Mobile phone owners' health behaviors

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A - Conception and study design, B - Data collection, C –Data analysis, D - Writing the paper,
E – Review article, F - Approval of the final version of the article

ABSTRACT

Introduction: The consistently growing number of mobile phone users has contributed to increasing interest in the effects of mobile phones on human health.
Purpose: To assess the preferred health behaviors of mobile phone users.
Materials and methods: The study included 175 mobile phone users and used standardized tools, such as the Multidimensional Health Locus of Control (MHLC) scale and the Health Behavior Inventory (HBI).
Results: Most respondents had an impact on their own health (avg. 26.9 points). Respondents showed the highest level of health behaviors in relation to attitude, whereas the lowest level towards health practices. We distinguished three groups in the study population: with high (14.9%), low (47.4%), and average (37.7%) levels of health behaviors. We cannot unequivocally state that there is a statistically significant correlation between the occurrence of certain fungal genera/species on mobile phone and hand surfaces and the health locus of control.
Conclusions: The respondents themselves mainly had an impact on their own health, and those in favor of this opinion attached greater importance to washing their hands. Respondents showed the highest level of health behaviors in relation to mental attitude, whereas the lowest level towards preferred health practices. Almost half of the respondents showed low levels of health behaviors, whereas almost every seventh respondent had high levels of health behaviors. No significant relationship was shown between the preferred health behaviors and the frequency of washing hands, the number of colonies and the isolation frequency of fungal strains collected from the surfaces of mobile phones and the hands of their owners.
Keywords: Hands, phone, fungi, MHLC, HBI

DOI: 10.5604/01.3001.0009.5134

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Received: 03.02. 2016
Accepted: 02.06.2016
Progress in Health Sciences
Vol. 6(1) 2016 pp 130-140

INTRODUCTION

The consistently growing number of mobile phone users has contributed to increasing interest in the effects of mobile phones on human health. The health effects of exposure due to long-term mobile phone use are the basis for research that has been conducted for many years in a number of European countries, the USA, and Japan [1].

Ponikło [2] stressed that the World Health Organization encourages scientists from around the world to conduct intensive research on the effects of mobile phones on humans due to the fact that a number of health conditions, such as headaches, insomnia and malignant brain tumors, are increasingly associated with their use.

Swedish scientists [as cited in 2] demonstrated that the risk of brain tumor is 26% higher in individuals using analog mobile phones for approximately 10 years compared with controls. In vitro studies conducted by Velizarov et al. [3], Goswami et al. [4], and Marinelli et al. [5] indicate that a high frequency electromagnetic field has potential effects on cell proliferation and oncogenic transcription activation. Some clinical trials have suggested a relationship between the use of mobile phones and the risk of brain, head and neck tumors, testiclular tumors as well as non-Hodgkin's lymphoma [6-18]. Myung et al. [19] performed a retrospective analysis of 23 studies on cancer etiology (with a total of 37,916 participants). Most studies showed a close correlation between the use of mobile phones for over 10 years and brain tumor development. The authors [19] emphasize that prospective cohort studies are necessary to support this correlation. Only Danish researchers [20] have conducted such a study; their preliminary results did not provide evidence for a correlation between the use of mobile phones and the standard cancer incidence rate [20].

Data on the negative effects of radiation emitted by mobile phones on peacemakers are also available in the literature [21].

Electromagnetic radiation also causes sleep disorders by delaying the onset of sleep [22], reducing melatonin production [23], causing headaches, impairing concentration, [24] and increasing blood pressure [25].

Agarwal et al. [26] investigated the sperm of 371 patients and showed reduced sperm quality, number, motility, and viability among mobile phone users, which was closely correlated with the duration of radiation exposure.

Reid and Reid [27] included 158 adults experiencing social anxiety and loneliness in their study and found that they preferred talking on a mobile phone to sending text messages.

Bloc [28] believes that excessive texting can be qualified as a psychiatric disorder that causes extensive damage to the human psyche. Bloc supports his theory with arguments that sending text messages is a kind of stimulant for people who never part with their mobile phones. He also claims that [28] depriving these people of their mobile phones may trigger aggression, anxiety, absent-mindedness or even depression. Furthermore, he [28] found that, in contrast to children, adults react more aggressively and express their desire to find another phone they could use more firmly.

Involvement in microbial transmission is another issue related to the use of mobile phones [29-32].

It is clearly highlighted in the literature [as cited in 1] that caution should be exercised in extensive use of mobile phones, especially in the case of children, as they are at greater risk of exposure to electromagnetic radiation compared with adults. This [as cited in 1] is due to a different geometrical shape of children's heads as well as different electrical properties of children's tissues compared with adults.

The aim of this study was to assess the preferred health behaviors of mobile phone users.

MATERIALS AND METHODS

The bioethics committee of the Medical University of Bialystok approved this study with approval no. RI-002/489/2010. 175 mobile phones and 175 hands of students and professors of the Medical University of Bialystok and the personnel of university hospitals were included in the study. Biological monitoring of mobile phone and hand surface contamination was performed with Count-Tact™ applicator using Count-Tact plates (bioMerieux) containing a medium complying with the requirements of the Draft European Standard CEN/TC 243/WG2. CandiSelect (Bio-Rad) was used to identify yeast-like fungi.

The study also used:

- a Polish adaptation by Juczyński of the standardized Multidimensional Health Locus of Control Scale (MHLC) by K.A., Wallston B.S., Devellis R., evaluating respondents' generalized expectations in three health loci of control: internal (conviction that health control depends on ourselves); the impact of others (conviction that other people, mainly medical personnel, affect our health); as well as coincidence (health depends on coincidence or other external factors). The reliability indicators for the Polish version of the test are: 0.77 for internal locus of control; 0.67 for the impact of other people, and 0.75 for coincidence [33,34].
- the standardized Health Behavior Inventory (HBI), in accordance with Juczyński, consisting of 24 statements that allow to determine the general index of the intensity of health behaviors as well as the intensity of these four categories related to health behaviors: proper nutrition,

primarily taking into account the type of food; preventive behaviors related to compliance with health care recommendations; as well as acquiring information on health and disease-related issues: health practices – daily habits associated with sleep, rest and physical activity; positive attitude – avoiding strong emotions, stress, and depressive situations. The Polish version of the questionnaire used several available tools for evaluating different health practices, mainly *The General Preventive Health Behaviors Checklist* (Amir, 1987) and the *Reported Health Behavior Checklist* (Prohaska et al. 1985). Internal consistency of the HBI, based on Cronbach's alpha, is 0.85 for the whole inventory, and from 0.60 to 0.65 for its four subscales [34].

RESULTS

A total of 175 respondents, mainly aged between 21 and 30 years (54.9%), participated in the study. Other respondents were aged 18-20 (30.9%), 31-40 and 41-50 (6.9% each), and 51-60 years (0.6%).

The majority of the respondents had one mobile phone (85.1%), some had two (13.7%) or more (1.1%). Mean mobile phone use duration was 9.4 years, with the last mobile phone used for an average of 1.9 years.

Most respondents (80.6%) never turned off their mobile phones. Others used their mobile phones only during the day (10.3%), in certain situations (8.0%), or at specific times (1.1%).

Phones were most frequently kept in a bag (54.9%). 43.4% of respondents kept their phones in their pockets, while 14.3% in a desk or cabinet. When moving about, the respondents usually kept their mobile phones in a bag (47%) or pocket (41). Further information has been provided in Fig. 1.

The main aim of this study was to assess the health locus of control (MHLC) as well as the preferred health-related habits in the overall study population.

Most respondents (94.9%) always remembered to wash their hands after toilet use, before preparing meals (69.7%), or after contact with a sick person (68.0%). Further information has been provided in Tab. I.

Candida glabrata dominated in the collected samples, but *Candida albicans* and *Candida krusei* were also common. These three species were found on over half of the respondents, both on their hands and their phone surfaces (Fig. 2).

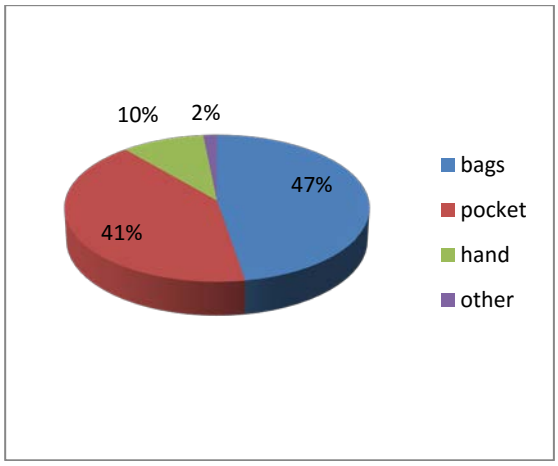

Figure 1. Place for storing mobile phone while moving about

Table1. Respondents' preferred tasks that require hand washing

Duration of hand washing	Frequency of hand washing			
	always	**often**	**rarely**	**never**
after toilet use	**94.90%**	4.60%	0.60%	0.00%
before preparing meals	**69.70%**	**27.40%**	2.30%	0.60%
after contact with a sick person	**68.00%**	23.40%	7.40%	1.10%
after getting up from bed, after night	**64.60%**	24.00%	8.00%	2.90%
in the evening before going to sleep	**64.60%**	24.00%	9.10%	1.70%
after returning home	57.10%	**34.30%**	7.40%	1.10%
after contact with an animal	54.30%	**29.70%**	**13.70%**	2.30%
before eating a meal	53.70%	**40.60%**	5.10%	0.60%
removing watch before washing	25.10%	14.30%	**28.00%**	**29.10%**
removing jewelry before washing	18.90%	16.00%	**36.60%**	**28.60%**

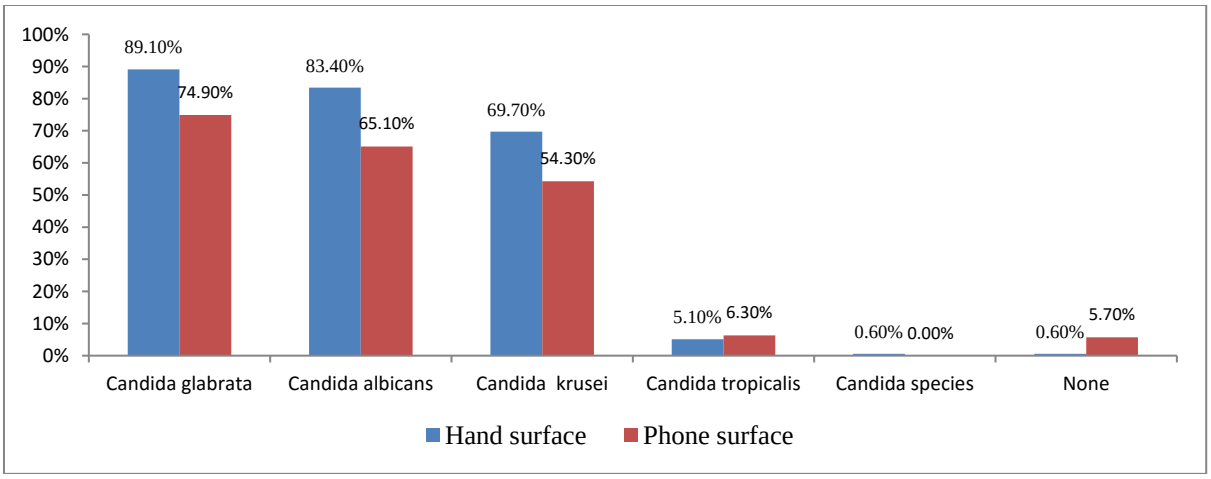

Figure 2. Fungi isolated from hand and mobile phone surfaces

Table 2 presents the distribution of values for three MHLC scale components: internal health control, the impact of others, and the impact of coincidence on health. Based on the 18-question survey, the respondents described their attitudes towards their impact on their health, expressed on a six-grade scale: from "I strongly disagree" (1 point) to "I strongly agree" (6 points). The results are not presented as a single indicator, but calculated separately for each of the three scales by summing the points from the individual questions. These scales illustrate the acceptance of the statements: "in terms of health, internal control is the most important," "in terms of health, the impact of others is the most important," and "in terms of health, coincidence is the most important." The possible results for each scale ranged between 6 and 36 points. The stronger conviction was that a certain factor had an impact on health.

Table 2. MHLC scale values obtained by the respondents

MHLC (health locus of control)		Me	*s*	c_{25}	c_{75}	min	max.
internal control	26.8	28	5.0	25	30	9	35
impact of others	21.0	22	5.7	16	25	6	36
coincidence	20.8	21	5.2	17	24	9	33

The study population quite strongly believed that they themselves had the greatest effect on their own health (the average for the assessment of the significance of internal health control was 26.9 points, whereas the average was lower by about 5-6 points for the two other components) (Table 2).

The number and percentage distribution of values for the evaluated scale, including division into 6-point ranges, is shown in the form of a histogram presented below (Figure 3). The largest percentage of high scores (over 30 points) was for the 'internal health control' component.

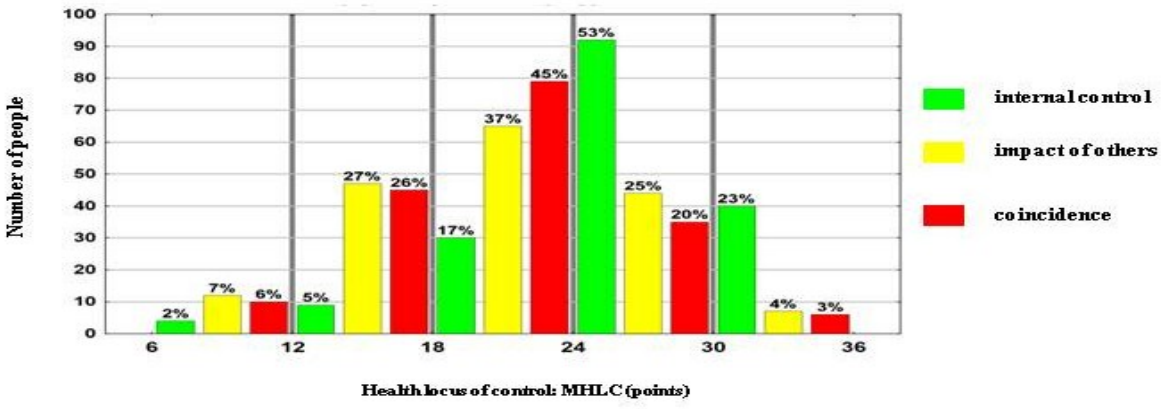

Figure 3. Distribution of numerical and percentage values for MHLC

We performed a correlation analysis to investigate the relationship between the respondents' assessment of health locus of control in the context of habits associated with hand washing. The ordinal nature of the features containing information on the respondents' attitude towards hand washing determined the choice of tool for statistical analysis - Spearman's rank correlation coefficient. Apart from the correlation coefficient, the result of an appropriate statistical test for the assessment of correlation coefficient significance was also provided. The analyzed correlations are presented in the form of scatter diagrams.

Relationships with the MHLC scale were investigated for two characteristics: self-assessment of knowledge on hand washing as well as an average estimation of hand washing habits in different life situations, calculated based on answers to question 21. In order to calculate this measure, we assumed that the hand washing habit is 'always' assessed based on a 3-point score, i.e. frequently – 3 pts., rarely – 1 pt., and never – 0 pts. A thus obtained hand washing habit average score was used for the analysis below (Table 3).

It could be expected that those in favor of the opinion that health is determined by an internal control will place more importance on washing hands, and indeed, the only statistically significant correlation was related to these two variables; however, its strength was low – the R value did not exceed 0.20. Other correlations were statistically insignificant, and the correlation coefficients were very close to zero.

Table 3. MHLC scale values in correlation to the assessment of hand washing habits and knowledge of hand washing principles

MHLC	Assessment of hand washing habits	Assessment of knowledge on hand washing principles
internal control	0.19 (p = 0.0103*)	0.05 (p = 0.4717)
impact of others	0.13 (p = 0.0766)	0.05 (p = 0.5530)
coincidence	0.11 (p = 0.1305)	0.04 (p = 0.6191)

We also used the Health Behavior Inventory (HBI) to assess the respondents' health habits. Data on the distribution of scores related to health habits within the four areas assessed using the HBI scale (these values were calculated as mean values derived from the questions and were within the range of 1-5 points, with higher values indicating an increase in a certain form of health behavior) are presented below, in the form of descriptive statistics. We calculated the overall HBI measurement as the sum of points. As you can see in Table 4, respondents showed the highest level of health behaviors in relation to attitude, whereas the lowest level towards health practices.

Table 4. Assessment of health behaviors using the HBI scale

HBI	N	$\overline{x}$	Me	s	c_{25}	c_{75}	min.	max.
Proper nutritional habits	175	3.26	3.33	0.67	2.83	3.67	1.50	5.00
Preventive behaviors	175	3.31	3.33	0.61	3.00	3.67	1.67	5.00
Positive attitude	175	3.45	3.50	0.61	3.00	3.83	1.83	5.00
Health practices	175	3.12	3.17	0.63	2.67	3.50	1.67	5.00
HBI	175	78.8	78	11.5	71	85	51	116

The level of health behavior was categorized based on the summary value of the HBI scale. We distinguished three groups in the study population: with high (14.9%), low (47.4%), and average (37.7%) levels of health behaviors. In this section, we investigated correlations between the respondents' opinions on health locus of control and the presence of fungal colonies on hand and mobile phone surfaces. We formed a working hypothesis that we would find fewer fungal colonies found on hand and mobile phone surfaces in the case of individuals who placed more importance on the internal health control. Analysis was performed in accordance with two concepts:

- the average level of MHLC measures in the group of people who had fungal colonies on their hand surfaces was compared with the other respondents,
- an assessment of the significance of differences between the groups was performed using the Mann-Whitney test,
- then, correlations between the MHLC coefficients and the number of fungal colonies were investigated using Spearman's rank

correlation coefficient; however, only in adults from whom fungal strains were isolated.

Analysis was performed for different genera/species of fungi by grouping the results in summary tables. *C. species* was excluded from analysis as it occurred on the hands in one case only (none were found on mobile phones); therefore, it was impossible to perform reliable statistical analyses. We cannot unequivocally state that there is a statistically significant correlation between the occurrence of certain fungal genera/species on mobile phone and hand surfaces and the health locus of control. The only difference close to statistical significance was shown for the assessment of the role of coincidence in health control, and it was a correlation between individuals with *C. tropicalis* and the remaining group. The T-test probability value p=0.075 allowed to assume that there might be some relationship between the occurrence of *C. tropicalis* on hand surfaces and greater conviction about the inability to control one's own health (assigning a greater role to coincidence). However, its full verification would require investigating a larger population due to the small percentage of the isolated species in the present study. Significant relationship was found between the 'appreciation' of the role of coincidence in health-related situations and the presence of *C. krusei* on mobile phone surfaces. The impact of coincidence was rated higher by those identified with the presence of strains of these fungi (21.6 pts. vs. 19.9 pts. in the remaining group). A relationship close to statistical significance (the T-test probability value of *p* was slightly higher than 0.05) was also related to the occurrence of *C. albicans* fungi and the assessment of the impact of other people on one's health. Individuals in whom these fungi were identified assigned a greater role to the impact of others compared with the remaining respondents. The results are presented in Table 5.

Table 5. Correlations between the isolated fungal species and the health locus of control

Hand surface							
MHLC (health locus of control)	***Candida albicans* (hand)**						***p***
	no (*N* = 29)			**yes (*N* = 146)**			
	$\overline{x}$	Me	*s*	$\overline{x}$	Me	*s*	
internal control	26.1	27.0	5.9	26.9	28.0	4.8	0.5940
impact of others	19.5	20.0	6.4	21.2	22.0	5.6	0.1355
coincidence	20.7	19.0	5.2	20.8	21.0	5.3	0.8154
MHLC (health locus of control)	***Candida glabrata* (hand)**						***p***
	no (*N* = 19)			**yes (*N* = 156)**			
	$\overline{x}$	Me	*s*	$\overline{x}$	Me	*s*	
internal control	26.2	27.0	5.9	26.9	28.0	4.9	0.6121
impact of others	19.8	21.0	5.7	21.1	22.0	5.7	0.3713
coincidence	21.0	22.0	4.1	20.8	21.0	5.4	0.7516
MHLC (health locus of control)	***Candida krusei* (hand)**						***p***
	no (*N* = 53)			**yes (*N* = 122)**			
	$\overline{x}$	Me	*s*	$\overline{x}$	Me	*s*	
internal control	26.3	27.0	5.4	27.0	28.0	4.9	0.3694
impact of others	20.4	21.0	5.9	21.2	22.0	5.7	0.4341
coincidence	19.8	20.0	4.6	21.3	22.0	5.5	0.1189
MHLC (health locus of control)	***Candida tropicalis* (hand)**						***p***
	no (*N* = 166)			**yes (*N* = 9)**			
	$\overline{x}$	Me	*s*	$\overline{x}$	Me	*s*	
internal control	26.8	28.0	5.1	26.4	26.0	4.1	0.6440
impact of others	20.9	21.5	5.7	22.0	24.0	6.7	0.4535
coincidence	20.6	21.0	5.1	24.2	24.0	6.2	0.0759
phone surface							
MHLC (health locus of control)	***Candida albicans* (phone)**						***p***
	no (*N* = 61)			**yes (*N* = 114)**			
	$\overline{x}$	Me	*s*	$\overline{x}$	Me	*s*	

internal control	26.1	27.0	5.9	27.2	28.0	4.5	0.3963
impact of others	19.7	21.0	6.3	21.6	22.0	5.3	0.0574
coincidence	20.1	20.0	4.7	21.2	21.5	5.5	0.2423
MHLC (health locus of control)	***Candida glabrata* (phone)**						***p***
	no (*N* = 44)			**yes (*N* = 131)**			
	$\overline{x}$	Me	*s*	$\overline{x}$	Me	*s*	
internal control	26.5	27.0	5.4	26.9	28.0	4.9	0.7352
impact of others	19.6	21.5	5.9	21.4	22.0	5.6	0.1249
coincidence	20.4	21.0	5.2	21.0	21.0	5.3	0.5683
MHLC (health locus of control)	***Candida krusei* (phone)**						***p***
	no (*N* = 80)			**yes (*N* = 95)**			
	$\overline{x}$	Me	*s*	$\overline{x}$	Me	*s*	
internal control	26.6	28.0	5.5	27.0	28.0	4.6	0.9545
impact of others	20.8	21.0	6.1	21.1	22.0	5.5	0.7562
coincidence	**19.9**	**19.5**	**5.3**	**21.6**	**22.0**	**5.1**	**0.0158***
MHLC (health locus of control)	***Candida tropicalis* (phone)**						***p***
	no (*N* = 164)			**yes (*N* = 11)**			
	$\overline{x}$	Me	*s*	$\overline{x}$	Me	*s*	
internal control	26.7	28.0	5.0	28.1	29.0	5.0	0.3376
impact of others	21.0	22.0	5.8	19.6	18.0	4.1	0.3927
coincidence	20.8	21.0	5.2	21.0	22.0	5.8	0.6732

Table 6 shows coefficients of correlations between the number of colonies of individual fungal species and the assessments of health locus of control. Significant correlation was found between the number of *C. albicans* colonies and the assessment of the impact of other people on health. This correlation was relatively weak and negative in direction, indicating that the more importance was attached to the impact of others on health, the fewer *C. albicans* colonies were isolated from hand surfaces. It is difficult to substantively explain this relationship. Strong correlations were found between the assessment of the external health control as well as the impact of other people, and the number of *C. tropicalis* colonies; however, these correlations cannot be considered statistically significant due to the small sample size, and therefore no generalizations can be made on their basis.

Table 6. Correlations between the numbers of fungal colonies isolated from the tested surfaces and the health locus of control

Number of fungal colonies on hand surfaces	**Health locus of control**		
	internal control	**impact of others**	**coincidence**
hands			
Candia albicans	-0.10 (p = 0.2197)	-0.28 (p = 0.0006***)	0.03 (p = 0.733)
Candida glabrata	-0.02 (p = 0.7793)	-0.13 (p = 0.100)	0.07 (p = 0.363)
Candida krusei	-0.09 (p = 0.3200)	-0.03 (p = 0.705)	0.01 (p = 0.899)
Candida tropicalis	-0.57 (p = 0.1107)	-0.54 (p = 0.129)	-0.20 (p = 0.598)
Phone			
Candida albicans	-0.04 (p = 0.653)	-0.12 (p = 0.193)	0.09 (p = 0.314)
Candida glabrata	-0.11 (p = 0.2028)	-0.09 (p = 0.331)	-0.05 (p = 0.566)
Candida krusei	0.01 (p = 0.910)	0.00 (p = 0.964)	0.08 (p = 0.429)
Candida tropicalis	0.26 (p = 0.4470)	-0.35 (p = 0.297)	-0.53 (p = 0.094)

No significant correlations were found between the numbers of fungal colonies present on mobile phones and the assessment of health locus of control. The only correlation close to statistical significance was shown for the role of coincidence on health status and the number of *C. tropicalis*

colonies ($R=-0.53$; $p<0.10$). However, the direction of this correlation was negative, which is difficult to substantively explain; therefore, it is impossible to attribute greater practical importance to this correlation.

DISCUSSION

In light of modern medical knowledge, health behaviors are those that evoke certain positive or negative health effects.

Health is expressed not only in the physical dimension, assessed based on medical tests, but also in the psychological dimension, i.e. subjective feeling of psychological comfort and wellness.

Health should not be seen merely as an absence of unpleasant symptoms or ailments, but also as an ability to perform tasks and fulfill the assigned roles. It occupies a high place in the hierarchy of values, and considering its psychological and social dimension, it could be attributed an autotelic value.

Health behaviors represent a vast and poorly structured area covering health-related issues. They may be measured via observation and recording of different behaviors, self-observation or automatic behavior monitoring. Recording health behaviors causes a number of difficulties associated with, among other things, the effects of observation or recording of behaviors on the course of these behaviors, the required duration of assessment, and the impact of social approval.

Specific Absorption Rate (SAR) is the rate at which energy is absorbed by a human body exposed to radio waves from an electromagnetic field [35]. SAR is expressed as power absorbed per mass of tissue. Data on SAR measured in accordance with the PN-EN 50361 standard is provided in mobile phone technical documentation, with the maximum values of 0.5 – 1 W/kg for the majority of mobile phones offered by national mobile phone operators [36]. According to Karpowicz and Gryż [1], a mobile phone with SAR 0 W/kg would be absolutely safe for the user. It is emphasized in the literature [1] that SAR occurring in a mobile phone user during a real-time conversation differs from SAR determined in a laboratory setting due to different factors, including the way in which users hold their phones, conditions in which the conversation takes place, and the anthropometric features of the user (e.g. the shape and the size of the head).

According to Ponikło [2], the risk mechanism associated with increased body temperature was described in the Center for Immunological Research in Australia. It was shown that [as cited in 2] increased temperature results in an enhanced production of so-called heat shock proteins, which are normally produced by the body's cells, and whose role is to repair other damaged proteins. However, excessive production of heat shock proteins is likely to make cells more prone to malignancy.

It was also noted that mobile phones are involved in microbial transmission. Srikanth et al. [37] found that 75% of medical personnel and 37% of corporate employees were aware of the fact that mobile phones are inhabited by microbes and may be involved in the transmission of infectious agents.

According to Annad et al. [38], potential bacterial pathogens can be transmitted onto mobile telephones from the hands of their owners, thus posing a health risk for them. Furthermore, it is emphasized in the literature [29-32] that contaminated hands of medical personnel are one of the main vectors for microbial transmission in a hospital setting as well as the most common "carrier" of potentially pathogenic microorganisms. Proper hand hygiene considerably reduces the risk of cross-transmission via this route [29-32].

Ulger et al. [32] included 200 operating room and intensive care unit workers as well as 200 of their mobile phones in their study. They found that 94.5% of the mobile phones were contaminated with bacteria, with similar microbes isolated from the samples collected from mobile phones and the hands of their owners. They also found [32] that approx. 35% of mobile phones were inhabited by two types of bacteria, and 11% by three or more strains.

In our study, *C. glabrata* dominated in the collected samples, followed by *C. albicans* and *C. krusei*. These three species occurred on over half of the respondents, both on their hands and mobile phone surfaces.

Gashaw et al. [39] showed that as many as 29.3% of medical personnel carried their mobile phones together with other medical equipment, such as a stethoscope or neurological hammer.

We found that respondents usually kept their mobile phones in a bag (54.9%), and when moving around in a bag (50.3%) or in their pocket (44%). Therefore, it seems advisable to investigate the preferred health behaviors among mobile phone users, especially among health care personnel.

For this purpose, we used the HBI, which allowed to determine the general index of intensity of health behaviors as well as the degree of intensity of the following four categories of these behaviors: proper nutrition, mainly including the type of food; preventive behaviors related to compliance with health care recommendations and acquiring information on health and disease-related issues; health practices, which are daily habits related to sleep, rest and physical activity; and positive attitude, which is avoiding strong emotions, stress, and depressive situations [34].

Proper eating habits primarily relate to the type of food (e.g. whole grain bread, fruits, and vegetables) [34]. The statements describing preventive behaviors relate to compliance with

health care recommendations and acquiring information on health and disease-related issues [34]. Health practices include daily habits related to sleep and recreation or physical activity. Finally, positive attitudes include such psychological factors as avoiding excessively strong emotions, stress and tension, or depressive situations [34].

Our respondents showed the highest level of health behaviors in terms of attitude (avg. 3.45±3.5) and the lowest for health practices (avg. 3.12±3.17). The latter may be due to the relatively young population included in the study. Almost half of the respondents showed low levels of health behaviors, whereas almost every seventh respondent had high levels of health behaviors.

The Multidimensional Health Locus of Control (MHLC) scale was also used. The MHLC scale is based on the assumption that the internal health locus of control promotes health-oriented behaviors. It turns out, however, that these relationships are more complex and that other variables, such as self-efficacy and health valuation, are also important [34].

In our study, the evaluated mobile phone users were shown to strongly believe that they themselves have the greatest impact on their own health, which may result from the specificity of the study group, i.e. health care personnel.

Analysis of the obtained results also showed that individuals in favor of the opinion that health is determined by internal control attached greater importance to washing their hands. However, the strength of this correlation was weak. The T-test probability value p=0.075 also allowed for an assumption that there could be a certain relationship between the occurrence of *C. tropicalis* on hand surfaces and greater conviction about the inability to control one's own health. The impact of coincidence on human health was rated higher by individuals in whom *C. krusei* was identified compared with other groups. Those from whom *C. albicans* strains were isolated attached greater importance to the impact of others compared with other respondents. A statistically significant correlation also occurred between the number of *C. albicans* colonies and the assessment of the impact of others on health; however, this correlation was rather weak and indicated that the greater the importance respondents attributed to the impact of other people on health, the less *C. albicans* colonies were isolated from their hands. It is difficult to substantively explain this relationship. We also found relatively strong correlations between the assessment of internal health control and the impact of other people, and the number of *C.tropicalis* colonies; however, these correlations cannot be considered statistically significant due to the small sample size, and therefore no generalizations can be made on their basis. Unfortunately, no reports on the health behaviors of mobile phone users are available in the world or national literature. Therefore, a more extensive discussion comparing our results with other authors' reports is impossible.

CONCLUSIONS

1. There was a relatively strong conviction in the study population that the respondents themselves mainly had an effect on their health, and individuals in favor of this opinion attached greater importance to washing their hands.
2. Respondents showed the highest level of health behaviors in relation to attitude, whereas the lowest level towards preferred health practices.
3. Almost half of the respondents showed low levels of health behaviors, whereas almost every seventh respondent had high levels of health behaviors.
4. We found no correlation between preferred health behaviors and hand washing frequency, the number of colonies, and the isolation frequency of fungal strains collected from the surfaces of mobile phones and the hands of their owners.

Conflicts of interest

The authors declare no conflicts of interest.

REFERENCES

1. Karpowicz J, Gryż K. Telefonia bezprzewodowa w naszym życiu, Bezpieczeństwo Pracy – Nauka i Praktyka. 2005;6:26-9. (Polish)
2. Ponikło W. Czy telefony komórkowe są bezpieczne? Służba zdrowia. 2001;8:88-9. (Polish)
3. Velizarov S, Raskmark P, Kwee S. The effects of radiofrequency fields on cell proliferation are non-thermal. Bioelectrochem Bioenerg. 1999 Feb;48(1):177–80.
4. Prabhat C. Goswami, Lee D. Albee, Azemat J. Parsian, Jack D. Baty, Eduardo G. Moros, William F. Pickard, Joseph L. Roti Roti, and Clayton R. Hunt . Pro-oncogene mRNA levels and activities of multiple transcription factors in C3H 10T1/2 murine embryonic fibroblasts exposed to 835.62 and 847.74 MHz cellular telephone communication frequency radiation. Radiat Res. 1999 Mar;15(3):300–9.
5. Marinelli F, La Salsa D, Cicciotti G, Cattini L, Trimarchi C, Putti S, Zamparelli A, Giuliani L, Tomassetti G, Cinti C. Exposure to 900 MHz electromagnetic field induces an unbalance between pro-apoptotic and pro-survival signals in T-lymphoblastoid leukemia CCRF-CEM cells. J Cell Physiol. 2004 Feb;198(2):324–32.
6. Hardell L, Nasman A, Pahlson A, Hallquist A, Hansson Mild K. Use of cellular telephones and the risk for brain tumours: A case-control study. Int J Oncol. 1999 Jul;15(1):113–6.

7. Muscat JE, Malkin MG, Thompson S, Shore RE, Stellman SD, McRee D, Neugut AI, Wynder EL. Handheld cellular telephone use and risk of brain cancer. JAMA. 2000 Dec 20;284(23):3001-7.
8. Inskip PD, Tarone RE, Hatch EE, Wilcosky TC, Shapiro WR, Selker RG, Fine HA, Black PM, Loeffler JS, Linet MS. Cellular-telephone use and brain tumors. N Engl J Med. 2001 Jan 11; 344(2):79-86.
9. Stang A, Anastassiou G, Ahrens W, Bromen K, Bornfeld N, Jöckel KH. The possible role of radiofrequency radiation in the development of uveal melanoma. Epidemiology. 2001 Jan;12 (1):7–12.
10. Auvinen A, Hietanen M, Luukkonen R, Koskela RS. Brain tumors and salivary gland cancers among cellular telephone users. Epidemiology. 2002 May;13(3):356–9.
11. Hardell L, Hallquist A, Mild KH, Carlberg M, Påhlson A, Lilja A. Cellular and cordless telephones and the risk for brain tumours. Eur J Cancer Prev. 2002 Aug;11(4):377–86.
12. Warren HG, Prevatt AA, Daly KA, Antonelli PJ. Cellular telephone use and risk of intratemporal facial nerve tumor. Laryngoscope. 2003 Apr;113(4):663–7.
13. Hardell L, Hallquist A, Hansson Mild K, Carlberg M, Gertzén H, Schildt EB, Dahlqvist A. No association between the use of cellular or cordless telephones and salivary gland tumours. Occup Environ Med. 2004 Aug;61(8):675–9.
14. Hardell L, Eriksson M, Carlberg M, Sundström C, Mild KH. Use of cellular or cordless telephones and the risk for non-Hodgkin's lymphoma. Int Arch Occup Environ Health. 2002 Sep;78(8):625-32.
15. Hardell L, Carlberg M, Hansson Mild K. Case-control study on cellular and cordless telephones and the risk for acoustic neuroma or meningioma in patients diagnosed 2000-2003. Neuroepidemiology. 2005;25(3):120–8.
16. Schoemaker MJ, Swerdlow AJ, Ahlbom A, Auvinen A, Blaasaas KG, Cardis E, Christensen HC, Feychting M, Hepworth SJ, Johansen C, Klaeboe L, Lönn S, McKinney PA, Muir K, Raitanen J, Salminen T, Thomsen J, Tynes T. Mobile phone use and risk of acoustic neuroma: results of the Interphone case-control study in five North European countries. Br J Cancer. 2005 Oct 3;93(7):842-8.
17. Hardell L, Carlberg M, Hansson Mild K. Case-control study of the association between the use of cellular and cordless telephones and malignant brain tumors diagnosed during 2000-2003. Environ Res. 2002;100:232–41.
18. Linet MS, Taggart T, Severson RK, Cerhan JR, Cozen W, Hartge P, Colt J. Cellular telephones and non-Hodgkin lymphoma. Int J Cancer. 2006 Nov;119(10): 2382–8.
19. Myung SK, Ju W, McDonnell DD, Lee YJ, Kazinets G, Cheng CT, Moskowitz JM.Mobile phone use and risk of tumors: a meta-analysis. J Clin Oncol. 2009 Nov;27(33):5565-72.
20. Schüz J, Jacobsen R, Olsen JH, Boice JD Jr, McLaughlin JK, Johansen C. Cellular telephone use and cancer risk: update of a nationwide Danish cohort. J Natl Cancer Inst. 2006 Dec 6;98(23):1707-13.
21. Irnich W, Batz L, Müller R, Tobisch R. Electromagnetic interference of pacemakers by mobile phones. Pacing Clin. Electrophysiol. 1996 Oct;19(10):1431-46.
22. Huber R, Graf T, Cote KA, Wittmann L, Gallmann E, Matter D, Schuderer J, Kuster N, Borbély AA, Achermann P. Exposure to pulsed high-frequency electromagnetic field during waking affects human sleep EEG. Neuroreport. 2000 Oct 20;11(15):3321-5.
23. Burch JB, Reif JS, Yost MG, Keefe TJ, Pitrat CA. Nocturnal excretion of a urinary melatonin metabolite among electric utility workers. Scand. J. Work Environ. Health, 1998 Jun; 24(3):183–9.
24. Preece AW, Iwi G, Davies-Smith A, Wesnes K, Butler S, Lim E, Varey A. Effect of a 915-MHz simulated mobile phone signal on cognitive function in man. Int J Radiat Biol. 1999 Apr;75 (4):447–56.
25. Braune S, Wrocklage C, Raczek J, Gailus T, Lücking CH. Resting blood pressure increase during exposure to a radio-frequency electromagnetic field. Lancet. 1998 Jun 20;351 (9119):1857-8.
26. Agarwal A, Singh A, Hamada A, Kesari K. Cell phones and male infertility: a review of recent innovations in technology and consequences. Int Braz J Urol. 2011;Jul-Aug;37(4):432-54.
27. Reid DJ, Reid FJ. Text or talk? Social anxiety, loneliness, and divergent preferences for cell phone use. Cyberpsychol Behav, 2007 Jun;10 (3):424-35.
28. Block JJ. Issues for DSM-V: Internet Addiction. Am J Psychiatry. 2008 Mar;165(3):306-7.
29. Coutinho FP, Cavalcanti MS, Neto FC. Isolation of filamentous fungi from public telephones of the metropolitan region of the city of Recife, Pe, Brazil. Braz J Microbiol. 2007;38:324-9.
30. Johlizanti F, Kylie H, Enzo PA. Isolation of pathogenic bacteria and opportunistic pathogens from public telephones. Environ Health. 2001; 2(1):74-9.
31. Akinyemi KO, Atapu AD, Adetona OO. The potential role of mobile phones in the spread of bacterial infections. J Infect Dev Ctries. 2009 Sep;3(8):628-32.
32. Ulger F, Esen S, Dilek A, Yanik K, Gunaydin M, Leblebicioglu H. Are we aware how contaminated our mobile phones with nosocomial pathogens? Ann Clin Microbiol Antimicrob. 2009 Mar;8:7

33. Wallston KA, Wallston BS, DeVellis RF. Development of the Mul-tidimensional Health LOC (MHLC) Scales. Health Educ Monogr. 1978;6:160.
34. Juczyński Z. Narzędzia pomiaru w promocji i psychologii zdrowia. Wyd. Pracownia Testów Psychologicznych Polskiego Towarzystwa Psychologicznego, Warszawa, 2009. (Polish)
35. Jianming J. Electromagnetic Analysis and Design in Magnetic Resonance Imaging. CRC Press, 1998.
36. PN-EN 50361:2003 Pomiary swoistego tempa pochłaniania energii związanego z ekspozycją ludzi na pola elektromagnetyczne o częstotliwościach od 300 MHz do 3 GHz, wytwarzane przez telefony ruchome. Norma podstawowa TCO'01 Certification. (Polish)
37. Srikanth P, Rajaram E, Sudharsanam S. The mobile phone in a tropical setting – emerging threat for infection control. Sri. Ramachandra. J Med. 2009;2:18-20.
38. Annand JW, Bajaj N, Sheth A, Burgess J, Brooke JS. Potential pathogens and effective disinfectants on public telephones at a large urban United States university. J Environ Health. 2009 Jan-Feb;71(6):24-8,48.
39. Gashaw M, Abtew D, Addis Z. Prevalence and Antimicrobial Susceptibility Pattern of Bacteria Isolated from Mobile Phones of Health Care Professionals Working in Gondar Town Health Centers, ISRN Public Health. 2014;1-7.