

**INVESTIGATION OF THE RELATIONSHIP BETWEEN DEPRESSION SYMPTOM PREVALENCE AND RELATED FACTORS AMONG HIGH SCHOOL STUDENTS**Hakki Aktas<sup>1</sup>, Gulcin Yapici\*<sup>1</sup>, Fazıl Kocas<sup>1</sup>, Cosar Uzun<sup>2</sup>, Fatih Cemal Tekin<sup>3</sup> and Nurten Erdal<sup>2</sup><sup>1</sup>Mersin University Faculty of Medicine, Department of Public Health, Mersin, TURKEY.<sup>2</sup>Mersin University Faculty of Medicine, Department of Biophysics, Mersin, TURKEY.<sup>3</sup>Necmettin Erbakan University Faculty of Medicine, Department of Public Health, Konya, TURKEY.

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**ABSTRACT**

**Objective:** It was aimed to investigate between the depression symptom prevalence and related factors among the high school students in a district of Mersin. **Materials and Methods:** The data of this cross-sectional study were collected in the high schools on 23-31 May 2016. The minimum sample size was calculated as 558 in, 50% prevalence,  $\pm 4$  error margin and 95% confidence interval for 7791 students. 605 questionnaires were evaluated in the study. The students filled out the questionnaire and Childhood Depression Scale. The electromagnetic field measurements in the classes were made with a Gaussmeter. **Results:** The average age of the students were  $16.3 \pm 0.9$  years and 54.5% of those are female. It was determined that 32.6% of the students had depressive symptoms. The mean of the electromagnetic field measurement was  $0.68 \pm 0.06$  mT in the classroom. There was no significant relationship between mean electromagnetic field level and the frequency of depression symptom. According to the binary logistic regression model, the factors related to the depressive symptom prevalence of the students were as follows: being a woman (OR=1.61), having chronic illness (OR=2.31), poor school performance (OR=5.54), poor (OR=6.64) and normal family relationship (OR=2.59) and the student's self assessment of his/her health status with low scores (OR=0.86). **Conclusion:** It is an important problem that one of the three students has depressive symptoms. Studies should be conducted for the identified risk groups. The further studies are needed to assess the relationship between depressive symptom prevalence at students and electromagnetic field levels.

**KEYWORDS:** School health, depression, adolescent, electromagnetic fields.**1. INTRODUCTION**

According to the World Health Organization (WHO), adolescence is a period, during which serious physical and psychological changes are experienced between the ages of 10 and 19, as well as important social interactions and relationships. The prevalence of psychological diseases in adolescents has increased in recent years due to stress, depression, economic dependence, and the changes in social, cultural and family values.<sup>[1]</sup>

Depression is a widely encountered psychological disorder with the symptoms of depressive mood, loss of interest, energy loss, guilt or worthlessness, sleep disturbance, loss of appetite and concentration problems.<sup>[2]</sup> Adolescents' cognitive functions develop during adolescence period, and their understanding of social events, and awareness levels increase. The prevalence of depression show an increase in adolescence period compared to the childhood, as a result of the social and biological changes they

experience during this period.<sup>[3]</sup> It has been reported in the international studies that the prevalence of depression changes between 5.7% and 31.3% in the adolescence period.<sup>[4-7]</sup> Studies conducted in our country, it is stated that the prevalence of depression in high school students is between 12.5% and 30.7%.<sup>[8-12]</sup>

Electromagnetic field (EMF) refers to the area that is formed by the particles with electric currents or charges in their circles by applying forces such as repelling and pulling. Magnetic field is an invisible field that can not be perceived by sense organs. Electrical appliances such as microwave ovens, hair dryers, televisions and computer screens, and satellite communication systems, radio and television stations, mobile phones and base stations emit non-ionizing electromagnetic radiation to their surroundings. The adverse effects of EMF on health are an important public health issue that has been discussed during the recent years. The adverse effects of EMF include headache, fatigue, nausea, anxiety, prematurity, low birth weight and childhood leucemia.<sup>[13]</sup> A health problem that the electromagnetic field might

have an effect on is also depression. The existence of the studies indicating the availability of the relationship between depression and the electromagnetic field was reported in the depression and electromagnetic field exposure report of Canadian Robert-Sauve Occupational Health and Safety Research Institute.<sup>[14]</sup> Although there is no direct electromagnetic field measurement in the literature, there are studies regarding that the uncontrolled use of virtual communication means, forming electromagnetic field around, such as mobile phone, internet, etc. increases depression.<sup>[15-19]</sup> No relationship was found between internet use and depression in a study conducted in our country.<sup>[20]</sup> However, a study investigating the relationship between depression and direct EMF measurements made in our country was not available.

It was aimed to evaluate between the depression symptom prevalence and EMF level in school environment, and other related factors among the high school students in Mezitli district of Mersin, Turkey.

## 2. MATERIALS AND METHODS

The data of this cross-sectional study was collected between 23-31 May 2016 in the high schools in Mezitli district. In total, 7791 students attend 12 high schools in the Mezitli district. The minimum sample size was calculated to be 558 students (50% prevalence,  $\pm 4$  error margin, 95% confidence interval) (Epi-info 7). Consequently, we decided to include 600 students in the study.

### Participants and procedure

The duration of high school education is four years in Turkey. The final year high school students were not included in the study due to the fact that they were in the preparation stage for the university entrance exam, and that their level of depression might be higher. One class from the ninth, tenth and eleventh grades of every school was planned to take part in the study. In order to reach the target number of students assuming that there are 25 students on average in a class, seven of the 12 high schools in the Mezitli district were determined using the random number table. Since there are less than 25 students in two of the 21 classes took part in the study, two more classes were included in the study, and 620 students from 23 classes were reached. 15 students whose questionnaires had substantial missing data were excluded from the study. Eventually, 605 questionnaires were included in the study and analyzed. After receiving information about the study, a written approval was obtained from students and their parents. Those who volunteered to participate in the study were given the self-administered questionnaire to be completed.

### Instruments

The questionnaire form, prepared by searching the literature, consisted of 29 questions including the sociodemographic characteristics of the students such as age, sex, educational and employment status of the

parents, information about their use of computer, internet and mobile phone, and childhood depression scale (CDS). CDS is a self assessment scale consisting of 27 items for children aged 6 to 17 years, used to investigate child-adolescent depression. CDS was developed by Kovacs in 1981, based on Beck Depression Inventory, to determine the prevalence of depressive symptoms.<sup>[21]</sup> The validity and reliability study for CDS in Turkey was conducted by Öy in 1991.<sup>[22]</sup> In every item of the scale there are three options, by which the existence and severity of a symptom of depression is questioned for the last two weeks. Accordingly, each item is scored between 0 and 2. "0" indicates no indication, "1" indicates a slight indication, "2" indicates a specific indication. The maximum score is 54, and the scores above 19 are assessed for the presence of a depressive disorder.<sup>[21,22]</sup> In the questionnaire form, students scored their health status between "0" and "10", where "0" referring to very bad, "5" intermediate, and "10" very good.

The magnetic field measurement in the classroom environment was performed through Gaussmeter (Sypris Test Measurement, Model 6010 Gauss / Teslameter) in the study. The measurement results were recorded as millitesla (mT). The EMF measurements were made from the seven points including 6 different points of each classroom (from the right and left front of class board, from the right and left of the middle side of classroom, from the right and left of back side of classroom), and from the corridor to be measured. The average of the obtained values was recorded as the result value of the environment measurement. The International Non-Ionizing Radiation Protection Commission has identified 1 mT field intensity as safe upper limit (assuming 50 Hz as media frequency value) for occupational exposure.<sup>[23]</sup> The safe upper limit was assumed as 1 mT for the EMF measurement in our study.

### Human Subjects Approval Statement

The approval was received from Mersin University Social Sciences Ethics Committee (Date: 26 April 2016, Ref. No: 2016/26) and official permission from Mersin Provincial Directorate of Education for the study. A written approval was obtained from students and their parents.

### Data Analysis

The dependent variable of the study was determined as the depressive symptom status of the students, independent variable of that were determined as the sociodemographic characteristics of students, computer, internet and mobile phone usage, and EMF measurement result of the classes. The descriptive statistics (frequency, mean $\pm$ standard deviation, median, minimum, maximum) were used for the summarization of the data. The Chi square test was used for the comparison of categorical variables. Because the continuous variables did not have the normal distribution, Mann Whitney U Analysis was used for the comparison. The independent variables, for

which significance was determined in single analyzes, were taken into binary logistic regression model, thus the risk factors determining depression prevalence were determined. The Forward LR method was used to distinguish the important risk factors in the model. The analysis results was explained in Odds Ratio (OR) and 95% Confidence Interval (CI). The statistical significance level was assumed as  $p < 0.05$  in the study.

### 3. RESULTS

The average age of the students was  $16.3 \pm 0.9$  and 328 (54.5%) of those were female. About 333 (55.0%) students were receiving education in vocational high school, 212 (35.1%) of those in the eleventh grade. It was found that 72 (11.9%) of the students participated in the study, had chronic illnesses; 58 (9.7%) of those had an employment, 32 (5.3%) of those smoked every day and 74 (12.3%) had poor school performance (Table 1).

**Table 1. Sociodemographic characteristics of the students participating in the study.**

| Characteristics                                  | n   | %    |
|--|-----|------|
| <b>Sex (n=602)</b>                               |     |      |
| Female   | 328 | 54.5 |
| Male   | 274 | 45.5 |
| <b>School type (n=605)</b>                       |     |      |
| General high school                              | 272 | 45.0 |
| Vocational high School                           | 333 | 55.0 |
| <b>Grade level (n=605)</b>                       |     |      |
| 9  | 198 | 32.7 |
| 10   | 195 | 32.2 |
| 11   | 212 | 35.1 |
| <b>Chronic illness (n=605)</b>                   |     |      |
| Yes  | 72  | 11.9 |
| No   | 533 | 88.1 |
| <b>Smoking status (n=598)</b>                    |     |      |
| Non-smoker and quitting                          | 528 | 88.3 |
| Occasional smoker                                | 38  | 6.4  |
| Smoking every day                                | 32  | 5.3  |
| <b>School course success (n = 601)</b>           |     |      |
| Bad  | 74  | 12.3 |
| Good   | 424 | 70.5 |
| Very good  | 75  | 12.5 |
| Excellent  | 28  | 4.7  |
| <b>Mother's employment (n=598)</b>               |     |      |
| Employed   | 168 | 28.1 |
| Unemployed                                       | 430 | 71.9 |
| <b>Father's employment (n=600)</b>               |     |      |
| Employed   | 519 | 86.5 |
| Unemployed                                       | 81  | 13.5 |
| <b>Student's employment (n=599)</b>              |     |      |
| Employed   | 58  | 9.7  |
| Nonemployed                                      | 541 | 90.3 |
| <b>Family life (n = 605)</b>                     |     |      |
| Parents together                                 | 540 | 89.3 |
| Parents apart                                    | 48  | 7.9  |
| Mather or Father is dead                         | 17  | 2.8  |
| <b>Relation with family (n = 604)</b>            |     |      |
| Good   | 370 | 61.3 |
| Normal   | 208 | 34.4 |
| Bad  | 26  | 4.3  |
| <b>Economic problems in the family (n = 601)</b> |     |      |
| No   | 139 | 23.1 |
| Rarely   | 241 | 40.1 |
| Sometimes  | 195 | 32.5 |
| Mostly   | 26  | 4.3  |

The median number of siblings of the students was found as 3.0 (min=1, max=12), that of the daily amount of pocket as 7.0 TL (approximately \$2) (min=0.0, max=200.0); that of the number of physical activity per month as 6.0 times (min=0, max=99) and score median of the assessment of health status as 7.0 (min=0, max=10).

It was found that 441 (73.4%) of the students had computer at their home, 475 (79.6%) had internet connection at home and 552 (92.5%) had their own mobile phone (Table 2).

**Table 2. The presence of electronic equipments in the house and the sleeping room.**

| Characteristics                                  | n   | %    |
|--|-----|------|
| <b>Computer at home (n=601)</b>                  |     |      |
| Yes  | 441 | 73.4 |
| No   | 160 | 26.6 |
| <b>Internet at home (n=597)</b>                  |     |      |
| Yes  | 475 | 79.6 |
| No   | 122 | 20.4 |
| <b>Own cell phone (n=597)</b>                    |     |      |
| Yes  | 552 | 92.5 |
| No   | 45  | 7.5  |
| <b>Television in the sleeping room (n = 605)</b> |     |      |
| Yes  | 150 | 24.8 |
| No   | 455 | 75.2 |
| <b>Computer in the sleeping room (n = 605)</b>   |     |      |
| Yes  | 266 | 44.0 |
| No   | 229 | 56.0 |
| <b>Modem in the sleeping room (n = 605)</b>      |     |      |
| Yes  | 120 | 19.8 |
| No   | 485 | 80.2 |
| <b>Tablet in the sleeping room the (n=605)</b>   |     |      |
| Yes  | 246 | 40.7 |
| No   | 359 | 59.3 |

The median number of electronic appliances in the students' sleeping rooms was determined as 2.0 (min=0.0, max=7.0). The median daily talk time by their mobile phone was determined as 13.5 minutes (min=0.0, max=500.0), of the duration of daily internet use at home as 2.0 hours (min=0.0, max=10.0) and of the duration of daily internet usage through mobile phone as 2.0 hours (min=0.0, max=15.0).

It was found that only one of the seven schools had computer laboratories, all classes had smart board and wi-fi was not available in two schools. While only one of the schools had wi-fi in the corridor, wi-fi was available in class in other schools.

The mean score of the depression scale of the students was found to be  $17.3 \pm 6.5$  (min=3, max=50). The depressive symptom prevalence of the students was determined as 32.6% (n=197). The prevalence of depression symptoms was found to be higher among women, those with chronic illnesses, occasional smokers, people with poor family relationship, mostly economic difficulties in the family, and poor school performance ( $p < 0.05$ ) (Table 3).

**Table 3. Relationship between the depressive symptom frequency and demographic characteristics of students.**

| Characteristics                                  | Depressive Symptom Score |      |     |      | Total |      | p      |
|--|--------------------------|------|-----|------|-------|------|--------|
|  | <19                      |      | ≥19 |      | n     | %    |        |
|  | n                        | %    | n   | %    |       |      |        |
| <b>Sex (n=602)</b>                               |                          |      |     |      |       |      |        |
| Female   | 198                      | 60.4 | 130 | 39.6 | 328   | 54.5 |        |
| Male   | 208                      | 75.9 | 66  | 24.1 | 274   | 45.5 | <0.001 |
| <b>Chronic illness (n=605)</b>                   |                          |      |     |      |       |      |        |
| Yes  | 35                       | 48.6 | 37  | 51.4 | 72    | 11.9 |        |
| No   | 373                      | 70.0 | 160 | 30.0 | 533   | 88.1 | <0.001 |
| <b>Smoking status (n=598)</b>                    |                          |      |     |      |       |      |        |
| Non-smoker and quitting                          | 371                      | 70.3 | 157 | 29.7 | 528   | 88.3 |        |
| Occasional smoker                                | 16                       | 42.1 | 22  | 57.9 | 38    | 6.4  |        |
| Smoking every day                                | 18                       | 56.3 | 14  | 43.7 | 32    | 5.3  | =0.001 |
| <b>Relation with family (n = 604)</b>            |                          |      |     |      |       |      |        |
| Good   | 288                      | 77.8 | 82  | 22.2 | 370   | 61.3 |        |
| Normal   | 112                      | 53.8 | 96  | 46.2 | 208   | 34.4 |        |
| Bad  | 7                        | 26.9 | 19  | 73.1 | 26    | 4.3  | <0.001 |
| <b>Economic problems in the family (n = 601)</b> |                          |      |     |      |       |      |        |
| No   | 111                      | 79.9 | 28  | 20.1 | 139   | 23.1 |        |
| Rarely   | 172                      | 71.4 | 69  | 28.6 | 241   | 40.1 |        |
| Sometimes  | 115                      | 59.0 | 80  | 41.0 | 195   | 32.5 |        |
| Mostly   | 8                        | 30.8 | 18  | 69.2 | 26    | 4.3  | <0.001 |
| <b>School course success (n = 601)</b>           |                          |      |     |      |       |      |        |
| Bad  | 29                       | 39.2 | 45  | 60.8 | 74    | 12.3 |        |
| Good   | 295                      | 69.6 | 129 | 30.4 | 424   | 70.5 |        |
| Very good  | 60                       | 80.0 | 15  | 20.0 | 75    | 12.5 |        |
| Excellent  | 23                       | 82.1 | 5   | 17.9 | 28    | 4.7  | <0.001 |

It was found that the students with depression had a lower number of physical activity (median 4.0 times/month, min=0.0, max=50.0) than those without depression (median 7.0 times/month, min=0.0, max=99.0) ( $p=0.001$ ). The median score of health status assessment was determined as 5.5 (min=0.0, max=10.0) for the students with depression, 8.0 (min=0.0, max=10.0) for those without depression, and the difference between them was found statistically significant ( $p < 0.001$ ).

The average EMF measurement was determined as  $0.68 \pm 0.06$  mT (min=0.53, max=0.83) at seven different points in the classrooms. The class region with the highest EMF level was the front right and left regions of the board, with averages of  $2.16 \pm 0.32$  and  $2.17 \pm 0.30$  mT respectively. There was no significant relationship between average EMF level in the classes and depression symptom prevalence ( $p=0.976$ ). No significant relationship was found between those including the number of electronic devices in the students' sleeping rooms, own mobile phone availability, talk time with mobile phone, internet availability at home, the duration of internet usage, and depressive symptom prevalence ( $p > 0.05$ ).

The variables that were found to have significant relationship in single analyzes were included in binary logistic regression model. According to binary logistic regression model, the factors regarding the students' depressive symptom prevalence were being female (OR=1.61,  $p=0.031$ ), having chronic illness (OR=2.31,  $p=0.004$ ), poor (OR=6.64,  $p < 0.001$ ) and normal family relationship (OR=2.59,  $p < 0.001$ ), poor school performance (OR = 5.54,  $p = 0.007$ ), and student's own health status assessment with lower score (OR=0.86,  $p < 0.001$ ) (Table 4). There was no significant relationship between depression symptom prevalence and age, the number of physical activities per month and smoking status of students.



**Table 4: Logistic regression predicting depressive symptom among students.**

| Characteristics                           | Odds Ratio | %95 CI*    | p      |
|---|------------|------------|--------|
| <b>Sex</b>                                |            |            |        |
| Female                                    | 1.61       | 1.04-2.48  | 0.031  |
| Male                                      | 1.00       |            |        |
| <b>Chronic illness</b>                    |            |            |        |
| Yes                                       | 2.31       | 1.30-4.10  | 0.004  |
| No  | 1.00       |            |        |
| <b>Relation with family</b>               |            |            |        |
| Bad                                       | 6.64       | 2.35-18.87 | <0.001 |
| Normal                                    | 2.59       |            |        |
| Good                                      | 1.00       | 1.68-3.98  | <0.001 |
| <b>School course success</b>              |            |            |        |
| Bad                                       | 5.54       | 1.60-19.18 | 0.007  |
| Good                                      | 1.69       |            |        |
| Very good                                 | 1.29       | 0.53-5.31  | 0.368  |
| Excellent                                 | 1.00       | 0.34-4.68  | 0.720  |
| <b>Health status assessment</b>           | 0.86       | 0.80-0.94  | <0.001 |
| Constant=- 1.422 *CI: Confidence interval |            |            |        |

**4. DISCUSSION**

Depression in adolescence period is an important public health problem that can lead to many adverse consequences.<sup>[24]</sup> The prevalence of depression regarding high school students has been reported between 5.7% and 31.3% in some foreign studies.<sup>[4,5,7]</sup> Similarly, the prevalence of depression of high school students have been reported to change between 12.5% and 30.7% by some domestic studies.<sup>[8-12]</sup> Our study showed that the prevalence of depressive symptoms in high school students was 32.6% and this result was higher than those of other studies. In our study, final year (twelved grade level) high school students were excluded in the study because of the high probability of prevalence of depression and anxiety during the preparation period of university entrance examination. Nonetheless, the high prevalence of depression in students who attending in the ninth, tenth and eleventh grade level suggests that this age group is a risky period in terms of depression. Other reasons besides university entrance examination anxiety may also be important in depression.

The studies have shown that gender plays an important role in the increase the prevalence of depression among adolescents, and that depressive features are more common in women.<sup>[5,25,26]</sup> The prevalence of depression symptoms was found to be higher in females among high school students.<sup>[8,11,12]</sup> It was determined in two different studies conducted on high school students that depression symptom prevalence was 3.93 and 2.45 times higher in females than males.<sup>[5,6]</sup> Similarly, the prevalence of depressive symptoms in females was found 1.61 times higher than those in males in our study.

Some studies showed that depressive symptom prevalence was higher in patients with chronic illness than those without illness.<sup>[7,10,26]</sup> It was determined in our study that the depressive symptom frequency was 2.31 times higher in the students with chronic disease than in

those without chronic disease. It is thought that students may experience limitations due to their chronic illnesses during social and physical activities with their peers, which may adversely affect students' psychology.

Sahin and Adana<sup>[27]</sup> reported that the prevalence of depressive symptoms was lower in those who assessed their health status as good. Zinn-souza et al.<sup>[6]</sup> determined that depressive symptom prevalence was 5.78 times higher in the students with low health status assessment score than those with higher health status assessment score. It was also determined in our study that each one-point increase in health status assessment increased depressive symptom frequency by 0.86 times.

Family plays an important role in the emotional, mental and physical development of children. Many family-related factors cause depression in adolescence period.<sup>[28]</sup> Zinn-souza et al.'s study<sup>[6]</sup> shows that the prevalence of depressive symptoms in the students who have problems in family relations was 2.14 times higher, while 2.28 times higher in adolescents, determined by Toros et al.'s study<sup>[8]</sup> compared to those without any problem. Similarly in our study, depressive symptoms were found to be 2.59 times more common in students with normal family relationships than those with good family relationships, and 6.64 times more common in students with bad family relationships than those with good family relationships. It is thought that students who have problems in family relations can be socially, physically and mentally affected, which is an important risk factor in terms of depressive symptoms.

Özfirat et al.<sup>[29]</sup> reported in a study conducted by high school students that depressive symptom prevalence in those who assessed themselves as unsuccessful at school was 1.5 times higher than those who assessed themselves as moderately successful, and 3.08 times higher than those who assessed themselves as successful. Türkleş et

al.<sup>[10]</sup> determined in their study that a negative relationship exists between school performance and depression symptom prevalence. Likewise other studies, in our study, depressive symptom prevalence was determined 5.54 times higher in those, who stated that their school performance was bad, than those, who stated that their school performance was excellent. It should not be forgotten that poor school performance can lead to an increase in depression in students, and that school success can also be adversely affected in the presence of depression. Therefore, the relationship between depression and school achievement should be evaluated carefully.

It has been determined in the studies conducted in adolescents that there is a relationship between depression and the use of mobile phones, computers, internet and television, which produce electromagnetic fields.<sup>[16-18]</sup> Thomas et al.<sup>[30]</sup> found that the level of radio frequency-induced electromagnetic field, to which adolescents are exposed, increase general behavioral problems, but there is no relationship in respect to emotional symptoms. In our study, it was not determined significant relationship between EMF level of adolescents exposed in school environment, and depression symptom prevalence. Moreover, no significant relationship was found between those including cell phone use, computer and internet usage times at home and outside, and depressive symptom prevalence.

## 5. LIMITATIONS

Since the study was conducted in a high school in a district of Mersin, it can not be generalized to all students in Mersin or Turkey. The highest values of the EMF measurement results in the class were obtained in the frontal areas of the board. But, since in which part of the class the students were sitting, was not questioned when the questionnaire was conducted, no comparison was made between the students who were sitting in front rows and other students in terms of depressive symptom prevalence.

## 6. CONCLUSION

Depression is an important problem in high school students in Mezitli district. In terms of depressive symptoms in the adolescent group, women, those with chronic illness, those with low health status, those with poor school success and poor family relationships should be considered as primary risk groups, and preventive actions should be done for these groups. The EMF measurement results were determined above the limit values in areas close to the boards in the classes. Therefore, placing front rows as far away as possible from the board will be appropriate. Besides, students should not always sit in the same location, and their sitting locations should be occasionally replaced. As well as the existence of the studies showing that the intensive use of communication tools such as mobile phones and the internet that create electromagnetic fields increase

depression, no significant relationship was found between the EMF level in the class and the depressive symptom prevalence in our study. It is thought that further research is needed on this issue.

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