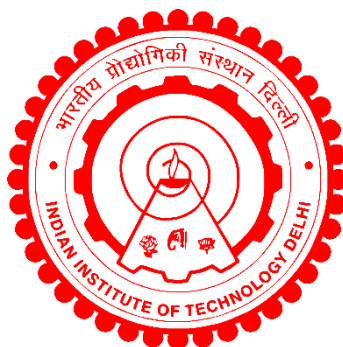


**A STUDY OF RISK PERCEPTION, COMMUNICATION
AND AWARENESS OF RF-EMF EXPOSURE FROM
MOBILE PHONES AND BASE STATIONS IN INDIAN
CONTEXT**

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by

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Submitted

in fulfilment of the requirements of the degree of Doctor of Philosophy

to the



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CERTIFICATE

This is to certify that the thesis entitled “**A Study of Risk Perception, Communication and Awareness of RF-EMF exposure from mobile phones and base stations in Indian Context**”, submitted by Ms. Rojalin Pradhan to Indian Institute of Technology Delhi, for the award of the degree of the Doctor of Philosophy is a record of bonafide research work carried out by her. She worked under our supervision for the submission of this thesis, which to the best of our knowledge has reached the requisite standard.

The research reports and the results presented in this thesis have not been submitted in parts or in full to any other University or Institute for the award of any degree or diploma.

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“The beginning of all wisdom is acknowledge of facts” Juho Kusti Passikivi

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Date:

(Rojalin Pradhan)

*I would like to dedicate this thesis to my Mom & Dad,
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ABSTRACT

Access to mobile communications has become an increasingly important part of the daily lives of most people. According to information from the telecommunications regulator, it has been said that the number of people using mobile phones in India has dramatically increased since its introduction in the mid-1990s. It has been predicted that the number of mobile subscriptions (both voice and data) will exceed the total global population by the end of this year, with India emerging as the world's second largest mobile phone subscriber market after China.

Due to the ever-increasing use of the mobile phones in India, RF-EMF exposure from mobile phones and base stations and their possible effects on human health has become a topic of increased research interest. There is a major apprehension among people that RF-EMF exposure from mobile phones and base stations are affecting human health. Even though the use of mobile phones has increased drastically, people are accustomed to believing that it causes no risk to their health. But there is negative perception towards base stations, which has resulted in the obstruction of base station installations near residential areas, hospitals, schools, etc. However, for better mobile service and larger demographic reach, there is a requirement for investment and development of telecom infrastructure. Therefore, it is necessary to understand the public's perception towards RF-EMF exposure, communicate them proper knowledge about mobile communication and make them take an informed choice for the same. Though there are several studies available worldwide to understand the public's risk perception towards RF-EMF exposure from mobile phones and base stations, but there is limited work done to identify the level of the public's perception towards RF-EMF exposure and to understand the reasons for their concerns on Indian citizens. So, there is a need to bridge the research gap in the Indian context by developing a risk awareness model for creating awareness among the public.

The main objective of this research is to understand the public's perception towards RF-EMF exposure from mobile phones and base stations and examine the impact of risk communication on their health risk perception to address the apprehension towards it. The main objective aims at achieving by the following three sub-objectives: (i) To identify the factors that influence public risk perception towards RF-EMF exposure and how these factors influencing those concern (ii) To study the impact of technical knowledge and precautionary guidelines on the public's health concern and risk perception towards RF-EMF exposure (iii) To identify the important factors that influence consumer health risk awareness of RF-EMF exposure and also helps to develop a consumer health risk awareness model for creating awareness among the public. These three objectives were achieved through three studies for each of the objectives correspondingly and provide a holistic view of risk in terms of risk perception, risk communication and risk awareness in the context to RF-EMF exposure from mobile phones and base stations.

Study 1 identified the factors that influence public risk perception towards RF-EMF exposure from mobile phones and base stations through semi-structured interviews on a small group of people and the results were then used to develop a survey questionnaire on larger sample size to understand the factors influencing those concerns. Correlation analysis and multiple regression analysis have been carried out to check the relation between the factors.

The result shows that many Indian citizens have a positive attitude towards mobile phones and were willing to accept the possible risks but they were against the installation of mobile base stations near their premises. It is also confirmed that the publics are not aware of guidelines produced by the regulatory body.

Study 2 evaluated the impact of technical knowledge about mobile communication and precautionary guidelines on mobile phone usage on participant's health concern and risk perception towards RF-EMF exposure by providing them with an information booklet.

Hypotheses were formulated to define the relationship between the variables identified from study 1 and literature review. Three stages experimental survey (before, after and two weeks after booklet) was designed to collect data. One Way ANOVA and independent sample t-test were done to examine the relationship between the variables and test the hypotheses.

There was an enhancement of participant's knowledge about RF-EMF exposure after reading the information booklet. The information booklet led to change in participant's perception regarding the thought that their health is being affected by mobile phones and base stations. A voluntary precautionary guideline has indicated a positive impact on the public's perception if it was provided by the regulatory body.

Study 3 identified various factors that influence consumer's health risk awareness of RF-EMF exposure and developed a hierarchical model for communicating and creating awareness about the facts of mobile communication and clear their misconceptions towards RF-EMF exposure. Clear hierarchies among the factors and various linkages between them have helped us to precisely analyze and understand how these factors interact with each other and what role they play in influencing the consumer's health risk awareness.

The present study discovered a new insight into risk communication by providing a consumer health risk awareness model. The awareness model is developed on the premises of aware consumer and informed choice. This serves to fill a significant research gap as far as understanding the process through which consumer health risk awareness of RF-EMF exposure is shaped up. This model will have a high social impact for all the stakeholders of the telecom industry (Regulator, Telecom Service Provider, Policy planer and Consumer) and can increase awareness among the general public to reduce risk perception.

सार

मोबाइल संचार तक पहुँच अधिकांश लोगों के दैनिक जीवन का एक महत्वपूर्ण हिस्सा बन गया है। दूरसंचार नियामक से मिली जानकारी के अनुसार, यह कहा गया है कि 1990 के दशक के मध्य से भारत में मोबाइल फोन का उपयोग करने वालों की संख्या नाटकीय रूप से बढ़ी है। यह अनुमान लगाया गया है कि मोबाइल सदस्यता (आवाज और डेटा दोनों) की संख्या इस वर्ष के अंत तक कुल वैश्विक आबादी से अधिक हो जाएगी, भारत चीन के बाद दुनिया का दूसरा सबसे बड़ा मोबाइल फोन ग्राहक बाजार के रूप में उभर रहा है।

भारत में मोबाइल फोन के लगातार बढ़ते उपयोग के कारण, मोबाइल फोन और बेस स्टेशनों से आरएफ-ईएमएफ एक्सपोज़र और मानव स्वास्थ्य पर उनके संभावित प्रभावों में वृद्धि हुई अनुसंधान रुचि का विषय बन गया है। लोगों में एक बड़ी आशंका है कि मोबाइल फोन और बेस स्टेशनों से आरएफ-ईएमएफ जोखिम मानव स्वास्थ्य को प्रभावित कर रहा है। भले ही मोबाइल फोन का उपयोग बहुत अधिक बढ़ गया हो, लेकिन लोग यह मानने के आदी हैं कि इससे उनके स्वास्थ्य को कोई खतरा नहीं है। लेकिन बेस स्टेशनों के प्रति नकारात्मक धारणा है, जिसके परिणामस्वरूप आवासीय क्षेत्रों, अस्पतालों, स्कूलों आदि के पास बेस स्टेशन की स्थापना में बाधा उत्पन्न हुई है, हालांकि, बेहतर मोबाइल सेवा और बड़ी जनसांख्यिकीय पहुँच के लिए, दूरसंचार के निवेश और विकास की आवश्यकता है आधारिक संरचना। इसलिए, आरएफ-ईएमएफ एक्सपोज़र के बारे में जनता की धारणा को समझना आवश्यक है, उन्हें मोबाइल संचार के बारे में उचित ज्ञान का संचार करें और उन्हें उसी के लिए एक सूचित विकल्प बनाएं। यद्यपि मोबाइल फोन और बेस स्टेशनों से RF-EMF जोखिम के प्रति जनता की जोखिम धारणा को समझने के लिए दुनिया भर में कई अध्ययन उपलब्ध हैं, लेकिन RF-EMF जोखिम के प्रति जनता की धारणा के स्तर की पहचान करने और इसके कारणों को समझने के लिए सीमित काम किया गया है भारतीय नागरिकों पर उनकी चिंता। इसलिए, जनता के बीच जागरूकता पैदा करने के लिए एक जोखिम

जागरूकता मॉडल विकसित करके भारतीय संदर्भ में शोध अंतर को पाटने की आवश्यकता है।

इस शोध का मुख्य उद्देश्य मोबाइल फोन और बेस स्टेशनों से आरएफ-ईएमएफ जोखिम के प्रति जनता की धारणा को समझना और इसके प्रति आशंका को दूर करने के लिए उनकी स्वास्थ्य जोखिम धारणा पर जोखिम संचार के प्रभाव की जांच करना है। मुख्य उद्देश्य निम्नलिखित तीन उप-उद्देश्यों को प्राप्त करना है: (i) आरएफ-ईएमएफ जोखिम के प्रति सार्वजनिक जोखिम धारणा को प्रभावित करने वाले कारकों की पहचान करना और ये कारक उन चिंताओं को कैसे प्रभावित करते हैं (ii) तकनीकी ज्ञान और एहतियाती प्रभाव का अध्ययन करना आरएफ-ईएमएफ एक्सपोज़र (iii) के प्रति जनता की स्वास्थ्य चिंता और जोखिम की धारणा पर दिशानिर्देश, आरएफ-ईएमएफ एक्सपोज़र के उपभोक्ता स्वास्थ्य जोखिम जागरूकता को प्रभावित करने वाले महत्वपूर्ण कारकों की पहचान करने और जनता के बीच जागरूकता पैदा करने के लिए एक उपभोक्ता स्वास्थ्य जोखिम जागरूकता मॉडल विकसित करने में मदद करता है। इन तीनों उद्देश्यों को प्रत्येक उद्देश्य के लिए तीन अध्ययनों के माध्यम से प्राप्त किया गया था और मोबाइल फोन और बेस स्टेशनों से आरएफ-ईएमएफ जोखिम के संदर्भ में जोखिम धारणा, जोखिम संचार और जोखिम जागरूकता के संदर्भ में जोखिम का एक समग्र दृष्टिकोण प्रदान करता है।

अध्ययन 1 ने उन कारकों की पहचान की जो लोगों के एक छोटे समूह पर अर्ध-संरचित साक्षात्कारों के माध्यम से मोबाइल फोन और बेस स्टेशनों से आरएफ-ईएमएफ जोखिम के प्रति सार्वजनिक जोखिम धारणा को प्रभावित करते हैं और परिणाम तब समझने के लिए बड़े नमूना आकार पर एक सर्वेक्षण प्रश्नावली विकसित करने के लिए उपयोग किए गए थे। कारक उन चिंताओं को प्रभावित करते हैं। कारकों के बीच संबंध की जांच करने के लिए सहसंबंध विश्लेषण और कई प्रतिगमन विश्लेषण किए गए हैं।

परिणाम से पता चलता है कि कई भारतीय नागरिकों के मोबाइल फोन के प्रति सकारात्मक दृष्टिकोण है और वे संभावित जोखिमों को स्वीकार करने के लिए तैयार हैं, लेकिन वे अपने परिसर के पास मोबाइल बेस स्टेशनों की स्थापना के खिलाफ थे। यह भी पुष्टि की जाती है कि जनता नियामक संस्था द्वारा निर्मित

दिशा-निर्देशों से अवगत नहीं है।

अध्ययन 2 ने प्रतिभागी के स्वास्थ्य की चिंता पर मोबाइल फोन के उपयोग और आरएफ-ईएमएफ जोखिम के बारे में सूचना पुस्तिका के साथ प्रदान करके मोबाइल संचार और एहतियाती दिशा निर्देशों के बारे में तकनीकी ज्ञान के प्रभाव का मूल्यांकन किया।

अध्ययन 1 और साहित्य की समीक्षा से पहचाने गए चर के बीच संबंधों को परिभाषित करने के लिए परिकल्पनाएं तैयार की गईं। तीन चरण प्रायोगिक सर्वेक्षण (बुकलेट से पहले और बाद के दो सप्ताह) को डेटा एकत्र करने के लिए डिज़ाइन किया गया था। एक तरह का एनोवा और स्वतंत्र नमूना टी-परीक्षण, चर के बीच संबंधों की जांच करने और परिकल्पनाओं का परीक्षण करने के लिए किया गया था।

सूचना पुस्तिका पढ़ने के बाद आरएफ-ईएमएफ एक्सपोज़र के बारे में प्रतिभागियों के ज्ञान में वृद्धि हुई थी। सूचना पुस्तिका ने प्रतिभागी की इस धारणा के बारे में सोचा कि उनके स्वास्थ्य पर मोबाइल फोन और बेस स्टेशनों का प्रभाव पड़ रहा है। एक स्वैच्छिक एहतियाती दिशानिर्देश ने नियामक संस्था द्वारा प्रदान किए जाने पर जनता की धारणा पर सकारात्मक प्रभाव का संकेत दिया है।

अध्ययन 3 ने विभिन्न कारकों की पहचान की है जो आरएफ-ईएमएफ जोखिम के बारे में उपभोक्ता के स्वास्थ्य जोखिम जागरूकता को प्रभावित करते हैं और संचार और मोबाइल संचार के तथ्यों के बारे में जागरूकता पैदा करने के लिए एक पदानुक्रमित मॉडल विकसित करते हैं और आरएफ-ईएमएफ जोखिम के प्रति उनकी गलतफहमी को दूर करते हैं। कारकों और उनके बीच विभिन्न संपर्कों के बीच स्पष्ट पदानुक्रमों ने हमें सटीक रूप से विश्लेषण करने और समझने में मदद की है कि ये कारक एक दूसरे के साथ कैसे बातचीत करते हैं और उपभोक्ता के स्वास्थ्य जोखिम जागरूकता को प्रभावित करने में उनकी क्या भूमिका है।

वर्तमान अध्ययन ने एक उपभोक्ता स्वास्थ्य जोखिम जागरूकता मॉडल प्रदान करके जोखिम संचार में एक नई अंतर्दृष्टि की खोज की। जागरूकता मॉडल को जागरूक उपभोक्ता और सूचित विकल्प के

परिसर में विकसित किया जाता है। यह एक महत्वपूर्ण शोध अंतर को भरने का कार्य करता है, जहां तक उस प्रक्रिया को समझने में जिसके माध्यम से आरएफ-ईएमएफ एक्सपोज़र के उपभोक्ता स्वास्थ्य जोखिम जागरूकता को आकार दिया जाता है। इस मॉडल का दूरसंचार उद्योग (नियामक, दूरसंचार सेवा प्रदाता, नीति नियोजक और उपभोक्ता) के सभी हितधारकों के लिए उच्च सामाजिक प्रभाव होगा और जोखिम धारणा को कम करने के लिए आम जनता में जागरूकता बढ़ा सकता है।

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ABBREVIATION

ANOVA	Analysis of Variance
BS	Base station
DoT	Department of Telecom
FCC	Federal Communication Commission
GDP	Gross Domestic Product
GT	Grounded Theory
IAR	International Agency for Research on Cancer
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ITU	International Telecommunication Union
KMO	Kaiser-Meyer-Olkin
MP	Mobile Phone
NIH	National Institutes of Health
PCA	Principal Component Analysis
RF-EMF	Radio Frequency Electro Magnetic Field
SAR	Specific Absorption Rate
SPSS	Statistical Package for the Social Sciences
TISM	Total Interpretive Structural Modelling
TRAI	Telecom Regulatory Authority of India
WHO	World Health Organization
SARF	Social Amplification of Risk Framework