     |         |
| <b>Depressive symptomatology subsample (PHQ-9 ≥ 10)</b> |                           |         |
| Gender (reference: men)                                 |                           |         |
| Women   | 1.59 (1.15; 2.20)         | 0.006   |
| Age in years (reference: 60-69)                         |                           |         |
| 70-79   | 0.52 (0.38; 0.71)         | < 0.001 |
| ≥ 80  | 0.22 (0.13; 0.38)         | < 0.001 |
| Personal income in minimum wages * (reference: ≤ 1)     |                           |         |
| 1-2   | 0.95 (0.65; 1.40)         | 0.800   |
| 2-3   | 2.31 (0.97; 5.49)         | 0.058   |
| > 3   | 4.40 (1.57; 12.31)        | 0.005   |
| Schooling level in years (reference: none)              |                           |         |
| 1-4   | 1.78 (1.23; 2.58)         | 0.002   |
| 5-8   | 2.52 (1.57; 4.03)         | < 0.001 |
| ≥ 8   | 2.96 (1.65; 5.31)         | < 0.001 |
| Model fit: pseudo-R <sup>2</sup>                        | 0.086                     |         |

95%CI: 95% confidence interval; OR: odds ratio; PHQ-9: *Patient Health Questionnaire-9*.

\* Minimum wage: BRL 998 (~ USD 197).

We investigated a population with approximately 60% of people with low level of formal education and personal income. Even in this context, being in the most disadvantaged group was negatively associated with mobile phone ownership and use of WhatsApp. Furthermore, individuals identified with depressive symptomatology were less likely to possess a mobile phone and use WhatsApp compared to the overall sample.

This study concludes that gender, age, schooling level, income, and depressive symptomatology are variables that are associated with the possession of a cell phone and with the use of WhatsApp by the studied older adults. Further studies on this topic are needed to empower these preliminary findings and enlarge it to a broader population.

**Table 3**

Results of the multiple logistic regression models performed in the overall sample and depressive symptomatology.

|   | Outcome: uses WhatsApp for messaging |         | Outcome: watches videos received via WhatsApp |         |
|---|--------------------------------------|---------|---|---------|
|   | OR (95%CI)                           | p-value | OR (95%CI)                                    | p-value |
| <b>Overall sample (including PHQ-9 screening)</b>       |                                      |         |   |         |
| PHQ-9 screening   |                                      |         |   |         |
| ≥ 10  | 0.84 (0.71; 1.00)                    | 0.045   | 0.84 (0.70; 0.99)                             | 0.040   |
| Gender (reference: men)                                 |                                      |         |   |         |
| Women   | 1.88 (1.58; 2.25)                    | < 0.001 | 1.78 (1.49; 2.13)                             | < 0.001 |
| Age in years (reference: 60-69)                         |                                      |         |   |         |
| 70-79   | 0.43 (0.36; 0.52)                    | < 0.001 | 0.47 (0.39; 0.57)                             | < 0.001 |
| ≥ 80  | 0.17 (0.11; 0.25)                    | < 0.001 | 0.16 (0.10; 0.26)                             | < 0.001 |
| Personal income in minimum wages * (reference: ≤ 1)     |                                      |         |   |         |
| 1-2   | 1.19 (0.97; 1.45)                    | 0.092   | 1.13 (0.92; 1.38)                             | 0.253   |
| 2-3   | 1.82 (1.33; 2.51)                    | < 0.001 | 1.66 (1.21; 2.26)                             | 0.002   |
| > 3   | 2.37 (1.62; 3.46)                    | < 0.001 | 1.96 (1.36; 2.83)                             | < 0.001 |
| Schooling level in years (reference: none)              |                                      |         |   |         |
| 1-4   | 2.53 (1.96; 3.27)                    | < 0.001 | 2.40 (1.85; 3.13)                             | < 0.001 |
| 5-8   | 4.52 (3.41; 5.99)                    | < 0.001 | 3.72 (2.79; 4.97)                             | < 0.001 |
| ≥ 8   | 8.39 (6.05; 11.62)                   | < 0.001 | 7.47 (5.40; 10.33)                            | < 0.001 |
| Model fit: pseudo-R <sup>2</sup>                        | 0.142                                |         | 0.122   |         |
| <b>Depressive symptomatology subsample (PHQ-9 ≥ 10)</b> |                                      |         |   |         |
| Gender (reference: men)                                 |                                      |         |   |         |
| Women   | 2.65 (1.85; 3.80)                    | < 0.001 | 2.36 (1.64; 3.41)                             | < 0.001 |
| Age in years (reference: 60-69)                         |                                      |         |   |         |
| 70-79   | 0.40 (0.29; 0.57)                    | < 0.001 | 0.43 (0.31; 0.61)                             | < 0.001 |
| ≥ 80  | 0.17 (0.08; 0.35)                    | < 0.001 | 0.12 (0.05; 0.28)                             | < 0.001 |
| Personal income in minimum wages * (reference: ≤ 1)     |                                      |         |   |         |
| 1-2   | 0.95 (0.63; 1.42)                    | 0.798   | 0.84 (0.55; 1.26)                             | 0.393   |
| 2-3   | 1.88 (0.91; 3.91)                    | 0.090   | 1.60 (0.78; 3.28)                             | 0.198   |
| > 3   | 4.96 (2.08; 11.84)                   | < 0.001 | 4.99 (2.12; 11.72)                            | < 0.001 |
| Schooling level in years (reference: none)              |                                      |         |   |         |
| 1-4   | 2.89 (1.81; 4.63)                    | < 0.001 | 2.27 (1.42; 3.65)                             | 0.001   |
| 5-8   | 5.74 (3.38; 9.77)                    | < 0.001 | 4.27 (2.51; 7.25)                             | < 0.001 |
| ≥ 8   | 8.30 (4.48; 15.38)                   | < 0.001 | 6.21 (3.39; 11.38)                            | < 0.001 |
| Model fit: pseudo-R <sup>2</sup>                        | 0.156                                |         | 0.139   |         |

95%CI: 95% confidence interval; OR: odds ratio; PHQ-9: *Patient Health Questionnaire-9*.

\* Minimum wage: BRL 998 (~ USD 197).

These findings can help to implement digital health programs better suited to disadvantaged populations in Brazil and other LMIC, especially mental telehealth interventions using WhatsApp and mobile health services for older adults.

## Contributors

F. A. Moretti contributed to the study conception, data analysis and interpretation, writing and review, and approved the final version of the manuscript. M. Scazufca contributed to the study conception, writing and review, and approved the final version of the manuscript. C. A. Nakamura contributed to the study conception, data analysis, and review, and approved the final version of the manuscript. C. H. Q. Souza contributed with the writing and review and approved the final version of the manuscript. N. Seward contributed with the writing and review, statistical analysis, and approved the final version of the manuscript. R. Araya contributed to the study conception, review, and approved the final version of the manuscript. D. Moreno-Agostino contributed to the study conception, statistical analyses, data analyses, writing and review, and approved the final version of the manuscript.

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## Resumo

*Este estudo teve como objetivo investigar a relação entre características sociodemográficas, sintomatologia depressiva, posse de telefone celular e diferentes usos do WhatsApp entre idosos cadastrados em unidades básicas de saúde de Guarulhos, São Paulo, Brasil. Trata-se de uma análise de dados secundários com informações coletadas na triagem dos participantes a serem incluídos neste estudo randomizado em cluster PROATIVO. Indivíduos com 60 anos ou mais, cadastrados em unidades básicas de saúde de Guarulhos, foram avaliados quanto a características sociodemográficas, sintomas depressivos, de acordo com o PHQ-9, posse de telefone celular e uso do WhatsApp. Foram utilizados modelos de regressão logística múltipla para investigar as características dos potenciais usuários de intervenções digitais. Dos 3.356 idosos depressivos, 45,7% usavam o WhatsApp para receber/enviar mensagens. Na subamostra que apresentou sintomatologia depressiva (n = 1.020), 41,9% disseram usar o WhatsApp. Adultos mais jovens e com melhor status socioeconômico usavam mais o WhatsApp e eram mais propensos a possuir um telefone celular. Participantes com níveis mais altos de sintomas de depressão eram menos propensos a utilizar o WhatsApp. Sexo, idade, escolaridade, renda e sintomatologia depressiva são variáveis associadas à posse de telefone celular e ao uso do WhatsApp pelos idosos da população estudada. Esses achados podem ajudar a implementar programas de saúde digital mais adequados para populações desfavorecidas no Brasil e em outros países de baixa e média renda, principalmente intervenções de telessaúde mental que utilizem o WhatsApp e serviços móveis de saúde para idosos.*

*Informática em Saúde Pública; Serviços de Saúde para Idosos; Depressão; Aplicações da Informática Médica; Telemedicina*

## Resumen

*Este estudio tuvo como objetivo determinar la relación entre las características sociodemográficas, los síntomas depresivos, la tenencia de teléfono celular y los diferentes usos de WhatsApp entre los ancianos inscritos en unidades básicas de salud en Guarulhos, São Paulo, Brasil. Este es un análisis de datos secundarios, que recopiló la información del triaje de los participantes a ser incluidos en este estudio aleatorio en un clúster PROACTIVO. Se evaluaron las características sociodemográficas, los síntomas depresivos según el PHQ-9, la tenencia de celular y el uso de WhatsApp de los participantes de 60 años o más, registrados en unidades básicas de salud de Guarulhos. Se utilizaron los modelos de regresión logística múltiple para identificar las características de los potenciales usuarios de las intervenciones digitales. De los 3.356 ancianos deprimidos, el 45,7% utilizaba WhatsApp para recibir/enviar mensajes. En la submuestra que presentó síntomas depresivos (n = 1.020), el 41,9% dijo usar WhatsApp. Los adultos más jóvenes con mejor nivel socioeconómico usaban más WhatsApp y tenían más probabilidades de tener un teléfono celular. Los participantes con niveles más altos de síntomas de depresión tenían menos probabilidades de usar WhatsApp. El sexo, la edad, la educación, la renta y los síntomas depresivos fueron las variables asociadas a la tenencia de celular y al uso de WhatsApp por parte de los ancianos de la población estudiada. Estos hallazgos pueden ayudar a implementar programas de salud digital que sean más adecuados para las poblaciones desfavorecidas en Brasil y en otros países de bajos y medianos ingresos, en particular las intervenciones de telesalud mental que utilizan WhatsApp y servicios de salud móviles para ancianos.*

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