

## THE EFFECT OF HABITUALLY CARRYING MOBILE PHONES IN TROUSER POCKETS ON URINE PROTEIN TEST RESULTS IN GORONTALO CITY

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### ABSTRACT

The widespread use of mobile phones has increased concerns regarding the potential health effects of prolonged exposure to radiofrequency electromagnetic fields, particularly among individuals who habitually carry mobile phones in their trouser pockets. This study aimed to determine the effect of this habit on urine protein examination results in Gorontalo City. A quantitative analytic study with a cross-sectional design was conducted at the BIOZIGMA Laboratory, Gorontalo City, from 4–6 September 2023. Thirty male students from Universitas Bina Mandiri Gorontalo were selected using purposive sampling. Data were collected through questionnaires assessing the duration of carrying mobile phones in trouser pockets and laboratory examination of urine protein using the dipstick method. Data were analyzed using descriptive statistics, followed by the Shapiro–Wilk normality test and the Mann–Whitney U test with a significance level of 0.05. Most respondents (76.7%) reported carrying their mobile phones for at least two hours daily, while 30.0% showed positive urine protein results. Normality testing indicated that the data were not normally distributed ( $p < 0.05$ ). The Mann–Whitney U test yielded a p-value of 0.052, indicating no statistically significant effect of carrying mobile phones in trouser pockets on urine protein examination results. These findings suggest that habitual storage of mobile phones in trouser pockets was not associated with proteinuria among healthy young adult males. Nevertheless, further studies involving larger sample sizes, longer exposure periods, and additional renal biomarkers are recommended to better understand the potential long-term effects of radiofrequency electromagnetic field exposure on kidney function.

**Keywords:** mobile phone; trouser pocket; urine protein; radiofrequency electromagnetic fields; kidney function.

### INTRODUCTION

The rapid advancement of mobile communication technology has made mobile phones an indispensable part of daily life. Globally, billions of people rely on smartphones for communication, education, work, entertainment, and access to digital services. While these devices provide substantial social and economic benefits, their widespread and prolonged use has raised increasing concerns regarding the potential health effects

associated with continuous exposure to radiofrequency electromagnetic fields (RF-EMF) emitted by mobile phones [1][2]. As smartphone ownership continues to increase across all age groups, understanding the biological implications of daily usage habits has become an important public health issue.

Mobile phones emit non-ionizing electromagnetic radiation during communication and data transmission. Although this type of radiation lacks

sufficient energy to directly damage DNA through ionization, prolonged and repeated exposure has been suggested to induce various biological responses, including oxidative stress, alterations in antioxidant defense mechanisms, DNA damage, and changes in cellular metabolism [3]. Furthermore, the International Agency for Research on Cancer (IARC) has classified RF-EMF as a Group 2B "possibly carcinogenic to humans," highlighting the need for continued investigation into its long-term biological effects [1]. Consequently, the safety of prolonged mobile phone exposure remains an active area of scientific inquiry.

In addition to exposure duration, the location where a mobile phone is carried has attracted growing attention. Many individuals habitually store their mobile phones in trouser pockets, attached to belts, or close to other body regions for extended periods. Such practices may increase localized RF-EMF exposure to nearby tissues and organs. Previous studies have reported that carrying mobile phones close to the body may contribute to localized tissue heating, oxidative stress, reproductive disturbances, neurological symptoms, and other biological alterations, although the available evidence remains inconsistent [4][5][6]. A survey conducted by Redmayne [7], also demonstrated that carrying smartphones in trouser pockets is a common behavior, particularly among young adults, indicating the importance of evaluating the biological consequences of this everyday habit.

The kidneys represent one of the organs that may receive relatively high RF-EMF exposure when mobile phones are frequently stored in trouser pockets.

Previous reports have suggested that radiofrequency energy can be absorbed by pelvic organs, including the kidneys, due to their anatomical proximity to the storage location of mobile phones. Experimental and physiological studies have proposed that prolonged RF-EMF exposure may influence renal function through oxidative stress mechanisms and cellular metabolic disturbances, potentially affecting biomarkers of kidney health. Since renal function plays a crucial role in maintaining protein homeostasis, alterations in kidney integrity may be reflected by changes in urinary protein excretion. Proteinuria is widely recognized as an early laboratory indicator of glomerular dysfunction and may precede the development of more severe renal impairment.

Chronic kidney disease (CKD) continues to be a significant global health burden. International epidemiological reports indicate that millions of individuals are affected by kidney diseases each year, contributing substantially to morbidity and mortality worldwide. In Indonesia, the prevalence of chronic kidney disease has also increased, making early identification of modifiable risk factors increasingly important for preventive healthcare. While established risk factors such as hypertension, diabetes mellitus, obesity, and lifestyle behaviors have been extensively investigated, environmental and behavioral factors related to modern technology use remain relatively understudied. This situation highlights the importance of exploring whether habitual mobile phone carrying practices may contribute to early changes in renal biomarkers.

Despite increasing evidence regarding the biological effects of RF-EMF exposure, most previous investigations have focused on cancer risk, oxidative stress, neurological disorders, reproductive health, or general exposure assessment [4][3]. Comparatively few studies have examined the association between mobile phone carrying habits and objective laboratory biomarkers that reflect renal function, particularly urinary protein levels. Moreover, evidence linking everyday body placement of mobile phones with laboratory-based clinical outcomes remains limited, creating an important gap in current scientific knowledge.

Therefore, this study aims to analyze the effect of the habit of carrying mobile phones in trouser pockets on urine protein examination results. The findings are expected to contribute additional laboratory-based evidence regarding the potential health implications of everyday mobile phone carrying behavior and provide valuable information for developing evidence-based recommendations on safer smartphone use.

## RESEARCH METHODS

### Study Design

This study employed a quantitative approach using an analytic cross-sectional design to determine the effect of the habit of carrying mobile phones in trouser pockets on urine protein examination results. In this design, data on the exposure variable (mobile phone carrying habit) and the outcome variable (urine protein examination results) were collected simultaneously during the study period.

### Study Setting and Period

The study was conducted at the BIOZIGMA Laboratory, Gorontalo City, over a period of three days, from 4 to 6 September 2023.

### Population and Sample

The study population consisted of individuals who habitually carried mobile phones in their trouser pockets in Gorontalo City. The research sample comprised 30 male students from Universitas Bina Mandiri Gorontalo who met the predetermined inclusion criteria.

The sample was selected using a purposive sampling technique, whereby participants were chosen according to specific characteristics relevant to the research objectives.

### Data Collection

Primary data were collected using two methods:

1. Questionnaire, to obtain respondent characteristics and information regarding the habit of carrying mobile phones in trouser pockets, particularly the duration of carrying the device.
2. Laboratory examination, to determine urine protein levels from urine specimens collected from each respondent using the urine dipstick (strip) method under standard laboratory procedures.

### Study Variables

The independent variable in this study was the habit of carrying a mobile phone in the trouser pocket, categorized according to the duration of exposure (<2 hours and  $\geq 2$  hours).

The dependent variable was the urine protein examination result, classified as positive or negative based on the dipstick test.

### Data Analysis

Data were analyzed using IBM SPSS Statistics.

Univariate analysis was performed to describe respondent characteristics and the distribution of each study variable using frequencies and percentages.

Prior to hypothesis testing, a Shapiro–Wilk normality test was conducted to assess the distribution of the study variables. Because the significance value was less than 0.05, the data were considered not normally distributed. Consequently, the planned Chi-square analysis was not performed, and the relationship between the study variables was analyzed using the Mann–Whitney U test as a non-parametric alternative. Statistical significance was determined at a 95% confidence level ( $\alpha = 0.05$ ).

## RESEARCH RESULTS

This study was conducted over a period of three days, from 4 to 6 September 2023, at the BIOZIGMA Laboratory, Gorontalo City. A total of 30 respondents who met the inclusion criteria participated in the study. The findings are presented according to respondent characteristics, distribution of study variables, and statistical analysis.

### Respondent Characteristics

The characteristics of respondents based on gender and age are presented in Table 1.

**Table 1. Respondent Characteristics**

Characteristics	Category	Frequency (n)	Percentage (%)
Gender	Male	30	100.0
	Female	0	0.0
	Total	30	100.0
Age (years)	17–19	19	63.3
	20–22	11	36.7
	Total	30	100.0

Table 1 shows that all respondents (100%) were male. Based on age distribution, the majority of respondents were 17–19 years old (63.3%), while the remaining 36.7% were 20–22 years old.

### Distribution of Mobile Phone Carrying Habits and Urine Protein Examination Results

The distribution of respondents according to the duration of carrying mobile phones in trouser pockets and urine protein examination results is presented in Table 2.

**Table 2. Distribution of Mobile Phone Carrying Habits and Urine Protein Examination Results**

Variable	Category	Frequency (n)	Percentage (%)
Duration of carrying mobile phone in trouser pocket	≥ 2 hours	23	76.7
	< 2 hours	7	23.3
	Total	30	100.0
Urine protein examination	Positive	9	30.0
	Negative	21	70.0
	Total	30	100.0

As shown in Table 2, most respondents (76.7%) reported carrying their mobile phones in their trouser pockets for two hours or longer, while 23.3% carried their phones for less than two hours. Laboratory examination using the urine dipstick method revealed that 9 respondents (30.0%) had positive urine protein results, whereas 21 respondents (70.0%) showed negative results.

### Normality Test

Before hypothesis testing, a normality test was performed using the

Shapiro–Wilk test. The results are presented in Table 3.

**Table 3. Shapiro–Wilk Normality Test Results**

Variable	n	p-value	Interpretation
Mobile phone carrying habit	30	0.000	Not normally distributed
Urine protein examination result	30	0.000	Not normally distributed

The Shapiro–Wilk test indicated that both study variables had significance values of 0.000, which were lower than the predetermined significance level of 0.05. Accordingly, the data were considered not normally distributed. Based on the statistical procedure adopted in this study, hypothesis testing was subsequently performed using the Mann–Whitney U test.

#### **Analysis of the Effect of Mobile Phone Carrying Habits on Urine Protein Examination Results**

The effect of carrying mobile phones in trouser pockets on urine protein examination results was analyzed using the Mann–Whitney U test, as presented in Table 4.

**Table 4. Mann–Whitney U Test Results**

Variable	n	p-value	Interpretation
Mobile phone carrying habit and urine protein examination result	30	0.052	Not significant

The Mann–Whitney U test yielded an Asymp. Sig. (2-tailed) value of 0.052, which exceeded the significance threshold of 0.05 ( $p = 0.052 > 0.05$ ). Therefore, the null hypothesis ( $H_0$ ) was accepted and the alternative hypothesis ( $H_a$ ) was rejected. These findings indicate that there was no statistically significant effect of the habit of carrying mobile phones in trouser

pockets on urine protein examination results among the respondents included in this study.

## **DISCUSSION**

The present study investigated the effect of the habit of carrying mobile phones in trouser pockets on urine protein examination results among young adult males in Gorontalo City. The statistical analysis using the Mann–Whitney U test demonstrated that there was no significant effect between the duration of carrying mobile phones in trouser pockets and urine protein examination results ( $p = 0.052$ ). Although 30.0% of respondents exhibited positive urine protein findings, these results were not statistically associated with the duration of mobile phone storage in trouser pockets.

The absence of a significant association suggests that the duration of carrying a mobile phone in the trouser pocket, as observed in this study, may not be sufficient to induce detectable alterations in renal function reflected by urine protein excretion. Proteinuria is commonly regarded as an early biomarker of glomerular injury, indicating increased permeability of the glomerular filtration barrier. Because urine protein levels are influenced by numerous physiological and pathological factors, including hydration status, physical activity, infection, hypertension, diabetes mellitus, and intrinsic kidney disease, exposure to low-level radiofrequency electromagnetic fields (RF-EMF) generated by mobile phones may contribute only minimally compared with these established determinants.

Several experimental studies have suggested that prolonged exposure to radiofrequency electromagnetic radiation may affect renal tissue. Borzoueisileh et al. [8], reported that radiofrequency electromagnetic field exposure produced histopathological alterations in renal tissue and changes in renal biochemical parameters in animal models, primarily through oxidative stress and inflammatory pathways. Likewise, experimental evidence has demonstrated that electromagnetic radiation may increase lipid peroxidation while reducing antioxidant defense mechanisms, potentially resulting in cellular injury and impaired renal function. These biological mechanisms are believed to involve excessive production of reactive oxygen species (ROS), mitochondrial dysfunction, and inflammatory responses that may eventually compromise kidney integrity [8].

Despite these experimental findings, evidence from human studies remains limited and inconsistent. Most available investigations have been conducted under controlled laboratory conditions using animal models with radiation exposures that differ substantially from normal human mobile phone use. Consequently, the biological effects observed experimentally may not directly translate to everyday exposure experienced by individuals who routinely carry mobile phones in their trouser pockets. Furthermore, the kidneys are anatomically located within the abdominal cavity and are relatively protected by surrounding tissues, reducing the amount of radiofrequency energy absorbed compared with superficial organs located closer to

the body surface [9]. This anatomical characteristic may partly explain why no significant relationship was identified in the present study.

Another consideration is the relatively low specific absorption rate (SAR) emitted by commercially available mobile phones during routine use. SAR represents the amount of electromagnetic energy absorbed by biological tissues. Previous investigations have indicated that RF-EMF exposure from mobile phones carried near the body generally remains below internationally recommended safety limits and may be insufficient to induce measurable biological alterations in internal organs during ordinary daily activities [10]. Therefore, the exposure experienced by respondents in this study may not have reached the threshold required to produce clinically detectable changes in urine protein levels.

The findings of this study also indicate that a substantial proportion of respondents (70.0%) had negative urine protein results despite reporting prolonged mobile phone storage in their trouser pockets. This observation supports the notion that habitual carrying of mobile phones alone is unlikely to represent an independent risk factor for proteinuria in healthy young adults. Since all respondents were relatively young males aged between 17 and 22 years, it is possible that their normal renal physiological function and absence of significant comorbidities contributed to maintaining normal urine protein excretion despite prolonged mobile phone exposure.

Although no statistically significant effect was identified, the present findings should be interpreted cautiously. The p-

value obtained (0.052) was very close to the predetermined significance level, suggesting that a larger sample size might provide greater statistical power to detect subtle associations if they exist. Moreover, the present study categorized exposure solely according to the duration of carrying mobile phones in trouser pockets (<2 hours and  $\geq$ 2 hours) without considering additional exposure-related factors such as mobile phone model, transmission power, specific absorption rate (SAR), frequency of active phone use, or cumulative years of exposure. These variables may influence the actual amount of radiofrequency energy absorbed by the body and should be incorporated into future investigations.

Another important limitation in the current body of literature is the absence of studies directly evaluating the relationship between habitual mobile phone carrying behavior and urine protein examination results in humans. Existing research has primarily focused on experimental renal histopathology, oxidative stress biomarkers, reproductive health, neurological outcomes, or the application of smartphones as diagnostic tools for urine protein analysis rather than as potential exposure sources [11][12][13]. Consequently, direct comparison between the findings of the present study and previous human studies remains difficult.

Overall, the present study contributes preliminary evidence indicating that the habit of carrying mobile phones in trouser pockets was not significantly associated with urine protein examination results among healthy young adults. Nevertheless, considering the limited human evidence and the biological

mechanisms reported in experimental studies, further investigations involving larger populations, longer exposure durations, quantitative RF-EMF measurements, and additional renal biomarkers are required to clarify the potential long-term effects of habitual mobile phone exposure on kidney function.

## CONCLUSION

This study concludes that the habit of carrying mobile phones in trouser pockets was not significantly associated with urine protein examination results among the respondents. Although some participants showed positive urine protein findings, statistical analysis indicated that these results were not related to the duration of carrying mobile phones in trouser pockets. These findings suggest that, within the characteristics of the study population, habitual mobile phone placement in trouser pockets did not produce measurable changes in urine protein levels. Nevertheless, considering the limited sample size and the complexity of factors influencing renal function, further studies involving more diverse populations, longer exposure durations, and additional kidney function biomarkers are recommended to provide more comprehensive evidence regarding the potential health effects of long-term mobile phone exposure.

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