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Phone behaviour and its relationship to loneliness in older adults

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Abstract

Objectives—Loneliness and social isolation are two important health outcomes among older adults. Current assessment of these outcomes relies on self-report which is susceptible to bias. This paper reports on the relationship between loneliness and objective measures of isolation using a phone monitoring device.

Method—Phone monitors were installed in the homes of 26 independent elderly individuals from the ORCATECH Life Laboratory cohort (age 86 ± 4.5 , 88% female) and used to monitor the daily phone usage for an average of 174 days. Loneliness was assessed using the 20-item University of California Los Angeles (UCLA) Loneliness scale. A mixed effects negative binomial regression was used to model the relationship between loneliness and social isolation, as assessed using the total number of calls, controlling for cognitive function, pain, age, gender, and weekday. A secondary analysis examined the differential effect of loneliness on incoming and outgoing calls.

Results—The average UCLA Loneliness score was 35.3 ± 7.6 , and the median daily number of calls was 4. Loneliness was negatively associated with telephone use (IRR = 0.99, $p < 0.05$). Daily phone use was also associated with gender (IRR = 2.03, $p < 0.001$) and cognitive status (IRR = 1.51, $p < 0.001$). The secondary analysis revealed that loneliness was significantly related to incoming (IRR = 0.98, $p < 0.01$) but not outgoing calls.

Conclusions—These results demonstrate the close relationship between loneliness and social isolation, showing that phone behaviour is associated with emotional state and cognitive function. Because phone behaviour can be monitored unobtrusively, it may be possible to sense loneliness levels in older adults using objective assessments of key aspects of behaviour.

Keywords

older adults; loneliness; cognitive function; telephone

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Disclosure Statement

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Introduction

Loneliness and social isolation have each received considerable attention in gerontology due to their association with numerous negative health outcomes (Heinrich & Gullone, 2006). For example, individuals experiencing loneliness have been found to exhibit increased morbidity and mortality (Luo, Hawkley, Waite, & Cacioppo, 2012), reduced sleep quality (Cacioppo et al., 2002), increased daytime dysfunction (Hawkley, Preacher, & Cacioppo, 2010), and increased rates of cognitive decline (Wilson et al., 2007). The relationship between loneliness and health may be in part because lonely individuals perceive less support from their social network (Routasalo, Savikko, Tilvis, Strandberg, & Pitkala, 2006), and therefore experience increased stress levels compared to non-lonely individuals (Steptoe, Owen, Kunz-Ebrecht, & Brydon, 2004). Likewise, people who are socially isolated tend to have increased morbidity and mortality with the increase in mortality similar to that of smoking (Holt-Lunstad, Smith, & Layton, 2010). Socially isolated people also exhibit poor sleep quality (Friedman et al., 2005) and increased risk of cognitive decline (Barnes, Mendes de Leon, Wilson, Bienias, & Evans, 2004). These associations with health may be a direct result of a poor social network, as isolated individuals have less access to resources and less encouragement to engage in healthy behaviours (Cohen, 2004; Cohen, Gottlieb, & Underwood, 2000; Hawkley & Cacioppo, 2007). But while both loneliness and social isolation are associated with significant negative health outcomes, it is difficult to isolate the contribution each state has on health in part due to problems with the assessment of loneliness and social isolation.

While loneliness is typically understood to refer to a subjective feeling of a deficit in social relationships (Peplau, 1985; Peplau & Perlman, 1982; Sermat, 1978), the term 'socially isolated' refers to a quantifiable state where the number of network members or frequency of contact with the network is small (Cornwell & Waite, 2009; Wenger, Davies, Shahtahmasebi, & Scott, 1996). As a result, while loneliness is typically assessed using subjective scales, assessment of social isolation has been performed simply by counting the number of network members and the frequency of contact with the network (Hirsch, 1979). However, most of the techniques currently used to assess social isolation rely on subjective self-report of the number of contacts and frequency of contact with the network. Relying on self-report to assess both loneliness and social isolation makes it challenging to isolate the impact each of these constructs has on health. For example, an individual experiencing loneliness may perceive (and report) infrequent contact with friends regardless of the true amount of contact. Thus, the development of an objective means to assess social isolation would advance the understanding of the relationship between loneliness and social isolation, and their differential effect on health.

One aspect of behaviour that directly relates to the level of isolation is telephone use. Because people use the phone to call their network members, monitoring phone calls would provide one measure of the frequency of contact (by monitoring total number of calls), and network size (by monitoring numbers dialled). Of course, this would only assess frequency of contact via the telephone, and network size of those with whom one corresponds via telephone, which may not be a complete picture of the level of isolation. Still, many of the

scales used to assess social isolation ask participants how often they contact friends and family by phone in addition to asking how often they are contacted in person, highlighting the importance of telephone contact in measures of isolation. In young adults, data collected from mobile phones have been used to quantify social groups and their evolution (Eagle & Pentland, 2006; Palla, Barabási, & Vicsek, 2007), infer friendship networks (Eagle, Pentland, & Lazer, 2009), and even assess mental health (Wang et al., 2014). These applications typically employ smart phone apps to record phone calls, Bluetooth proximity logs (records when the phone is close to another Bluetooth user), and GPS or cell-phone tower information. However, older adults still largely use landline phones and flip phones (as opposed to smart phones): while 69% of those 65 and older own a cell phone, only 18% owned a smart phone in 2012 (Zickuhr & Madden, 2012). Thus, the smart phone apps developed to assess phone use do not currently work in well this population. Monitoring landline phone use can be performed by installing a device in the home that records signals on the phone line. This technology can easily be employed with other unobtrusive in-home monitoring systems which detect important behavioural features, such as time out-of-home (Petersen, Austin, Kaye, Pavel, & Hayes, 2014), sleep quality (Hayes, Riley, Pavel, & Kaye, 2010), visitors to the home (Petersen, Larimer, Kaye, Pavel, & Hayes, 2012), or computer use (Kaye et al., 2013), and provides a longitudinal measure of a key behavioural parameter.

In this paper, we used phone monitors placed in the homes of 26 older adults to objectively assess social isolation and its relationship to loneliness. We hypothesized that increased levels of loneliness, as measured using the University of California Los Angeles (UCLA) Loneliness scale, would be associated with fewer daily calls. As a secondary analysis, we also sought to determine whether loneliness had a differential effect on outgoing or incoming calls. Previous work on loneliness has demonstrated that individuals experiencing loneliness may attempt to overcome their loneliness by reaching out to others (Sullivan, 1953; Weiss, 1973). Thus, while incoming calls may decline as individuals become lonely, outgoing calls may remain constant or increase. In the later phases of loneliness, both incoming and outgoing calls are likely to decline as individuals may adjust their expectations for social contact or become resolved in their loneliness (Cacioppo & Patrick, 2008; Peplau & Perlman, 1982). Thus, we hypothesize that loneliness will be significantly related to incoming calls but not outgoing calls.

Methods

Participants

The participants for this study were recruited from the ORCATECH Intelligent Systems for Assessing Aging Changes (ISAAC) (Kaye et al., 2010) cohort, an ongoing observational study aimed at understanding the relationship between daily behaviour and health in older adults. The minimum age for participation in the ISAAC study is 80 years (or 70 for non-whites). Participant inclusion criteria include living independently in a house or an apartment larger than a studio, a minimum score of 25 on the mini-mental state examination (Tombaugh & McIntyre, 1992), and a maximum score of 0.5 on the Clinical Dementia Rating (Morris, 1993) scale. Participants were also required to be in average health for their age with either no or well-controlled chronic health conditions. Exclusion criteria were

health conditions that may limit physical participation or lead to death within three years. Subjects from the ISAAC cohort who agreed to participate in this additional study received phone monitors (Shenzhen Fiho Electronic, Fi3001B) on their landline phone line for up to one year. All subjects signed informed consent prior to participating in any study activity, and the study was approved by the OHSU Institutional Review Board (IRB #4661). A total of 26 individuals agreed to participate; the mean age of the participants was 86 ± 4.5 years, 88% of the cohort was female, and 46% had completed college (see Table 1).

Data and measures

Phone calls—Installation of the phone monitors began in December 2011 and continued on through February 2012. Once installed, the monitors were left in the home for at least 6 months. During this time, subjects had a mean of 174 ± 87 days of valid monitoring data. The differences in number of days of data between subjects were influenced primarily by device functionality. That is, the devices occasionally stopped collecting data due to a device failure, and would not turn back on for a period of up to several months. Thus, the missing data mechanism was not related in any way to the study participants or their characteristics. As a result, we assumed the phone call data were missing completely at random, and dropped days with missing data from the model. The monitors plug directly into the phone line, and are designed to record all signals on the line, including ‘on hook’, ‘off hook’, ‘ring start’, ‘ring stop’, and ‘dtmf’ (numbers dialed encoded as dual-tone multi-frequency). Incoming and outgoing phone calls were counted separately. Because the phone must ring prior to being taken off the hook for an incoming call, all calls where the phone rang and was subsequently removed from the hook within 30 seconds of the final ring signal were counted as incoming calls. It should be noted that missed calls (calls where the resident did not answer the phone) would not be treated as incoming calls in this paradigm. For a call to be treated as outgoing, a number must have been dialed. Because several of our participants live in retirement communities, four digit codes could be used to call within the building to other residents of the retirement community. As a result, a call was treated as outgoing if an ‘off hook’ signal was followed by at least four numbers dialed and not preceded by a ring signal. It should be noted that there is no signal to detect whether an outgoing call was completed (that is, whether the other end picked up the phone or not). Caller-ID information was not reliably collected, and therefore data regarding the number dialed was not used in this analysis.

Loneliness—Loneliness was assessed online in June 2012 using the 20-item UCLA Loneliness survey (Russell, Peplau, & Cutrona, 1980), which asks questions such as ‘I feel part of a group of friends’ and ‘I do not feel alone’. Response options for each question are (1) never, (2) rarely, (3) sometimes, and (4) often. The survey is scored by first reversing the value of positive questions and then summing the value of each answer to give a composite ‘loneliness’ score between 20 and 80, with 80 being the loneliest. The loneliness survey was administered to participants in conjunction with a regular weekly health form, a questionnaire with 11 questions that was administered online to all ISAAC participants each week. This weekly health form is programmed to appear on participant computers every time they log in to the computer (beginning on Monday of each week) until it is completed. Once completed, the weekly health form will not appear again until the following Monday.

For a period of up to 2 months beginning in June 2012, the loneliness survey appeared immediately after the completion of the weekly health form. Participants were told the general nature of the ensuing questions and given the option to accept, decline, or postpone survey completion. If a participant opted to postpone survey completion, it appeared after subsequent weekly health forms until either the subject completed the entire survey, declined to complete the survey, or a period of two months passed. Once the participant completed this online administration of the UCLA Loneliness survey once, they were not asked to complete it again. Thus, we collected the UCLA Loneliness survey data from each participant at most one time, but the date at which they completed it ranged from early June to late July.

Covariates—We included several variables in the model that might confound the relationship between loneliness and incoming phone calls. Individuals with cognitive difficulties might initiate fewer conversations, and those with more physical symptoms might reach out to other people more or less than others would. Global cognitive status was assessed using a composite score including z-scores tabulated from two or three representative neuropsychological tests in each of five cognitive domains. Cognitive domains included working memory: letter–number sequencing (WMS-III) (Wechsler, 1997) and Digit Span Backward length (WAIS-R) (DA Wechsler, 1981); attention/processing speed: Digit Span Forward length (WAIS-R), Digit Symbol (WAIS-R), and Trail Making Test Part A (Armitage, 1946); memory: WMS-R Logical Memory II Story A, WMS-R Visual Reproduction II, and CERAD Word-List Recall (Rosen, Mohs, & Davis, 1984); executive function: letter fluency (CFL), Trail Making Test Part B (Armitage, 1946), and Stroop color-word conflict (Jensen & Rohwer, 1966); and visual perception/construction: WAIS-R Block Design, WAIS-R Picture Completion, and WMS-R Visual Reproduction I. Individual test z-scores were calculated using group mean and standard deviations of the raw test scores from all cognitively intact participants at study entry into the ORCATECH cohort. All individual participant scores were z-normalized, summed, and averaged to obtain the composite score.

Pain level was assessed weekly using a question from the weekly health form. The question asked participants to rate their pain by indicating the number that best described their pain on average in the last week. Participants answered on an 11-point Likert scale (0–10) with lower scores indicating less pain. In the model, we also included gender, age at baseline, and a flag for weekend days (this was included because weekend behaviour is often different from weekday behaviour due to work hours, community events, and the availability of resources; this flag will allow the model to fit these behaviours separately).

Data analysis

We first computed descriptive statistics for all variables included in the model. Because the telephone data is left skewed, we calculated the median and interquartile range (IQR) to describe the data. The IQR is a robust measure of standard deviation that is given by the 75th percentile minus the 25th percentile of the data. Because the daily number of calls is a count variable, we tested it for over-dispersion to determine whether the Poisson model, a standard model for count data, is a good fit to the data. This was tested using a χ^2 test, with null

hypothesis that α (the dispersion parameter) equals zero. This test indicated the data is over-dispersed ($\chi^2 = 7782$, $p < 0.001$), so a negative binomial regression was used to model the data. We modelled the effect of loneliness on phone use using a mixed effects negative binomial regression, controlling for age, sex, and cognitive function. A total of 4519 days of data were included in the model, representing an average of 174 days of monitoring for each participant (days of data included in the model differed across participants due to both data outages due to device failure and differences in the date of installation). In our secondary analysis (models 2a and 2b), we sought to determine the differential effect of loneliness on incoming and outgoing phone calls. For this analysis, we ran two mixed effects negative binomial regressions, after testing for over-dispersion in the output for these models ($\chi^2 = 1337$, $p < 0.001$ for model 2a, and $\chi^2 = 936$, $p < 0.001$ for model 2b). The dependent variable in model 2a was the total daily number of incoming calls, while that for model 2b was the daily number of outgoing calls. All analyses were performed in Stata (StataCorp, Texas, Version 13). A p -value of 0.05 was considered significant.

Results

Descriptive statistics

Participants received a median of 2 (IQR: 3) phone calls each day, and placed a median of 2 (IQR: 4) calls each day. The median total calls each day was 5 (IQR: 6). The correlation (r) between daily number of incoming and out-going phone calls was 0.47. The average loneliness score in this cohort was 35.3 ± 7.62 , which is consistent with previous studies on loneliness in older adults (Russell, 1996). The average cognitive z-score score was 0.276 ± 0.55 , indicating little to no cognitive impairment in this cohort. The median level of pain reported each week was 1, with an IQR of 4.

Mixed effects negative binomial regression on total daily calls

The results of the mixed effects negative binomial regression are shown in Table 2. It should be noted that the effective sample size for all cross-sectional variables included in this model (age, gender, loneliness, and cognitive function) is 26. From the negative binomial regression, the incidence rate ratio (IRR) represents the proportional change in number of calls for a unit increase in the independent variable. An IRR that is greater than 1 means the number of calls increases for each unit increase in that independent variable, and an IRR of less than 1 indicates the number of calls will decrease for each unit increase in that independent variable. For example, an IRR of 0.5 would mean that for each unit increase in the independent variable, the daily number of calls would decrease by a factor of 0.5. Thus, if the independent variable could vary from 0 to 3, the change in daily calls over this range would drop by 0.5^3 or 0.125.

As can be seen from Table 2, loneliness is significantly related to the daily number of phone calls. Individuals with higher loneliness scores had fewer calls on average (IRR = 0.99, $p < 0.05$; 95% CI 0.99, 1.00) such that the individual with the highest loneliness score of 60 averaged nearly two-thirds the number of calls each day ($0.990^{(60-23)} = 0.69$) compared to the individual with the lowest loneliness score, holding all other variables constant. Other factors also significantly affected the total number of calls each day. Gender was

significantly associated with the daily number of calls, with women making or receiving twice the number of calls as compared to males (IRR = 2.03, $p < 0.001$; 95% CI 1.63, 2.52). This result should be interpreted with caution, however, as the number of males included in the study was very small ($n = 3$). Due to the small number of men, as a *post hoc* analysis we re-ran the model with men excluded to ensure the consistency in our estimated coefficients. The results were not significantly different: no coefficient changed to a value outside the previously estimated 95% confidence intervals suggesting the small number of males in the model will not bias the coefficients when accounting for gender. In addition, superior cognitive function was associated with a higher daily number of calls (IRR = 1.51, $p < 0.001$; 95% CI 1.33, 1.72). People also had fewer calls on the weekend than the weekday (IRR = 0.65, $p < 0.001$; 95% CI 0.612, 0.680). Age and pain level were not significant predictors of the daily number of calls.

Mixed effects negative binomial regression on incoming and outgoing calls

To test whether loneliness was differentially related to incoming and outgoing phone calls, we ran two additional mixed effect negative binomial regressions, with daily number of incoming phone calls as the outcome for the first regression, and daily number of outgoing phone calls as the outcome for the second regression. The comparative results of this analysis are shown in Table 3. Consistent with our hypothesis, loneliness was negatively related to incoming calls but not outgoing calls. The loneliest individual received 40% of the number of calls received by the least lonely (IRR = 0.98, $p < 0.01$; 95% CI 0.96, 0.99). The non-linear relationship between loneliness and daily number of incoming phone calls is shown in Figure 1. This figure shows the probability density of the daily number of calls as a function of the UCLA Loneliness score, holding all continuous variables at their means (gender was taken to be female, and the flag for weekend was held at weekday). That is, at each possible value of the UCLA Loneliness scale, the probability of receiving a given number of calls (between 0 and 5) is computed and plotted in colour, with higher probabilities plotted in red and lower probabilities plotted in blue. The mean is also plotted in black. As can be seen, the average daily number of incoming calls decreases from 4.6 when the loneliness score is 23 (the lowest observed score) to 1.9 when the loneliness score is 60 (the highest observed score). It should be noted that the UCLA Loneliness scale can range from 20 to 80, but no participants scored higher than 60 or lower than 23 in this cohort, so the values plotted do not exceed this observed range.

In this analysis, age was also found to be significantly related to outgoing calls (IRR = 0.97, $p < 0.01$; 95% CI 0.956, 0.99) but not incoming calls. Gender was significantly related to both incoming and outgoing calls, such that women received 60% more calls than men, and placed 128% more calls than men (although this should be interpreted with caution due to the small number of males in the cohort). In addition, cognitive status was significantly related to the number of incoming calls (IRR = 1.69, $p < 0.01$; 95% CI 1.39, 2.06) but not the number of outgoing calls.

Discussion

This paper presents the first results on the relationship between loneliness and objective measures of social isolation using a landline phone monitoring system. We found that increased loneliness is associated with decreased daily phone use, such that the loneliest individual uses the phone nearly two-thirds as much as the least lonely. This result supports the work of prior studies suggesting loneliness is closely tied to the quality of the social network (Litwin & Shiovitz-Ezra, 2011; Stephens, Alpass, Towers, & Stevenson, 2011), and suggests that loneliness may also be closely tied to the level of social isolation. In addition, this suggests that by objectively monitoring isolation levels in older adults, it may be possible to understand the differential effect that loneliness and social isolation have on health. Finally, because loneliness is tied to social isolation, it may be possible to unobtrusively monitor loneliness levels in addition to isolation levels, using both measures of social isolation and emotional well-being (for example, time out-of-home (Petersen et al., 2014)).

Consistent with our hypothesis, we also found that loneliness was more closely tied to incoming than outgoing phone calls. This is consistent with the previous work on loneliness which suggests that in the early stages of loneliness, people may attempt to overcome their loneliness by forming new social connections, even when meeting new people causes great emotional stress (Sullivan, 1953; Weiss, 1973). Attempting to form new connections may manifest as an increase in the number of outgoing calls while the number of incoming calls declines. After a time of being lonely, one may adjust expectations for support, becoming content to have fewer contacts and less support (Peplau & Perlman, 1982). Thus, while outgoing calls may first increase and then decrease, incoming calls are more likely to universally decrease with the manifestation of loneliness. Of course, with only one loneliness time point, it is difficult to understand how telephone use changes with changes in loneliness levels within the same individual. Thus, future studies on the time-course of loneliness and isolation should investigate the differential relationship between loneliness and incoming and outgoing calls in the earliest phases of loneliness onset.

Among our covariates, age was also found to be significantly related to the number of outgoing calls, but not the number of incoming calls. This may be suggestive of difficulties with using the phone that occur with age, especially with placing calls. For example, while hearing impairments may make it challenging to use the telephone to communicate at all (reducing the total number of calls), arthritis and vision impairments may cause difficulties in dialling numbers to place outgoing calls, thus reducing the number of outgoing calls to a greater degree than incoming calls.

Increased cognitive function was found to be positively associated with telephone use, which is consistent with work tying the ability to perform instrumental activities of daily living including the ability to use the phone with cognitive ability (Barberger-Gateau et al., 1992). Thus, as cognitive function declined, phone use also declined. Increased pain was also associated with increased phone use, which may represent the increased support given when people fall, go to the emergency room, or have other adverse events likely to increase pain levels. We also found that women make more calls than men, people receive fewer calls on

the weekend than on the weekday, and superior cognitive function was associated with more telephone use.

This study has several limitations. Notably, there were relatively few subjects, and as a result, the number of constant or control variables that could be included in the model was small despite the large number of data points (the effective sample size for each cross-sectional variable is 26). Future studies should incorporate data from more subjects with additional potentially explanatory variables to fully understand the relationship between phone use and outcomes of interest among older adults. We also did not explicitly test whether participant characteristics were related to the number of days of monitoring data as this was determined primarily by how well the phone monitor worked in each home. Still, the subjects who have more observed days of data will have the largest influence on the estimated coefficients. Thus, if any participant characteristic were in fact related to the number of days of observed data, the coefficients may be biased. This study did not monitor the duration of each phone call or the number dialled due to shortcomings with the phone monitoring software. Because of the importance of social network on multiple health outcomes (Gow, Corley, Starr, & Deary, 2013), developing techniques to unobtrusively monitor multiple aspects of social network, including number of contacts or changes in the social network (addition of new members or loss of old ones) may be increasingly important (Cornwell & Laumann, 2015). Further, the average age of this cohort was 86 years, and the youngest participant was aged 73 years. Despite their older age, everyone in the cohort lived alone and independently (although they may live in a retirement community). In addition, all participants used landline phones only, and did not use wireless telephone devices. The results of this study may not generalize to younger populations, to those whose physical health is imposing more serious limitations on their lifestyle, or to those populations where wireless devices have become the norm.

This work shows that in-home monitoring can be used to objectively analyse the relationship between loneliness and social isolation. Using this approach in longitudinal models on health, it may be possible to understand the differential effect these variables have on health. In addition, using a phone monitor in conjunction with in-home monitoring platforms designed to assess multiple aspects of behaviour known to be associated with loneliness (for example, sleep (Hawkey & Cacioppo, 2010), time out-of-home (Petersen et al., 2014), and computer use (Amichai-Hamburger & Ben-Artzi, 2003)), it may be possible to monitor loneliness levels unobtrusively and continuously in the home environment. Such models would contribute greatly to the understanding of loneliness and its effectors, time course, and outcomes. By monitoring for loneliness in the home environment, it may also be possible to detect lonely individuals earlier than currently possible, thereby enabling outreach programmes to give lonely persons appropriate help and assistance.

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Figure 1.

Probability density of the daily number of incoming calls as a function of (a) the UCLA Loneliness score and (b) the z-normalized cognitive score, holding all other variables at their means. Shade represents density; discrete probabilities were linearly interpolated for graphical clarity. The mean function, μ (black trace), has been overlaid on the density to show central tendency. Number of incoming calls decreases with increasing loneliness and decreasing cognitive abilities.

Table 1

Demographic characteristics of the population.

Characteristic	Statistic	Range (min, max)
Age (yrs)	86 ± 4.5	(73, 94)
Gender (% female)	88%	–
Education (% completed college)	46%	–
Race (% Caucasian)	100%	–
MMSE	29.1 ± 1.04	(26, 30)
Cognitive Z-score	0.28 ± 0.55	(−0.81, 1.39)
Loneliness	35.3 ± 7.6	(23, 60)
Pain level	1.89 ± 2.2	(0, 10)

Table 2

Results of the mixed effects negative binomial regression on daily number of phone calls.

Variable	Incidence rate Ratio	Std. err.	z	95% CI	
Loneliness	0.990 [*]	0.005	-1.96	0.980	1.000
Gender (male)	2.026 ^{**}	0.225	6.37	1.630	2.518
Age	0.982	0.010	-1.81	0.963	1.001
Cognitive z-score	1.512 ^{**}	0.098	6.36	1.331	1.717
Weekend	0.647 ^{**}	0.017	-17.02	0.616	0.680
Pain level	1.007	0.011	0.68	0.987	1.028
Date (normalized)	0.999	0.011	-0.06	0.977	1.022
Constant	5.099	4.322	1.92	0.968	26.854

^{*}
 $p < 0.05$,

^{**}
 $p < 0.001$

Table 3

Comparative results on the relationship between loneliness and incoming/outgoing phone calls.

	Number incoming calls			Number outgoing calls		
	Incidence rate ratio	Std. error	z	Incidence rate ratio	Std. error	z
Loneliness	0.950 ^{**}	0.009	-2.74	1.001	0.005	0.25
Gender (male)	2.281 ^{***}	0.440	4.27	1.613 ^{***}	0.188	4.09
Age	1.014	0.016	0.87	0.972 ^{**}	0.010	-2.74
Cognitive z-score	1.694 ^{***}	0.171	5.22	1.065	0.076	0.88
Weekend	0.686 ^{***}	0.018	-14.68	0.625 ^{***}	0.023	-13.01
Pain level	1.023	0.012	1.90	0.992	0.013	-0.58
Time	0.888 [*]	1.198	2.84	1.001	0.005	-1.91
Constant	0.950	0.009	-0.09	1.613 [*]	0.188	2.15

*
 $p < 0.05$,**
 $p < 0.01$,***
 $p < 0.001$