Environmental Research 175 (2019) 266–273

Contents lists available at ScienceDirect

Environmental Research

journal homepage: www.elsevier.com/locate/envres

Personal RF-EMF exposure from mobile phone base stations during temporary events

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A R T I C L E I N F O

Keywords:
Radiofrequency electromagnetic fields (RF-EMF)
Personal exposure
Exposimeter
Temporal events

A B S T R A C T

Background: In recent years, radiofrequency electromagnetic fields (RF-EMF) exposure has increased owing to new communication technologies. Simultaneously, increased exposure to RF-EMF has led to society's growing concern about the possible effects they may have on human health. Many studies have described personal RF-EMF exposure by using personal exposimeters to know a population's daily exposure to mobile phone base stations and to other sources whose installations tend to be permanent. Nonetheless during special events like concerts or fairs, where many people gather, permanent installations might not suffice to cover demand. So telephone companies install temporary stations for these events, and modify the exposure pattern of these areas or populations.

Objective: To study if installing temporary antennae for large events, and high concentrations of mobile phones, modify the exposure pattern compared to usual situations.

Methods: Personal RF-EMF exposure from mobile phones (uplink) and mobile phone base stations (downlink) installed at the 2017 Albacete Fair (Spain) was recorded. Between 7 and 17 September, more than 2,500,000 people visited this Fair. Measurements were taken by two Satimo EME SPY 140 personal exposimeters, placed one each side of a research team member's waist. These exposimeters were programmed to take measurements every 4 s at different time of day; morning, afternoon and night; and in several places, around the Fair Enclosure (zones Ejidos and Paseo) and inside the enclosure (Interior). These measurements were repeated on a weekday, at the weekend and the day after the Fair ended after temporary base stations had been removed. They were also taken for 1 h in all three zones, for each time of day; that is, 9 h were recorded for each study day.

Results: The mean RF-EMF recorded exposure from base stations (downlink-DL) on the days the Fair opened (morning, afternoon and night) for the three studied zones was 791.8 $\mu W/m^2$, while the exposure produced by mobile phones (uplink-UL) was 59.0 $\mu W/m^2$. These values were 391.2 $\mu W/m^2$ (DL) and 10.3 $\mu W/m^2$ (UL) a few days after the event ended.

In study zones Ejidos and Paseo, both outside, the highest mean exposure was recorded at the weekend as 1494.1 and 848.1 $\mu W/m^2$ respectively. For the Interior zone, the mean value recorded during the Fair was 354.8 $\mu W/m^2$. These values contrast with those recorded in the three zones after the event ended: 556.37 (Ejidos), 144.1 (Paseo); 473.21 $\mu W/m^2$ (Interior).

The fact that the mean exposure recorded at Interior was slightly higher after the Fair could be due to signal shielding by so many people. The reduction in exposure in Paseo after the Fair was outstanding, probably due to the antennae being placed on low towers. Major differences were also found in the RF-EMF exposure from UL. In this case, the weekend values taken during the Fair were between 28.2 $\mu W/m^2$ at Interior (weekday) and 98.1 $\mu W/m^2$ at Ejidos (weekend), which dropped to 5.5 at Paseo after the Fair, to 11.7 $\mu W/m^2$ at Interior and to 13.6 $\mu W/m^2$ at Ejidos.

Conclusions: Installing mobile phone base stations, and a dense public using mobile phones, imply a significant increase in personal RF-EMF exposure compared to that recorded during normal periods in the same area. However, the recorded measurements were below legally established limits.

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https://doi.org/10.1016/j.envres.2019.05.033
Received 16 January 2019; Received in revised form 16 May 2019; Accepted 17 May 2019
Available online 21 May 2019

1. Introduction

In recent years, radiofrequency electromagnetic fields (RF-EMF) exposure has increased owing to new communication technologies, particularly mobile phone and Internet technologies (Neubauer et al., 2007). Simultaneously, increased exposure to RF-EMF has led to society's growing concern about the possible effects they may have on human health (Röösli et al., 2010a).

In this context, the use of personal exposimeters has allowed different studies that describe this personal exposure to be conducted (Sagar et al., 2016, 2017), with possible applications for map making (Gonzalez-Rubio et al., 2016) and epidemiological studies (Gonzalez-Rubio et al., 2017). The most widely used exposimeters in most of these studies were EME SPY by Satimo (http://www.satimo.fr) and, to a lesser extent, ESM 140 by Maschek (www.maschek.de) and ExpoM by Fields at Work (http://www.fieldsatwork.ch).

The main advantages of using personal exposimeters is that they are small, easy to handle, offer excellent sensitivity and can store large volumes of data (Frei et al., 2009a). To homogenise different studies, a protocol appeared in 2010 that offers patterns to avoid undesired artefacts and biases (Röösli et al., 2010b). However, technical (effects of the human body, fading, calibration, crosstalk, etc.) and methodological (measuring protocol) difficulties come into play, as do data analysis types (non-detects, suitably using central tendency measures, such as means or medians). These difficulties can condition research results and must be taken into account (Bolte, 2016; Bolte and Eikelboom, 2012; De Miguel-Bilbao et al., 2017; Eeftens et al., 2018; Frei et al., 2009b; Gajsek et al., 2015; Gryz et al., 2015; Knafl et al., 2008). Therefore, the personal exposure evaluations made by exposimeters still have their limitations (Bhatt et al., 2016), which lead to some uncertainties (Bolte et al., 2011; Neubauer et al., 2007).

In the majority of the studies conducted with personal exposimeters, the objectives were to: firstly characterise the population's personal exposure; secondly, measure the exposure levels in different microenvironments; e.g., public transport, public outdoor places, places inside homes, etc. (Aminzadeh et al., 2016; Bhatt et al., 2016; Bolte and Eikelboom, 2012; De Miguel-Bilbao et al., 2015; Frei et al., 2009b; Gonzalez-Rubio et al., 2017; Joseph et al., 2008, 2010, 2012; Juhasz et al., 2011; Markakis and Samaras, 2013; Neubauer et al., 2007; Thomas et al., 2008; Thuroczy et al., 2008; Tomitsch et al., 2010; Urbinello et al., 2014a, 2014b; Vermeeren et al., 2013; Viel et al., 2009a, 2009b, 2011). These studies have attempted to describe personal exposure under normal conditions, and also under the normal conditions of populations in their respective environments.

During large events like concerts, fairs and sport events, vast numbers of people concentrate in a relatively small space. This, in turn, represents a substantial increase in coverage requirements and mobile phones having access to networks. Consequently, personal RF-EMF exposure could increase when such events are held.

Albacete is a relatively small city (170,000 inhabitants) that belongs to the Spanish Autonomous Community of Castilla-La Mancha. Every year from 7 to 17 September, it holds its Fair in a special area, built specifically for it in 1783, known as the Fair Enclosure (16,000 m^2). Around this area lies a space called Ejidos de la Feria (72,000 m^2) and Paseo de Acceso (45,000 m^2) which, in all, cover a surface area of approximately 133,000 m^2. During this event, vast numbers of people concentrate (almost 2.5 million people came in 2017 on the 11 days that the event lasted). To prevent their networks from overloading, telephone companies temporarily install seven mobile phone base stations, apart from the nine set stations found in the area.

The main objective of this work was to characterise personal RF-EMF exposure during a large temporal event such as the 2017 Albacete Fair (Spain). To study if installing temporary antennae, plus a high concentration of mobile phones, during large events modify the exposure pattern compared to the normal situation in the same area.

2. Material and methods

2.1. Measurement characteristics

Meaurements were taken in three different zones (Fig. 1): outside (Ejidos), inside the building (Interior) and in the main access (Paseo). They were taken during three 3-h periods every 4 s, and for 1 h in each zone: in the morning, the afternoon and at night, on three different days: one weekday when the Fair was underway (Wednesday, 13 September), one weekend day when the Fair was held (Saturday, 16 September), and one day after the Fair ended (Wednesday, 19 September, when measurements were taken only in the afternoon) once the temporary stations had been removed.

Different telephone companies installed seven temporary antennae as so: 4 by the company Telefónica Móviles SA (Movistar), 2 by the company Orange Spagne SAU and 1 by the company Vodafone Group PLC (Fig. 2).

2.2. Exposure measurement

Two personal model EME SPY 140 exposimeters by Satimo were used, which measure 14 frequency bands between 88 MHz and 5 GHz

Fig. 1. Zones into which the Fair's area of influence was divided to be measured.

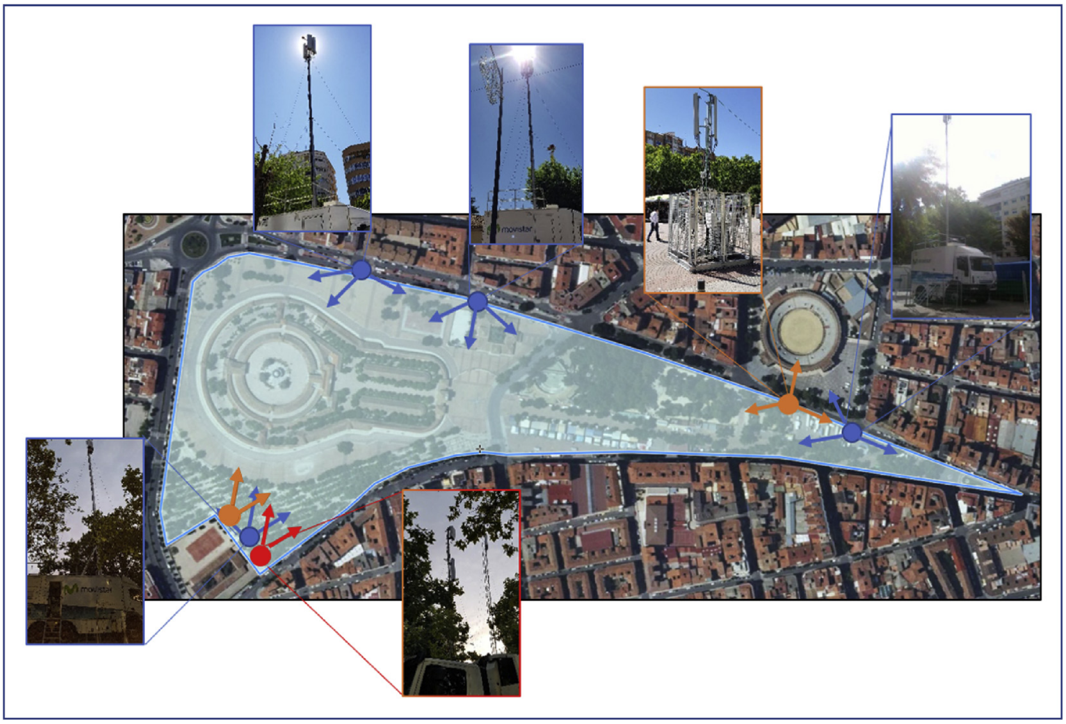

Fig. 2. Location of the temporarily installed antennae. Dots indicate the location of all the antennae, while arrows show the direction of the main beams. Colours deno te the telephone companies they belong to: blue = Movistar, orange = Orange Spagne SAU, Red = Vodafone Group PLC. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

(Table 1) with different detection limits for each band.

This study only considers those frequency bands related to mobile telephones, which include both transmissions from handset to base station (uplink, UL) and transmissions from base station to handset (downlink, DL); that is: GSM, DCS and UMTS. The exposimeters employed in this study were calibrated by the French company Antenessa/Satimo.

This study has been reviewed and approved by the institutional review board (IRB). Measurements were taken by a research team member, who walked about and carried two exposimeters on either side of her waist. She spent 1 h in each zone during each measurement period. The research team member‘s mobile phone was switched off during measurements period. The exposimeters were placed on both sides of her body make measurements easier (Left, L; Right, R) to increase the reliability of the measurements, and as an attempt to compensate for any possible body effects (Nájera Lopez et al., 2015). The mean value of both recordings (L and R) was calculated.

The time of day when measurements were taken were: in the morning from 08:00 h to 11:00 h; in the afternoon from 15:00 h to 18:00 h; at nightime from 22:00 h to 01:00 h, on each day, except for the measurements taken on the day after the Fair ended (After Fair), which were measured only in the afternoon. When the fair ended on 17 September, the Fair Enclosure remained open for a few days, but only at certain times. In order to ensure that the measurement conditions were "antenna-less", we waited until the temporary base stations had been removed. After they had been removed, it was only possible to measure in the afternoon, and the Fair Enclosure was closed at other times. Weather conditions were similar.

2.3. Data processing

The statistical data analysis was done using the R software (version 3.5.1) and SPSS (version 22). All the calculations were made using electromagnetic wave intensity values expressed as μW/m^2.

The values below the exposimeter's detection limit for each frequency band were processed by determining the mean values of the data adjusted by the Robust Regression on Order on Statistics (ROS) method (Helsel, 2005) on those bands with a percentage over 60% (Table 2). After correcting these values, the arithmetic mean of the measurements taken by both exposimeters (L and R) were calculated. This step of the analysis was done using the R Software NADA package.

To study the possible differences among the records taken at the different time points and in the various places, Mann-Whitney *U* test was used. As the analyzed data did not follow a normal distribution, the Mann-Whitney was used to check the consequent hypotheses and to seek possible statistically significant differences. This test has been used in other studies about RF-EMF measurements to make comparisons and to seek statistically significant differences to check hypotheses (Aksen

Table 1
Frequency bands and detection limits of EME SPY 140 measured in the study.

Description of bands	Frequency (MHz)	Detection limit (μW/m^2)
GSM-UL - Transmission from handset to base station	880–915	0.066
GSM-DL - Transmission from base station to handset	925–960	0.066
DCS-UL - Transmission from handset to base station	1710–1785	0.066
DCS-DL - Transmission from base station to handset	1805–1880	0.066
UMTS-UL - Transmission from handset to base station	1920–1980	0.066
UMTS-DL - Transmission from base station to handset	2110–2170	0.066

Table 2
Number of valid records, number of data below detection limit (non-detect) and its percentage for device's position (left, L; Right, R) per frequency band. Bold denotes the records to which ROS correction was applied.

Frequency band and exposimeter (R or L)		Valid	Non-detects	%
Right	**GSM-UL-R**	6506	12394	**65.6**
	GSM-DL-R	18876	24	0.1
	DCS-UL-R	17273	1627	8.6
	DCS-DL-R	18719	181	1.0
	UMTS-UL-R	7187	11713	**62.0**
	UMTS-DL-R	18845	55	0.3
Left	**GSM-UL-L**	4406	14494	**76.7**
	GSM-DL-L	18887	13	0.1
	DCS-UL-L	17302	1598	8.5
	DCS-DL-L	18851	49	0.3
	UMTS-UL-L	7237	11663	**61.7**
	UMTS-DL-L	18873	27	0.1

et al., 2004; Andresen et al., 2017; Cam et al., 2014; Dasdag et al., 2004; Mazmishvili et al., 2018; Najera et al., 2015; Ramirez-Vazquez et al., 2019; Ribeiro et al., 2013).

3. Results

The mean RF-EMF exposure from the mobile phone base stations (DL) from the whole study period and for the three bands (GSM, DCS and UMTS) was 658.3 µW/m^2 (Fig. 3). The greatest daily mean contribution was recorded on one weekend day when the Fair was underway (899.0 µW/m^2), followed by one weekday when the Fair was held (684.6 µW/m^2) and, finally, After Fair (391.2 µW/m^2). Exposure from mobile phones (UL) followed the same tendency with 43.1 µW/m^2, 74.9 µW/m^2 and 10.3 µW/m^2 for the weekday, weekend day and After Fair, respectively.

The total mean RF-EMF exposure from the DL of the whole study period as the sum of the three bands (GSM, DCS and UMTS) was 1885.0 µW/m^2 (95%CI: 177.8, 1991.1) for the weekday, 2767.8 µW/m^2 (95%CI: 2600.3, 2935.5) for the weekend and 581.2 µW/m^2 (95%CI: 542.6, 619.8) for After Fair. The total exposure from the mobile phone antennae (DL) was similar during the Fair for both the weekday and weekend (p-value > 0.05). When comparing the values recorded on the weekday and After Fair, and those recorded at the weekend and After Fair, the Mann-Whitney *U* test indicated statistically significant differences in both cases (p-value < 0.05).

The mean RF-EMF exposure recorded from DL on the days when the Fair was held (morning, afternoon and night) for the three study zones was 791.8 µW/m^2. The mean exposure caused by UL was 59.0 µW/m^2.

Table 3
Mean RF-EMF exposure for the series of DL and UL bands expressed in µW/m^2 per zone and time point.

		Time point	DL	UL	Zone	DL	UL
Fair	**Weekday**	**Morning**	611.6	25.3	**Ejidos**	1157.4	64.4
		Afternoon	604.3	45.0	**Interior**	332.2	28.2
		Night	838.1	59.0	**Paseo**	564.3	36.7
	Weekend	**Morning**	686.8	33.2	**Ejidos**	1494.1	98.1
		Afternoon	1217.7	81.5	**Interior**	354.8	81.9
		Night	792.5	110.1	**Paseo**	848.1	44.7
After Fair		**Afternoon**	391.2	10.3	**Ejidos**	556.4	13.6
					Interior	473.2	11.7
					Paseo	144.1	5.5

Of the three studied zones, the highest mean exposure from DL was recorded at Ejidos and Paseo (both outside) at the weekend, with 1494.1 and 848.1 µW/m^2, respectively (Table 3). However at Interior, the mean value measured at the weekend while the Fair was held was 354.8 µW/m^2. These values contrast with those recorded in the three zones After Fair, with 556.37 (Ejidos), 144.1 (Paseo) and 473.21 µW/m^2 (Interior).

The mean personal exposure per time point, frequency band (DL and UL) and zone is provided in Table 4 (DL) and 5 (UL), along with the 95 percentiles. The highest recorded intensity came from GSM-DL with 1113.7 (µW/m^2) for a weekend day while the Fair was held, recorded in the afternoon at Ejidos. It was followed by that recorded for UMTS-DL with 687.9 µW/m^2, also for a weekend day, in the afternoon at Paseo. The time of day and zone at which the least RF-EMF intensity from DL was recorded from DCS-DL After Fair and at Paseo with 29.0 µW/m^2.

The band for which the least exposure was recorded was UMTS-UL with 0.160 µW/m^2, which corresponded to both the afternoon and After Fair. From all the data (Tables 4 and 5), we can see that the highest exposure was recorded on Fair days, mainly at the weekend. However, the lowest exposure values were recorded After Fair.

From the 95 percentiles offered in Tables 4 and 5, we stress that the values recorded in the several zones and at the different time points while the Fair was underway are much higher than those recorded After Fair. The highest value (for bands DL) was recorded in the afternoon at Ejidos, weekend, while the Fair was held, with 4403.5 µW/m^2 (GSM-DL), whereas no 95 percentile exceeded 850.8 µW/m^2 After Fair. For the UL bands, the highest recorded 95 percentile corresponded to band

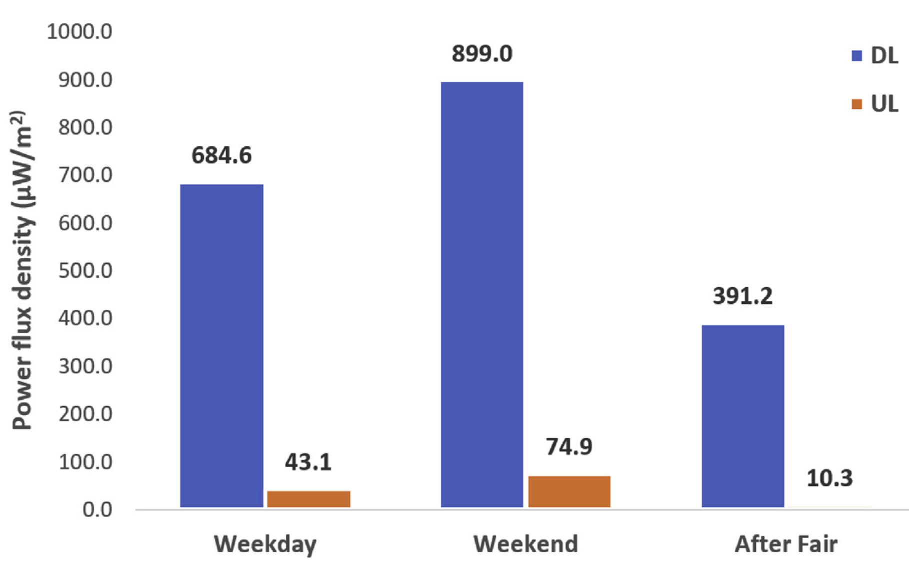

Fig. 3. Mean exposure contribution per measured day for the downlink and uplink frequency bands (GSM, DCS and UMTS).

Table 4
Mean exposure (M) and total in μW/m^2 and the 95 percentile (P95) per frequency band per day and zone for transmissions from base station to handset (DL).

			GSM + DCS + UMTS (DL)	GSM-DL		DCS-DL		UMTS-DL	
				M	P95	M	P95	M	P95
Weekday	**Morning**	Ejidos	907.0	560.4	1777.7	119.7	416.6	226.9	667.3
		Interior	320.3	135.8	430.8	78.3	287.4	106.2	372.1
		Paseo	607.5	270.0	913.8	50.5	144.8	287.0	1099.7
	Afternoon	Ejidos	1024.2	421.7	1620.4	282.0	1201.0	320.5	1070.1
		Interior	249.8	88.3	288.9	80.8	333.2	80.7	350.0
		Paseo	538.9	211.3	648.8	80.3	290.8	247.2	837.5
	Night	Ejidos	1541.1	637.0	2622.4	468.0	2197.8	436.1	1522.4
		Interior	426.5	138.8	484.9	166.7	584.1	121.1	424.9
		Paseo	546.6	216.1	750.9	81.2	258.5	249.2	867.0
Weekend	**Morning**	Ejidos	1006.8	628.2	2606.7	147.8	578.5	230.7	677.0
		Interior	239.6	114.7	494.7	44.7	188.0	80.2	270.7
		Paseo	814.0	312.1	1171.9	62.2	214.3	439.6	1683.7
	Afternoon	Ejidos	2028.9	1113.7	4403.5	379.2	1381.1	536.1	2143.7
		Interior	522.2	215.1	1245.8	133.2	611.8	173.9	828.9
		Paseo	1102.1	305.6	1290.5	108.5	345.4	687.9	3537.2
	Night	Ejidos	1446.7	578.2	2424.5	380.4	1620.6	488.2	2005.6
		Interior	302.6	83.9	262.8	100.4	357.4	118.3	432.0
		Paseo	628.2	145.4	515.6	90.5	285.6	392.3	1410.2
After Fair		Ejidos	556.4	268.8	850.8	138.8	513.3	148.7	534.2
		Interior	473.2	191.9	770.6	128.8	545.2	152.5	640.6
		Paseo	144.1	72.5	232.2	29.0	104.1	42.6	141.8

DCS-UL with 221.8 μW/m^2 at Ejidos at night and at the weekend, but it did not exceed 55.9 μW/m^2 After Fair (DCS-UL at Interior).

Fig. 4 shows that the frequency band with the highest recorded intensity was GSM-DL at Ejidos at the weekend. The frequency band with the least recorded intensity was UMTS-UL at Paseo After Fair.

4. Discussion

Despite the problems described by Bolte (2016), such studies act as a reliable tool for the personal characterisation of RF-EMF and to provide measures from different microenvironments, zones and time points, where the measurements taken by fixed measurement device would be complicated. One of the main problems with such studies is the body's effect when carrying a measuring device on only one side (Nájera Lopez et al., 2015). For this reason, two exposimeters were carried, one on each side of the body, during the measuring process, which enabled the means from each measured time point to be calculated. Another possible approach would be to consider the maximum value obtained with the two exposimeters instead of the mean of both. Nonetheless, as the research team member had to move about through the studied zones, a decision was made to use the first option.

The systematic review by Sagar et al. (2017) included 21 studies into the personal characterisation of RF-EMF exposure by spot measurements taken with personal exposimeters used by trained researchers and volunteers. In the first case, and by bearing in mind only the studies conducted by spot measurements and the results obtained outdoors, the mean value was 34.8 μW/m^2, which is similar to that determined by studies using personal exposimeters carried by volunteers (17.3 μW/m^2), but much lower than that established by personal exposimeters carried by researchers (1375.1 μW/m^2). In our case, the maximum total recorded exposure caused by radiation from DL, calculated as the sum of the mean values of the three frequency bands, was

Table 5
Mean exposure (M) in μW/m^2 and the 95 percentile (P95) per frequency band per day and zone for transmissions from handset to base station (UL).

			GSM + DCS + UMTS (UL)	GSM-UL		DCS-UL		UMTS-UL	
				M	P95	M	P95	M	P95
Weekday	**Morning**	Ejidos	27.8	0.5	2.3	26.5	103.2	0.8	2.3
		Interior	10.7	0.3	0.5	9.8	37.1	0.7	2.6
		Paseo	37.4	1.4	1.5	35.8	134.4	0.2	0.4
	Afternoon	Ejidos	62.7	10.0	7.6	25.4	93.1	27.3	11.7
		Interior	37.6	0.7	1.5	33.8	43.8	3.1	7.2
		Paseo	34.8	1.8	1.4	32.8	129.8	0.2	0.6
	Night	Ejidos	102.8	42.2	42.4	56.6	142.4	4.0	18.9
		Interior	36.3	3.3	4.9	30.6	119.7	2.5	8.3
		Paseo	38.0	2.6	2.9	35.1	150.7	0.3	0.7
Weekend	**Morning**	Ejidos	35.4	0.9	4.2	33.8	124.4	0.7	3.5
		Interior	31.9	0.2	0.4	29.8	30.1	1.8	2.6
		Paseo	32.2	0.4	1.1	31.5	98.6	0.3	0.4
	Afternoon	Ejidos	72.3	30.5	35.1	38.4	106.8	3.4	12.3
		Interior	144.0	44.5	4.9	77.3	99.4	22.2	39.6
		Paseo	28.1	1.2	3.1	26.6	124.7	0.2	0.4
	Night	Ejidos	186.5	23.9	36.5	150.4	221.8	12.2	17.2
		Interior	69.8	14.0	30.3	54.5	108.9	1.3	3.9
		Paseo	74.0	8.9	3.4	64.9	123.1	0.2	0.4
After Fair		Ejidos	13.6	0.3	1.3	12.6	54.5	0.7	3.3
		Interior	11.7	0.3	1.4	10.9	55.9	0.5	2.0
		Paseo	5.5	0.4	0.2	4.9	19.3	0.2	0.2

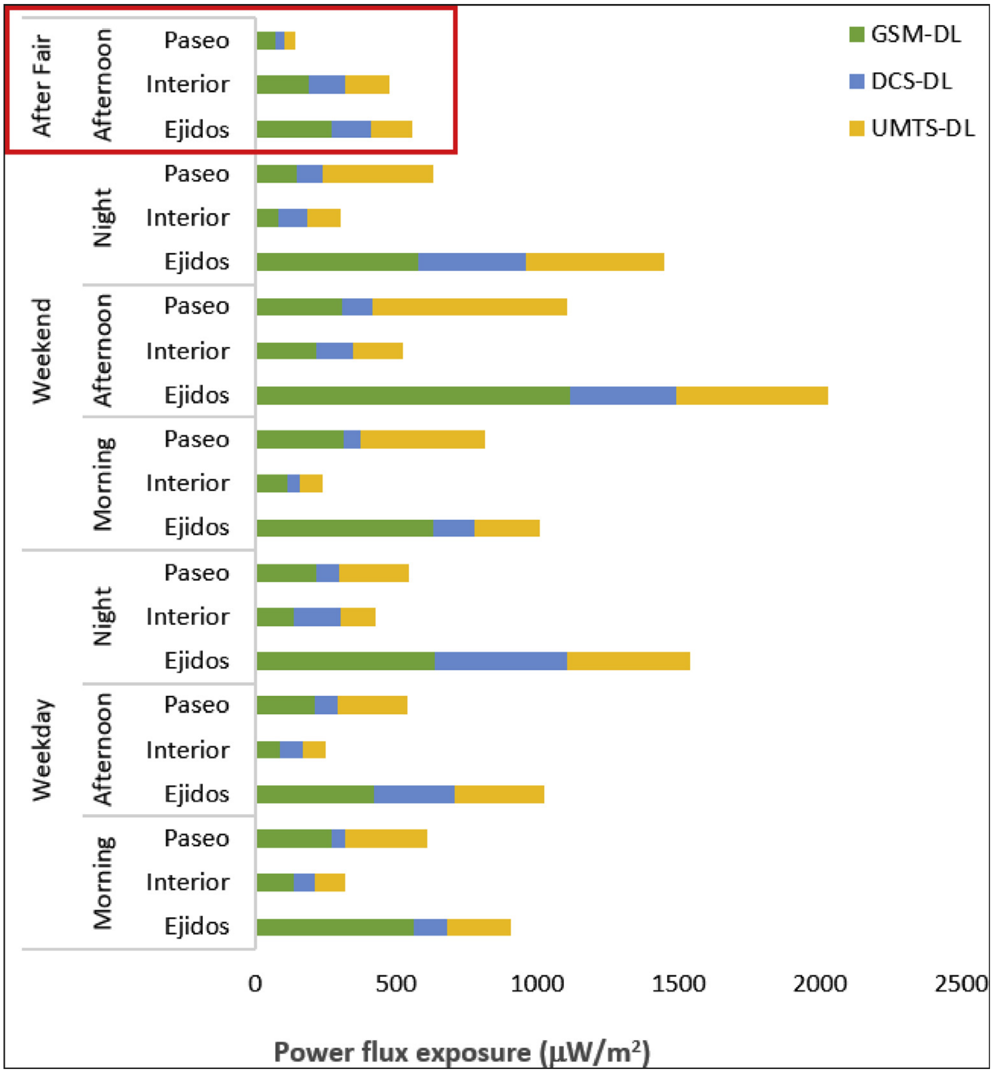

Fig. 4. Mean personal RF-EMF exposure (power flux density in μW/m^2) per zone and time point.

2028.9 μW/m^2, recorded in the afternoon on a Fair weekday at Ejidos. The minimum total value was 144.1 μW/m^2 and was recorded at Paseo afternoon After Fair. Determined values After Fair are comparable to those recorded by Gonzalez-Rubio et al. (2016) for the city of Albacete, which were determined on different dates to those when the Fair was held. One of our study's strong points is that the measurements were taken by trained experienced research personnel.

As far as we know, no study has been conducted like that herein presented about an event visited by so many people, and installing a good number of mobile phone base stations in a relatively small and very delimited area, whose beams move directly towards the study area. Indeed we were unable to compare our results with other similar studies.

Apart from the weak points and uncertainties described by Bolte (2016) in such studies, in our case the influx of people visiting the Fair was also very irregular. Indeed the measuring process was carried out relatively easily in the mornings, but it was harder to constantly move around the different areas in the afternoons, especially the Saturday afternoon, given the high density of people present. This vast presence of people around the devices could condition the recordings as bodies acted as a shielding effect given their closeness. This would explain the highest After Fair values recorded at Interior, when the space was virtually empty and no shielding from the public took place. Given the limitations when taking measurements in all the set places once the fair had ended, data were compared only with those recorded after the fair in the afternoon. This could be a study limitation, but it is hard to solve because the Fair Enclosure was closed from 17 September. However, as this area has no housing, with barely any traffic or pedestrians when the fair does not take place, exposure was expected to be similar at different times of the day.

The exposure under study increased for both visitors and workers in the different Fair facilities. In fact many fair workers move to other fairs to continue working when a fair ends. So these workers could be exposed to high RF-EMF intensity values for most of the year, which would be interesting to follow up.

Based on the temporary installation of mobile phone antennae in the Fair Enclosure, this study identified how the RF-EMF intensity levels were higher than on After Fair days. Yet despite intensity levels increasing during Fair periods, these levels were below the reference levels set by the ICNIRP (International Commission on Non-Ionizing Radiation Protection). The possibility of thoroughly performing monitoring during such events should be considered.

5. Conclusions

Installing temporary mobile phone base stations during large events, and the vast numbers of people visiting with mobile phones, imply personal RF-EMF exposure considerably exceeding the values recorded during normal periods in the same zone.

Nonetheless, the personal exposure levels were lower for all the frequency bands at the reference levels set by the International Commission on Non-Ionizing Radiation Protection (ICNIR).

Conflicts of interest

There was not any conflict of interest.

Conflict of interest and authorship conformation form

- ✓ All authors have participated in (a) conception and design, or analysis and interpretation of the data; (b) drafting the article or revising it critically for important intellectual content; and (c) approval of the final version.
- ✓ This manuscript has not been submitted to, nor is under review at, another journal or other publishing venue.
- ✓ The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript
- ✓ The following authors have affiliations with organizations with direct or indirect financial interest in the subject matter discussed in the manuscript:

Acknowledgements

We are grateful to the Albacete City Council, particularly to the Department of Urban Development, for providing us with the available information in the files and applications to install the antennae to be temporally placed in the Fair Enclosure.

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