Numeracy and Preventive Health Care Service Utilization Among Middle Aged And Older Adults In The U.S.

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Publication date: May 7, 2018 (online first) in Clinical Gerontologist.

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This project has been partially funded by the American Institutes for Research through a contract with the National Center for Education Statistics (NCES) of the U.S. Department of Education. This report is based on PIAAC data released in October 2016. The views expressed in this paper do not necessarily reflect the views or policies of the American Institutes for Research, National Center for Education Statistics, or the U.S. Department of Education, nor does mention of trade names, commercial products, or organizations imply their endorsement by the U.S. Government. Also, the research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Grant R305A170183 to Miami University and the University of Maryland, Baltimore County. The opinions expressed are those of the authors and do not represent views of the Institute or the U.S. Department of Education.

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Abstract

Objectives: Determine whether a specific numeracy skill cut-point(s) reflects an empirical threshold in the context of preventive health service utilization, and identify associations between numeracy and preventive health services utilization among middle-aged and older adults in the United States.

Methods: A nationally representative sample (n = 2,989) of adults 45-years and older from the International Assessment of Adult Competencies (PIAAC) was analyzed. Binary logistic regression was used to examine the utilization of dental checkup, vision screening, influenza vaccination, and osteoporosis screening, using multiple numeracy level classifications.

Results: A dichotomous classification of numeracy skill levels (low vs. moderate to high proficiency) was associated with dental checkup utilization, but vision screening, influenza vaccination, and osteoporosis screening.

Conclusions: Middle-aged and older adults with sufficient numeracy skills are more likely to have had a dental check up in the past 12-months. Findings suggest that numeracy may be more relevant for long-term vs. short-term risk assessment in determining preventive health care service utilization.

Clinical Implications: Two-level numeracy categories are recommended in preventive health contexts. Numeracy proficiency-sensitive risk communication by health care providers and education programs may enhance awareness of preventive health care and promote the utilization of specific preventive health service utilization among older adults.

Key words: health literacy; quantitative literacy; prevention; aging

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Introduction

Health literacy --- broadly defined as a set of skills for one to obtain, process, and understand health information to maintain/promote one' health and to navigate complex health care systems (Berkman, Sheridan, Donahue, Halpern, & Crotty, 2011) --- is recognized as an important factor in preventive health care utilization. The general basic skills that compose health literacy include reading, writing, speaking, and numeracy competencies (Lipkus & Peters, 2009; Yamashita & Kunkel, 2015). However, existing research has yet to rigorously examine a key health literacy component --- quantitative skills (i.e., numeracy) (U.S. Department of Health and Human Services, 2010) in a preventive health context (Bennett, Chen, Soroui, & White, 2009; Berkman et al., 2011). Additionally, specific thresholds (e.g., categorical cut-points) for these proficiency levels have yet to be established in empirical studies on preventive health care utilization (Paasche-Orlow & Wolf, 2007). A next logical step to advance current knowledge surrounding health literacy is to examine associations between health behaviors and numeracy, and to identify potentially meaningful cut-points in numeracy levels (Ancker & Kaufman, 2007; Berkman et al., 2011; Kim & Han, 2016).

Numeracy and Preventive Health Behaviors

Numeracy is defined as "the ability to access, use, interpret, and communicate mathematical information and ideas, to engage in and manage mathematical demands of a range of situations in adult life" (National Center for Education Statistics, 2012, p. 1). Numeracy, in the context of health, reflects the set of skills for the "productive use of quantitative health information" (Ancker & Kaufman, 2007, p. 713), which enable individuals to seek reliable

information and make correct interpretations and optimal health-related decisions (Reyna & Brainerd, 2007). In terms of literacy/numeracy measurement in the context of health, commonly used assessment tools include The Test of Functional Health Literacy in Adults (TOFHLA: Parker, Baker, Williams, & Nurss, 1995), the Rapid Estimates of Adult Literacy in Medicine (REALM: Davis et al., 1993) and the Newest Vital Sign (Weiss et al., 2005). These instruments have been developed and primarily used in the hospital/health care settings. In national surveys such as the National Assessment of Adult Literacy (NAAL), Adult Literacy and Life Skills Study (IALS) and the Program for the International Assessment of Adult Competencies (PIAAC), a series of domain specific assessment items are implemented to assess general literacy, numeracy, and other competency indicators (e.g., problem-solving skills) (National Center for Education Statistics, 2016). For example, respondents read line graphs and a thermometer in multiple units and are asked to interpret the numeric data (see National Center for Education Statistics, 2018 for more examples)). These national survey-based measures are not designed specifically for a health context, but they are closely linked to health literacy.

Numeracy skills are thought to be crucial for preventive health care decisions and behaviors, because such skills are needed for individuals to estimate risks and benefits and make related decisions regarding behavior modification based on an array of quantitative health information. For example, numeracy drives one's perception concerning risks and benefits of preventive health behaviors in everyday life (e.g., nutrition labels, portion size, chronic disease risk factors) as well as health care settings (e.g., self-management, blood pressure and glucose levels) (Cavanaugh, Huizinga, Wallston, & et al., 2008; Rothman et al., 2006).

Numeracy can be considered an asset or a risk based on one's skills (Nutbeam, 2008; Reyna & Brainerd, 2007). Individuals with relatively low numeracy skills may misunderstand

and/or misinterpret basic health information (e.g., nutrition labels), medication dosage instructions, and medical statistics (e.g., risks associated with a certain behavior, health condition, or medical procedure) (Berkman et al., 2011; Kim & Han, 2016). The uneven distribution of numeracy skills across social divides (e.g., race, sex, and socioeconomic status) has given rise to the concern for increased health disparities (Bennett et al., 2009; Reyna, Nelson, Han, & Dieckmann, 2009). Yet, individuals are increasingly expected to take charge of their own health and health care decisions, which may make those with poor numeracy skills exceptionally vulnerable or especially dependent on health care professionals (Gaglio, Glasgow, & Bull, 2012).

While numeracy remains understudied, health literacy, in general, has been linked to preventive health behaviors. For example, health literacy has been shown to be associated with knowledge of preventive health care services, such as cancer screenings (Morris et al., 2013; Peterson, Dwyer, Mulvaney, Dietrich, & Rothman, 2007), and to be a good predictor of influenza and pneumococcal vaccination, dental checkups, and mammograms (Bennett et al., 2009; Scott, Gazmararian, Williams, & Baker, 2002). At the same time, some studies have shown health literacy to have no association with preventive health behaviors such as smoking and seatbelt use (Wolf, Gazmararian, & Baker, 2007) and physical activity (Fernandez, Larson, & Zikmund-Fisher, 2016). However, few studies disentangle specific health literacy components, and there are no previous studies that focus specifically on numeracy. Thus, the current study fills a major gap in this literature by providing some of the first nationally representative evidence on numeracy and preventive health care service utilization.

Conceptual Framework

The current study was informed by two distinct conceptual frameworks. First, Andersen's (1995) behavioral model was used to identify and organize relevant preventive health care

service utilization factors. Andersen's model has been extensively used as a framework to depict complex theoretical pathways to health care utilization as well as health outcomes (see Babitsch, Gohl, & von Lengerke, 2012 for a relevant review). Andersen's model is useful for distinguishing between predisposing (e.g., age, sex, race, and education), enabling (e.g., health insurance), and need (e.g., health status) factors in the context of health care service utilization. Second, Lipkus and Peters' (2009) medical decision-making framework was adopted to situate numeracy within Andersen's (1995) enabling factors. This medical decision-making framework connects the roles of numeracy, relevant factors and heath decisions/behaviors outcomes in a theoretical sequence, as well as illustrates the interactions between them. Specifically, Lipkus and Peters' (2009) framework illustrates that numeracy is relevant for information seeking, comprehension, interpretation, and decision-making in terms of quantitative health information, as numeracy skills differentiate the ways in which individuals initially perceive and process quantitative information as it relates to health-related decisions. In conjunction, numeracy is viewed as promoting preventive health care service utilization.

Research Questions and Hypotheses

The current study was designed around two research questions. First, the association between preventive health care utilization and numeracy is likely non-linear (Paasche-Orlow & Wolf, 2007; Wolf et al., 2007). Therefore, continuous numeracy measures may be inadequate for use in statistical analyses. Thus, a strategy to analyze numeracy skills with a categorical measures (e.g., skill levels) is needed, but relative cut-points have yet to be examined to determine whether there is a threshold effect. Thus, the first research question is concerned with identifying a numeracy threshold in the context of preventive health care utilization. The second research question focuses on identifying associations between preventive health care service

utilization and numeracy in a multivariate framework that accounts for predisposing, enabling, and need factors (Andersen, 1995; Lipkus & Peters, 2009).

R1: What cut-point(s) reflects a threshold for numeracy skills in the context of preventive health care service utilization?

H1: Given a lack of existing theory and previous research, the first research question is empirically driven, and, thus, lacking detailed hypotheses. It is expected that numeracy based on categorical measurement is a better predictor of preventive health care utilization compared to numeracy based on continuous measurement (Paasche-Orlow & Wolf, 2007; Wolf, Feinglass, Thompson, & Baker, 2010).

R2: Is numeracy associated with preventive health care service utilization after accounting for predisposing, enabling, and need factors?

H2: Previous research regarding health literacy and preventive health behaviors is limited, and findings are mixed (Bennett et al., 2009; Fernandez et al., 2016; Scott et al., 2002). Moreover, numeracy represents a key component of health literacy that has yet to be disentangled (U.S. Department of Health and Human Services, 2010). Additionally, numeracy is recognized as being essential for many different types of health-related decisions (Berkman et al., 2011). Thus, it is expected that numeracy is positively associated with preventive health care service utilization.

Methods

Data

The 2012/2014 Programme for the International Assessment of Adult Competencies (PIAAC) (Rampey et al., 2016) was utilized, which includes nationally representative data on adult competency indicators, and social, demographic, and health care service utilization

information for individuals between the ages of 16 and 74-years old (Rampey et al., 2016). Prior to this survey, nationally representative data on adult numeracy and literacy in the U.S. had not been collected since the 2003 National Assessment of Adult Literacy (NAAL) (Kutner, Greenburg, Jin, Paulsen, & White, 2006). Thus, the PIAAC data provides a unique opportunity to evaluate numeracy thresholds in the context of preventive health care service utilization. The present study focuses on middle-aged and older adults in the U.S., and the analytic sample is restricted to respondents aged 45-years and older. The initial sample size was 3,279. Missing cases (n = 290, 8.84%) were listwise deleted, which resulted in a final analytic sample of 2,989 respondents.

Measures

Outcome variables: Preventive health care service utilization

Four preventive health care services that are generally applicable for middle-aged to older adults were considered as outcome variables, and they include ***dental checkup***, ***vision screening***, ***influenza vaccination***, and ***osteoporosis screening***. A series of dichotomous indicators were used to reflect whether the specific service was, or was not, utilized in the year prior to the survey date.

Predisposing factors

Age was measured with the use of six age groups that span approximately 5-years each (i.e., 45-49, 50-54, 55-59, 60-65, 66-70, and 71-74). These age groups were provided in the PIAAC public use file, which does not include a continuous age measure. ***Sex*** included options for male and female. ***Race/ethnicity*** was dichotomized to reflect whether a respondent identified as non-Hispanic white or some other race/ethnicity. ***Education***, due to a skewed distribution, was dichotomized to indicate whether a respondent has a college education (e.g., associate's degree

or higher) versus less than a college education. ***Employment status*** indicates whether the respondent had worked for pay—full or part-time—at the time of the survey or not. ***Number of household members*** was also accounted for.

Enabling factors

Numeracy skills were defined in the PIAAC as "the ability to access, use, interpret, and communicate mathematical information and ideas, in order to engage in and manage the mathematical demands of a range of situations in adult life" (PIAAC Numeracy Expert Group, 2009, p. 14). Numeracy assessment focused on the four domains of numerate behaviors: contexts, responses, mathematical content, and representations. Similar measurement approaches have been employed in previous national literacy assessments (e.g., NAAL). Numeracy scores were derived by the PIAAC based on ten plausible values, with a possible range from 0 to 500, where higher scores reflect greater numeracy skills. The plausible values were derived from a series of statistical analyses (e.g., item response theory scaling and a latent regression model with the respondents' background information) using the numeracy assessment results (OECD, 2016). PIAAC, based on this continuous numeracy measure, also classified respondents into 6 numeracy skill categories (i.e., Below Level 1, Level 1, Level 2, Level 3, Level 4, and Level 5). These levels were determined based on the difficulty in each assessment item and performance of the respondents (OECD, 2016). However, a 5-level measure that combined the upper two levels (i.e., Level 4 and 5) was utilized due to an insufficient sample size. Additionally, a 3-level classification [i.e., low proficiency (Below Level 1 and Level 1); moderate proficiency (Level 2 and Level 3); and high proficiency (Level 4 and Level 5)] (see Soroui, 2017), and a dichotomous classification [i.e., low proficiency (Below Level 1 and Level 1); moderate to high proficiency (Level 2 and above)] were also evaluated.

A measure for ***general literacy skills*** (hereafter simply referred to as literacy) was included as a covariate (Goodman, Finnegan, Mohadjer, Krenzke, & Hogan, 2013). Literacy scores were derived by the PIAAC based on ten plausible values, with a possible range from 0 to 500, and, as with the numeracy measure, continuous, 5-level, 3-level, and dichotomous classifications were evaluated. A measure for ***use of numeracy skills at home*** was included as a covariate, and this measure is based on quintiles that indicate frequency of use (i.e., 0 = no use, to 5 = most frequent use). Furthermore, an indicator variable was used to denote whether a respondent has ***health insurance***.

Need factors

A dichotomous ***self-rated health*** measure was constructed based on an original 5-point scale (i.e., 0 = fair or poor health, and 1 = good or better health), given an insufficient sample size in the "poor" health category.

Analytic approach

The current analytic approach was limited to available applications provided in the IDB Analyzer version 4.0.14, which provides algorithms to incorporate the set of ten plausible values and sampling weights to estimate representative figures with PIAAC data (IEA, 2017). The IDB analyzer is a desktop application that generates macro programs for commonly used statistical packages including (e.g., SAS and SPSS) according to the analysis (i.e., statistical model) of interest. First, the four different proficiency level classifications for numeracy and literacy skills (i.e., continuous, 5-level, 3-level, and dichotomous) were evaluated for a threshold effect in their association with each of the preventive health care services, respectively. Next, descriptive statistics were computed by each of the preventive health care services, and unconditional logistic regression models were used to identify associations between each outcome, numeracy,

literacy, and all other variables of interest, respectively. Given existing limitations in the IDB Analyzer, more conventional approaches (e.g., chi-square test) were unavailable.

A stepped modeling approach was used to examine the association between preventive health care utilization and numeracy in a multivariate framework. First, unconditional binary logistic regression was used to respectively model each of the four preventive health care measures as a function of numeracy (Model 1) and literacy (Model 2), independently. Next, all covariates (i.e., predisposing, enabling, and need factors) were simultaneously inserted into the model to examine their impact on the association between preventive health care service utilization and numeracy (Model 3). The PIAAC final sample weight (SPFWT0) and 80 replicate weights (SPFWT1-SPFWT80) were applied in all analyses. Statistical significance was evaluated at the 0.05 level.

Results

An evaluation of the four different numeracy and literacy proficiency level classifications (i.e., continuous, 5-level, 3-level, and dichotomous) indicated that the dichotomous classification was the most appropriate. Specifically, the continuous numeracy and literacy classifications were highly correlated with one another ($r = 0.88$, $p < 0.05$), and multicolleniarity (i.e., VIF > 4) prevented these two classifications from being simultaneously included in a single model. Additionally, neither the 5-level nor the 3-level numeracy or literacy classifications were associated with any of the preventive health care services. However, the dichotomous classifications were associated with at least some of the preventive health care services. Therefore, the dichotomous numeracy and literacy proficiency level classification (i.e., low proficiency vs. moderate to high proficiency) was employed.

Weighted descriptive statistics and results from bivariate significance tests are shown in Table 1. The most commonly utilized preventive health care services were dental (67.37%) and vision screening (62.28%). Nearly half of the sample (49.71%) received an influenza vaccination in the year prior to the survey, and approximately one-quarter (25.10%) of respondents had an osteoporosis screening. Overall, age, sex, education, and insurance are consistently associated with each of the four preventive health care services, respectively. Other associations with the four preventive health care services are mixed. Race was only associated with dental checkups and osteoporosis screenings. Whereas employment status was not associated with vision screening, and self-rated health was not associated with having had an influenza vaccination. Numeracy was associated with having had a dental checkup and osteoporosis screening, respectively. Whereas literacy was only associated with having had a dental checkup.

Table 2 through 5 show the results from binary logistic regression models used to predict each of the four preventive health services, respectively. The unconditional models show that individuals with moderate to high numeracy skills were 156% more likely to have had a dental checkup (see Table 3) and 22% less likely to have had an osteoporosis screening (see Table 5) compared to those with low numeracy skills. Furthermore, those with moderate to high literacy skills were 133% more likely to have had a dental checkup (see Table 3). When numeracy and literacy skills were considered simultaneously along with all other covariates, only dental checkups remain statistically significantly associated with numeracy skills (OR = 1.41, $p < 0.05$). In other words, individuals with moderate to high numeracy skills are 41% more likely to have had a dental checkup in the year prior to the survey date, even after accounting for predisposing, enabling, and need factors, as well as general literacy skills.

Discussion

The two aims of this paper were to (1) determine whether a specific cut-point(s) of numeracy measures reflects an empirical threshold in the context of preventive health care service utilization, and (2) to identify associations between numeracy and utilization of specific preventive health care service among middle-aged and older adults in the United States. With respect to the first aim, previous findings regarding numeracy thresholds are mixed and generally based on analyses of non-representative data (Paasche-Orlow & Wolf, 2007). As such, the PIAAC data provided a unique opportunity to examine numeracy thresholds among a nationally representative sample of middle-age and older adults. We identified that a low versus moderate to high threshold was more useful to predict preventive health care utilization. With respect to the second aim, while numeracy is recognized to play a key role in many health-related decisions, associations between numeracy and preventive health care service utilization remain largely unknown (Berkman et al., 2011). Our findings show that numeracy is a strong predictor of having had a dental checkup in the past year, but it is not predictive of having had a vision screening, influenza vaccination, or osteoporosis screening after accounting for theoretically meaningful factors (Andersen, 1995; Lipkus & Peters, 2009).

In regard to the first research question, the potentially meaningful cut-point between low and moderate to high numeracy may be useful for informing future research and identifying vulnerable populations. While the approach taken in the current study was empirically driven, numeracy thresholds were tested for each specific preventive health care service. In general, health literacy thresholds differ across outcomes (Wolf et al., 2010), and present findings do support a threshold versus gradient effect for numeracy in terms of preventive health care service utilization. Moreover, thresholds have often been defined out of statistical necessity, because many studies have simply lacked the statistical power to detect potential differences among

numeracy categories (Berkman et al., 2011). Thus, the current study adds to the applicability of a threshold approach by providing nationally representative empirical evidence.

In regard to the second research question, there are at least two explanations for the association between having had a dental checkup and numeracy. First, in view of the enabling context in which numeracy was situated (Andersen, 1995; Lipkus & Peters, 2009), it is possible that the perceived risk of dental issues differs between those with low versus moderate to high numeracy skills (Cavanaugh et al., 2008; Kim & Han, 2016). Indeed, enabling factors may be a necessary resource for, but not always a robust predictor of, health care utilization. Specifically, when enabling and need factors are considered in conjunction, individuals with low numeracy may not seek health care until experiencing a serious health problem. Whereas those with relatively greater numeracy may be more likely to take a proactive approach (e.g., preventive care) due to adequate risk assessment and perception (Berkman et al., 2011).

Second, in light of both the statistically significant and non-significant associations, the type of preventive health care service needs further consideration. For example, the influenza vaccination prevents against a single, and relatively short-term, risk that generally occurs during a specific time of year, whereas dental health reflects a long-term risk that is ongoing. Furthermore, both vision and osteoporosis screenings are possibly more need-driven, in general, compared to dental care. In other words, the influenza vaccination, vision screening, and osteoporosis screening are potentially reactive behaviors (e.g., influenza epidemic, sudden vision deterioration, and bone fractures). Thus, numeracy may be more relevant for long-term, compared to short-term, risk assessment in determining preventive health care service utilization. The association between numeracy and dental health and dental health care utilization requires future attention (Nelson, Reyna, Fagerlin, Lipkus, & Peters, 2008; Reyna et al., 2009).

Limitations

Possible omitted variable bias needs to be considered, as traditional sociodemographic measures, such as marital status and income were not available in the PIAAC. As such, we made use of alternative measures, such as number of house hold members and employment status. Additionally, need factors (e.g., health status measures) were limited to self-rated health, and it would have been ideal to have measures for specific factors such as dental health problems and vision issues. Furthermore, while much of the present study was framed and discussed in the context of health literacy, the numeracy and literacy measures utilized in this study do not specifically reflect "health literacy." While these basic skills represent the basis of health literacy, findings should be interpreted with caution in comparison to previous studies that specifically examined health literacy (Berkman et al., 2011).

Contribution to the literature and practice

We advanced current knowledge by (a) empirically identifying a potentially meaningful threshold in numeracy skills, and (b) examining detailed associations between utilization of specific preventive health care services and numeracy among a nationally representative sample of middle-aged and older adults (Berkman et al., 2011). Given the limited nationally representative data on, and the non-linear relationship between, numeracy and preventive health behaviors, the identification of a low versus moderate to high cut-point provides an informed foundation from which researchers can build upon (Paasche-Orlow & Wolf, 2007; Wolf et al., 2010). Future studies should focus on theoretical development surrounding numeracy thresholds and preventive health care service utilization (Lipkus & Peters, 2009). Findings also suggest that future numeracy research should focus on health services aimed at long-term, or ongoing,

prevention (e.g., dental checkups) versus services that genearlly address short-term risks (e.g., influenca vacination).

In the context of health care settings, our findings suggest that providers should pay special attention to how numeric information regarding long-term risks and benefits is communicated to their patients (Simonds, Omidpanah, & Buchwald, 2017). For example, graphs and other visualizations may be particularly advantageous for adults with low numearcy skills (Ancker & Kaufman, 2007; Lipkus, Samsa, & Rimer, 2001). Furthermore, the development of a rapid numeracy assessment tool would be advantageous for identifying older adults with low numeracy proficiency on site and to craft risk/benefit communication in a preventive health care context. At the same time, numeracy education programs should focus on building pratical links between numeracy and preventive health care (Lipkus & Peters, 2009). In regard to future middle-aged and older adults (i.e., individuals who are currently children and young adults), early numeracy education interventions would be ideal (U.S. Department of Health and Human Services, 2010). Future research should consider both the advantages and disadvantages of various numeracy, as well as health literacy, assessment tools (Agency for Healthcare Research and Quality, 2016) to ensure their applicability among specific subpopulations and for specific outcomes.

Findings from the present study represent a foundation from which future research can advance knowledge surrounding numeracy and preventive health care service utilization, which in turn should infrom population health practices. One key strategy aimed at promoting preventive health behaviors has been to improve health literacy. Yet, health literacy is a complex and multifaceted construct, and we have only just begun to understand how specific components are linked to certain health behaviors. Given the “dismal” state of numeracy in the U.S. (U.S.

Department of Health and Human Services, 2010, p. 8) and in light of a rapid increase in quantitative health information (Reyna & Brainerd, 2007) coupled with population aging and health trends (Centers for Medicare & Medicaid Services, 2017), much more research on the role of numeracy in shaping preventive health behaviors is needed.

Clinical Implications

- When assessing numeracy in preventive health care settings, two-level categories that distinguish between low and moderate/high proficiency are recommended.
- Numeracy proficiency-sensitive risk communication by health care providers and education programs may enhance the awareness of preventive health care and promote the utilization of specific preventive health service (i.e., dental checkup) among older adults.

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Table 1. Descriptive Summary by the Preventive Health Behaviors

	Flu Shot		Dental Checkup		Vision Screening		Osteoporosis Screening	
	No n = 1590 Percentages 50.29%	Yes n = 1608 Percentages 49.71%	No n = 1082 Percentages 32.63%	Yes n = 2116 Percentages 67.37%	No n = 1204 Percentages 37.72%	Yes n = 1994 Percentages 62.28%	No n = 1913 Percentages 74.90%	Yes n = 641 Percentages 25.10%
Variables								
Age group		*		*		*		*
Age4549	62.41%	37.59%	30.85%	69.15%	44.21%	55.79%	NA	NA
Age5054	59.12%	40.88%	31.20%	68.80%	40.84%	59.16%	83.06%	16.94%
Age5559	54.85%	45.15%	33.73%	66.27%	42.68%	57.32%	77.67%	22.33%
Age6065	42.25%	57.75%	32.72%	67.28%	33.00%	67.00%	74.17%	25.83%
Age6670	31.90%	68.10%	34.43%	65.57%	30.05%	69.95%	67.08%	32.92%
Age71plus	30.39%	69.61%	36.01%	63.99%	22.27%	77.73%	68.08%	31.92%
	*		*		*		*	
Gender								
Female	47.49%	52.51%	30.41%	69.59%	35.80%	64.20%	64.59%	35.41%
Male	53.45%	46.55%	35.14%	64.86%	39.89%	60.11%	88.12%	11.88%
Race	NS		*		NS		*	
White	49.19%	50.81%	30.48%	69.52%	38.56%	61.44%	77.30%	22.70%
Non-White	53.14%	46.86%	38.57%	61.43%	35.82%	64.18%	71.19%	28.81%
Number of household members	*		NS		NS		*	
1	48.60%	51.40%	37.64%	62.36%	38.50%	61.50%	73.78%	26.22%
2	46.45%	53.56%	31.11%	68.89%	35.56%	64.44%	73.85%	26.15%
3	51.04%	48.96%	31.30%	68.70%	39.54%	60.46%	78.39%	21.61%
4	59.93%	40.07%	27.39%	72.61%	36.98%	60.02%	79.97%	20.03%
5	56.21%	43.79%	29.59%	70.41%	41.36%	58.64%	82.31%	17.69%
6 or more	58.16%	41.84%	55.22%	44.78%	48.70%	51.30%	82.84%	17.16%
Education	*		*		*		*	
College	43.71%	56.29%	15.10%	84.90%	30.11%	69.89%	72.80%	27.20%
Less than College	54.25%	45.75%	43.20%	56.80%	42.30%	57.70%	77.41%	22.59%
Employment status	*		*		NS		*	
Employed	53.15%	46.85%	28.61%	71.39%	38.39%	61.61%	79.11%	20.89%
Not employed	45.26%	54.74%	39.83%	60.17%	36.59%	63.41%	70.78%	29.22%
Health insurance	*		*		*		*	
Insured	46.25%	53.75%	27.91%	72.09%	34.03%	65.98%	74.22%	25.78%
Not insured	75.75%	24.25%	63.35%	36.65%	61.75%	38.25%	87.00%	13.00%
Numeracy skill level	NS		*		NS		*	
Low proficiency	51.43%	48.57%	46.96%	53.04%	39.17%	60.83%	72.59%	27.41%
Medium & high proficiency	49.75%	50.25%	25.83%	74.17%	37.04%	62.96%	77.24%	22.76%
Literacy skill level	NS		*		NS		NS	
Low proficiency	50.90%	49.10%	47.95%	52.05%	40.01%	59.99%	73.59%	26.41%
Medium & high proficiency	50.14%	49.86%	28.20%	71.80%	37.08%	62.92%	76.39%	23.61%
Numeracy skill use at home	*		*		*		NS	
None	63.05%	36.95%	58.67%	41.33%	46.40%	53.60%	74.05%	25.95%
Lowest to 20%	51.49%	48.51%	45.01%	54.99%	47.20%	52.80%	79.99%	20.01%
21% to 40%	49.45%	50.55%	36.69%	63.31%	38.01%	61.99%	76.88%	23.12%
41% to 60%	50.72%	49.28%	30.33%	69.67%	36.46%	63.54%	72.18%	27.82%
61% to 80%	45.18%	54.82%	26.31%	73.69%	36.69%	63.31%	74.32%	25.68%
> 80%	51.32%	48.68%	19.14%	80.86%	28.99%	71.01%	78.09%	21.91%
Self-rated health	NS		*		*		*	
Good or better	50.75%	49.26%	27.33%	72.67%	36.44%	63.56%	76.89%	23.11%
Fair or poor	48.56%	51.44%	51.46%	48.54%	42.12%	57.88%	72.08%	27.92%

* indicates the statistically significant associations with the preventive health behavior ($p < 0.05$)
NS indicated not statistically significant association with the preventive health behavior ($p > 0.05$)
n shows the unweighted sample sizes
For each variable, the sample size may be slightly different due to the missing values
The sampling and replicates were applied for all analyses

Table 2. Preventive Health Behaviors: Estimated Odds Ratios from Binary Logistic Regression Models of the Flu Shot

Variables	Model 1 OR (SE)	Model 2 OR (SE)	Model 3 OR (SE)
Predisposing factors			
Age group (45-49, 50-54, 55-59, 60-65, 66-70, 71 plus)			1.32 (0.03)*
Female (vs. Male)			1.30 (0.07)*
White (vs. Non-White)			0.97 (0.12)
Number of household members			0.98 (0.04)
College (vs. <College)			1.49 (0.10)*
Employed (vs. Not employed)			1.02 (0.10)
Enabling factors			
Health insurance (insured vs. not insured)			2.86 (0.14)*
Numeracy Level (low vs. medium & high proficiency)	1.06 (0.11)		1.04 (0.16)
Literacy Level (low vs. medium & high proficiency)		1.03 (0.13)	0.81 (0.18)
Numeracy skill use at home (1-5)			1.05 (0.03)
Need factor			
Good or better self-rated health (vs. Fair or poor)			0.89 (0.10)

Note: The models predicted the odds of using the preventive health service
* indicates the statistically significant associations with the preventive health behavior ($p < 0.05$)
OR = Odds ratio [obtained by exp(the estimated regression coefficient)]; SE = Standard error (associated with the estimated regression coefficient)
The PIAAC final sampling weights and replicate weights were applied.

Table 3. Preventive Health Behaviors: Estimated Odds Ratios from Binary Logistic Regression Models of the Dental Checkup

Variables	Model 1 OR (SE)	Model 2 OR (SE)	Model 3 OR (SE)
Predisposing factors			
Age group (45-49, 50-54, 55-59, 60-65, 66-70, 71 plus)			0.94 (0.03)
Female (vs. Male)			1.37 (0.11)*
White (vs. Non-White)			0.94 (0.13)
Number of household members			0.99 (0.05)
College (vs. <College)			2.63 (0.12)*
Employed (vs. Not employed)			1.15 (0.12)
Enabling factors			
Health insurance (insured vs. not insured)			4.00 (0.13)*
Numeracy Level (low vs. medium & high proficiency)	2.56 (0.12)*		1.41 (0.17)*
Literacy Level (low vs. medium & high proficiency)		2.33 (0.12)*	0.90 (0.16)
Numeracy skill use at home (1-5)			1.19 (0.03)*
Need factor			
Good or better self-rated health (vs. Fair or poor)			1.92 (0.11)*

Note: The models predicted the odds of using the preventive health service
* indicates the statistically significant associations with the preventive health behavior ($p < 0.05$)
OR = Odds ratio [obtained by exp(the estimated regression coefficient)]; SE = Standard error (associated with the estimated regression coefficient)
The PIAAC final sampling weights and replicate weights were applied.

Table 4. Preventive Health Behaviors: Estimated Odds Ratios from Binary Logistic Regression Models of the Vision Checkup

Variables	Model 1 OR (SE)	Model 2 OR (SE)	Model 3 OR (SE)
Predisposing factors			
Age group (45-49, 50-54, 55-59, 60-65, 66-70, 71 plus)			1.18 (0.03)*
Female (vs. Male)			1.19 (0.08)*
White (vs. Non-White)			0.69 (0.11)*
Number of household members			0.99 (0.04)
College (vs. <College)			1.47 (0.09)*
Employed (vs. Not employed)			1.03 (0.09)
Enabling factors			
Health insurance (insured vs. not insured)			2.70 (0.17)*
Numeracy Level (low vs. medium & high proficiency)	1.10 (0.11)		0.91 (0.17)
Literacy Level (low vs. medium & high proficiency)		1.14 (0.13)	0.93 (0.17)
Numeracy skill use at home (1-5)			1.14 (0.03)*
Need factor			
Good or better self-rated health (vs. Fair or poor)			1.15 (0.03)

Note: The models predicted the odds of using the preventive health service
* indicates the statistically significant associations with the preventive health behavior ($p < 0.05$)
OR = Odds ratio [obtained by exp(the estimated regression coefficient)]; SE = Standard error (associated with the estimated regression coefficient)
The PIAAC final sampling weights and replicate weights were applied.

Table 5. Preventive Health Behaviors: Estimated Odds Ratios from Binary Logistic Regression Models of the Osteoporosis Checkup

Variables	Model 1 OR (SE)	Model 2 OR (SE)	Model 3 OR (SE)
Predisposing factors			
Age group (45-49, 50-54, 55-59, 60-65, 66-70, 71 plus)			1.23 (0.05)*
Female (vs. Male)			4.17 (0.13)*
White (vs. Non-White)			0.62 (0.15)*
Number of household members			0.91 (0.06)
College (vs. <College)			1.45 (0.13)*
Employed (vs. Not employed)			0.93 (0.13)
Enabling factors			
Health insurance (insured vs. not insured)			2.17 (0.25)*
Numeracy Level (low vs. medium & high proficiency)	0.78 (0.25)*		1.03 (0.21)
Literacy Level (low vs. medium & high proficiency)		0.86 (0.15)	0.89 (0.24)
Numeracy skill use at home (1-5)			1.03 (0.04)
Need factor			
Good or better self-rated health (vs. Fair or poor)			0.75 (0.28)*

Note: The models predicted the odds of using the preventive health service
* indicates the statistically significant associations with the preventive health behavior ($p < 0.05$)
OR = Odds ratio [obtained by exp(the estimated regression coefficient)]; SE = Standard error (associated with the estimated regression coefficient)
The PIAAC final sampling weights and replicate weights were applied.