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Students Exposure to Radio Frequency Electromagnetic Fields in Marmara University

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ABSTRACT

In recent years, there has been increasing public concern about the health implication of electromagnetic (EM) wave exposures due to the electronic sources. For this reason, various public organizations in the world have been established safety guidelines. In this study, electric field strength values are measured at 44 different location points of Marmara University in Göztepe Campus. In addition to the spot measurements, 24 hours measurement is also done to analyze the variation of electric field strength values. The results show that the measured electric field strength values are below the recommended international standard limits.

Keywords: Electromagnetic Pollution, Measurements, Radio Frequency Radiation.

I. INTRODUCTION

With the rapid growth of new technologies, there has been a considerable raise of exposure to radio frequency (RF) electromagnetic fields (EMF) [1]. Beside radars, radio, broadcast transmitters and phone base stations are among the most powerful, high-frequency sources of EMFs. Because RFs are invisible and imperceptible, individuals cannot directly determine at what level they are exposed to RF EMF. There are therefore significant challenges in assessing the exposure of individuals in the general population from RF signals, including the number and range of sources involved, and the effect of the environment on signal strengths as people move around.

To evaluate personal exposure to RF EMF in daily life, recently developed exposure meters are useful and have been recommended [1, 2]. Radiation measurement probes are used in several studies [1, 3-10] in which they contribute to total exposure from all RF EMF sources in different locations during everyday life activities. In addition, more detailed studies have been conducted using spot measurements at the homes of study participants [11, 12], 24 hours personal measurements [4-7], measurements in different microenvironments [3] or modeling of mobile phone base station or broadcast transmitter radiation [13-15].

Some of the studies are population surveys where the personel exposure distribution in the population of interest is determined in different countries. Mantiply et. al. has made a summary of data from a number of studies on the range of RF field levels associated with a variety of environmental studies [16]. Frei et. al. investigated the levels, the sources and the variability of exposure to environmental RF EMF in a group of adult volunteers living in a Swiss city using personal exposimeters [17]. Viel, et. al. assesses RF exposure on a population basis in France, checks its variability with time, location and activity, and clarifies the relative contribution of different sources to the total exposure [18]. [19] compares personal RF EMF exposure in different microenvironments between urban areas in Belgium, Switzerland, Slovena, Hungary, and the Netherlands. Moreover, in another study, the potential health effects from telecommunication emissions in Greece is assessed with respect to location and time [20].

The ultimate goal of this research work is to survey RF EMF exposure levels in Marmara University Göztepe Campus. The objective of this contribution is the evaluation of the EMF exposure assessment of the possible health hazards for technical personnel and students in the university. In Section 2, the details of the exposimeter that is used in the measurements as well as the measurement methods are presented. Section 3 depicts the results of RF EMF spot and 24 hours measurements on the google map of the campus. The study is concluded with Section 4 describing the discussion of the method, and comparisons with ICNIRP Guidelines.

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II. MEASUREMENT MATERIALS AND METHODS

Measurements have been carried out in Marmara University, Göztepe Campus using NBM 550, personal exposure meter. NBM 550 is a portable measurement device which covers 100 kHz to 3 GHz frequency range with the isotropic probe, EF-0391.

As an initial survey, electric field strengths have been measured at points where the technical staff and students spend most of the time during working hours in the university. The detailed analysis has been conducted at the points where the maximum field strength values are noted. These locations are reported as Sport Areas, Student and Guest Parking Area, Handan Ertuğrul Girl Domitory, and Mechatronic Building in the university. Detailed analysis has been performed at different heights relative to the ground as well as at different distances from the point where the maximum field strength has been noted.

Following Narda instructions the probe was never closer than the distance of 20 cm from the metallic objects and the estimated source of radiation in order to avoid mutual coupling between the probe and the source and other measuring irregularities. To minimize the effects of the ambient sources, appliances and equipments in the area of the device under test were turned off. This survey is repeated five times in a day. Spot measurements were done at fixed locations with the measurement device.

During the measurements, the broadband probe/instrument was held in an extended arm as far as possible away from the body to minimize the effect of the human body on the electric field distribution. Six minute averaging was not done, since the measured values were stable during the measurements. Instead, the maximum value in one minute was taken as the result of the measurement.

III. RESULTS AND DISCUSSION

Spot measurements were done at 44 different locations in Goztepe Campus both on a weekday and a weekend day. Because measured exposure levels on the work day was higher than the weekend day, only the work day's measurements were given in this study. The maximum root-meansquare (RMS) value of the field strength were recorded at each measurement points.

Measurement results are given in Figure 1 and Figure 2 in colors which corresponds to electric and magnetic field strength ranges, respectively. Field intensity is shown in units of volts/meter for electric field strength and in amperes/meter for magnetic field strength. The highest mean values were recorded for outdoor sports area and Handan Ertugrul girl dormitory in the campus. Electric field strengths at an outdoor area were typically 2 to 2.5 V/m, and at girl dormitory 1.7 to 2 V/m. Numbers in the figures are the building names which are tabulated in Table 1.

The detailed measurements are performed for Outdoor Sports Area and Handan Ertugrul Girl Dormitory buildings . Their locations in Göztepe Campus are shown on the map in Figure 3. Firstly, the electric field values have been measured all around the outdoor sports area. At the point where the maximum field value is noted, that location is taken as a reference point. As it is clearly seen in Figure 4, that reference point is shown with 0 m range. The colors in the figure corresponds to different height levels where the probe location is moved to 0 m to 2 m in 0.5 m intervals. As indicated in the figure, as the height rises, the electric field strength values are also climbing, in addition as the distance increases the electric field values gradually decreases. Because the purpose of this study is to analyze the health effects of students, the measurements above the humans' height is not considered.

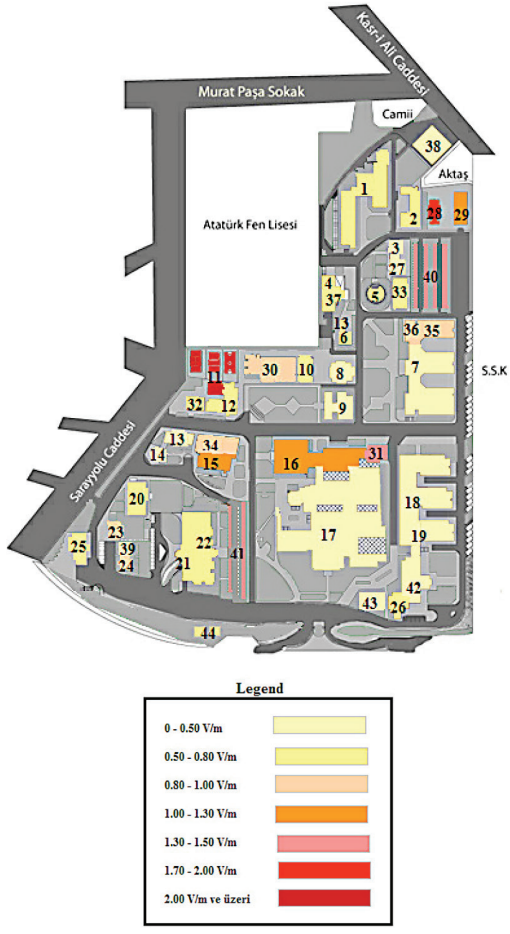

Figure 1. The measured electric field values in Goztepe Campus, Marmara University

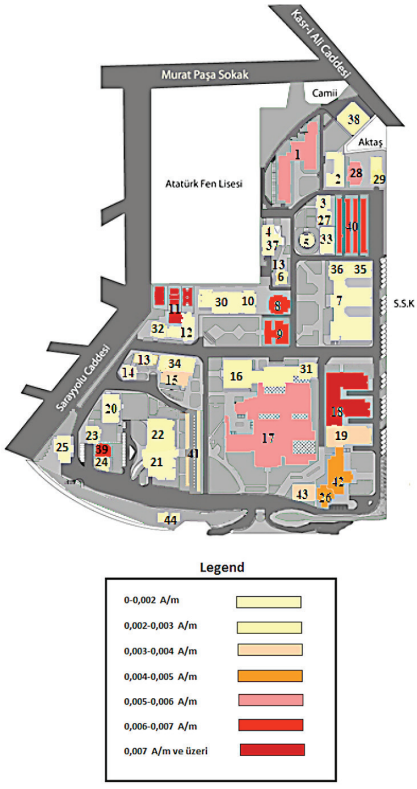

Figure 2. The measured magnetic field values in Goztepe Campus, Marmara University

Table 1. Building names in Goztepe Campus

No	Building Names
1	A.F.E. School of Foreign Languages
2	Faculty of Engineering D Block
3	Medico-Social Center
4	Campus Dining Hall
5	125th Year Theatre
6	Historical Turkish Bath
7	Faculty of Arts and Sciences
8	Faculty of Engineering B Block
9	Faculty of Engineering Administrative Building
10	Faculty of Engineering C Block
11	Outdoor Sports Area
12	Faculty of Economics
13	School of Foreign Languages Administrative Building
14	School of Foreign Languages Classrooms
15	Dr. İbrahim Uzumcu Auditorium
16	Indoor Sports Hall
17	Ataturk Faculty of Education
18	Faculty of Technical Education
19	Vocational School of Technical Sciences
20	Ozmen Aktar Girl Dormitory
21	Rector's Office
22	Central Library
23	Institute of Turkish Studies
24	European Union Institute
25	Guet House
26	Revolving Fund Administration
27	Health, Culture, Sports Administrative Dept.
28	Handan Ertugrul Girl Dormitory
29	Prosthetics Orthotics Rehabilitation Center
30	Market Area
31	Mechatronic Systems Laboratory
32	School of Banking and Insurance
33	The Student Information Processing Area
34	Institute of Banking and Insurance
35	Institute of Pure and Applied Sciences
36	Institute of Educational Sciences
37	Mustafa Necati Auditorium
38	Heat Power Station
39	International Office
40	Student and Guest Parking
41	Academic Member Parking Lot
42	Revolving Fund Accountancy Office
43	Life-Long Learning Programme Center
44	Post Office

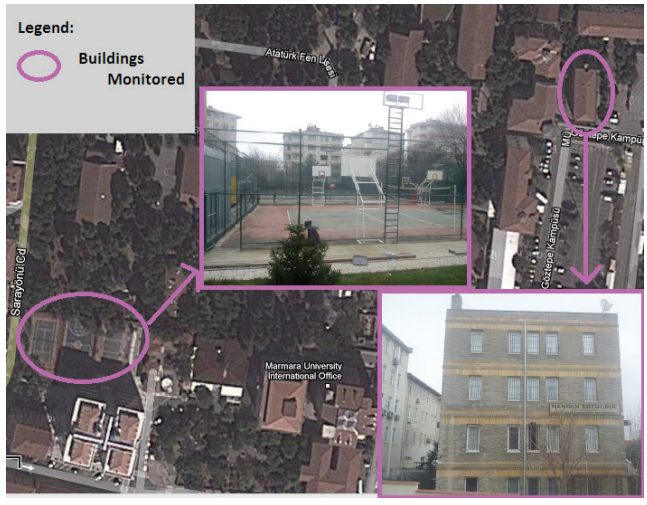

Figure 3. The view of Outdoor Sport Areas and H.E. Girl Dormitory buildings in the map

Secondly, electric field measurements for Handan Ertugrul Dormitory are monitored for 24 hours. According to the measurement results which are given in Figure 5, at midnight and in the morning time intervals electric field strength values fluctuate in between 1.28 V/m and 1.18 V/m. In the evening the values decline to 1.1 V/m and then stabilizes in late evenings.

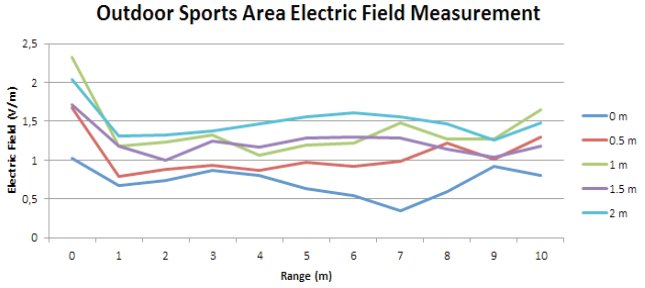

Figure 4. Electric field measurements for Outdoor Sports Area

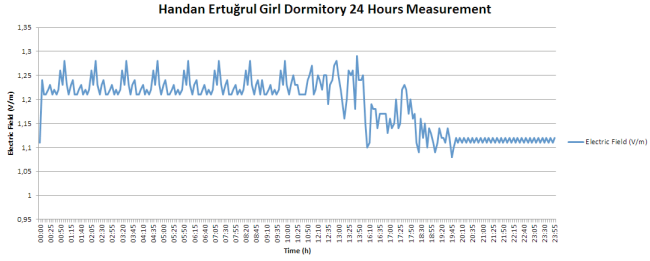

Figure 5. 24 Hours electric field measurement for Handan Ertugrul Dormitory

IV. CONCLUSIONS

Measurements of field strengths using the exposimeters at different points have been made in Marmara University, Goztepe Campus. The intention of presenting this study was to quantify exposure levels to RF from different sources such as mobile phone base stations, mobile phone handsets, DECT cordless phones for students in Marmara University.

All sets of measurements which were performed in Marmara University, Goztepe Campus, were made at the point where the maximum reading was achieved using the hand held devices at RF ranges. All represented RMS levels of electric and magnetic field strength expressed in V/m and A/m. The maximum electric field measurements were 2.4 V/m at a distance of 1 m from outdoor sport area and 1.28 V/m for Handan Ertuğrul Dormitory. When the results are compared with the ICNIRP guidelines safety limits (Table 3), it is obviously seen that the measured values complied with the limits.

To our knowledge, this is the first study to assess RF EM field exposure by combining personal measurements with spot and full day measurements in a university. However, with measurement results for different exposure locations, we expect the results to become more useful for risk assessment of students, personnel and instructor studying close to EMF sources. The data presented herein should be especially useful in understanding the fall-off of the electric field from any appliance with distance.

Table 3. ICNIRP reference limits for RF fields

	Frequency (f), MHz	Electric field Strength, V/m	Magnetic Field Strength, A/m	Power Flux Density, mW/cm²
Occupational & Public	0.3-3	632	1.6	100
	3-30	1897/f	4.74/f	$(30/f)^2$
	30-300	63.2	0.16	1.0
	300-1500	$3.65f^{1/2}$	$0.009f^{1/2}$	f/300
	1500-100000	14.1	0.35	5.0

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