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ГЕНДЕРНЫЕ И ВОЗРАСТНЫЕ РАЗЛИЧИЯ ЛИЦ С СУИЦИДАЛЬНЫМ ПОВЕДЕНИЕМ

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Настоящее исследование рассматривает контингент лиц с суицидальным поведением сквозь призму половозрастных различий. Изучены архивные материалы ГБУЗ КО «Калужская областная психиатрическая больница им. А. Е. Лифшица» за период 2017—2018 гг. Выделенные 435 случаев госпитализаций лиц с суицидальным поведением разделены на поступления с суицидальными мыслями и госпитализации с суицидальными попытками и самоповреждениями с уточненными суицидальными намерениями. Полученные данные обработаны с помощью пакета программ Microsoft Excel с применением коэффициентов ассоциации Д. Юла и контингенции К. Пирсона, критерия Пирсона χ² и критерия Стьюдента. Результаты исследования указывают на отсутствие различий в суицидальных проявлениях с поправкой на пол, но позволяют выделить возрастные интервалы риска. Так, среднее значение возраста в группе поступлений с суицидальными мыслями находилось в интервале 29,8—35,2 года, в группе суицидальных попыток — 36,0—41,4 года. В возрастной когорте 5—19 лет вероятность поступлений с суицидальными мыслями была выше, чем с суицидальными попытками и самоповреждениями; напротив, в возрастном интервале 25—44 лет поступления с суицидальными попытками и самоповреждениями превалировали. Настоящие сведения дополняют научные данные и указывают направления для дальнейших исследований по профилактике смертности от внешних причин (самоубийств) в этой области теории общественного здоровья.

К л ю ч е в ы е   с л о в а : общественное здоровье; смертность от внешних причин; самоубийство; половозрастные различия; профилактика.

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THE GENDER AND AGE DIFFERENCES OF PERSONS WITH SUICIDAL BEHAVIOR

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The study examines cohort of people with suicidal behavior in the light of gender and age differences. The archive materials of the Kaluga Regional Psychiatric Hospital for the period of 2017–2018 were studied. The allocated 435 cases of hospitalizations with suicidal behavior are allocated to admissions with suicidal ideation and hospitalizations with suicidal attempt and self-harm with specified suicidal intentions. The data obtained was processed using the Microsoft Excel software applying the Yule's coefficient of association and Pearson's contingency coefficient, Pearson's χ² test and Student's t-test. The results of study established no differences in suicidal manifestations adjusted for gender, but allow to distinguish risk age intervals. Thus, mean age in the group of admission with suicidal ideation was in the range of 29.8–35.2 years and 36.0–41.4 years in the group of suicidal attempt. In the age cohort of 5–19 years, probability of admission with suicidal ideation was higher than with suicidal attempt and self-harm. On the contrary, in the age range of 25–44 years, admission with suicidal attempt and self-harm prevailed. This information complements scientific evidence and points out directions for further research concerning prevention of mortality from external causes (suicide) in this area of public health theory.

K e y w o r d s : public health; mortality; external cause; suicide; gender and age differences; prevention.

Introduction

Annually, more people die from suicide than from HIV, malaria, breast cancer, or from war and murder. In 2019, more than 700,000 people died this way, that is, one out of every 100 deaths is suicide [1].

McDowell AK et al. indicate the prevalence of suicidal behavior in the population based on data from the Centers for Disease Control and Prevention, USA. Thus, serious suicidal thoughts were noted in 3.7% of the population, 1.0% had a plan of suicide at the time of the study, 0.5% had a history of attempts, and 0.01% ended their lives by suicide [2]. According to Zubrick SR et al., in the Australian population in the age interval of 12–17 years, the prevalence of suicidal ideation was 7.5% over the past 12 months, suicidal attempts — 2.4%, while only 0.6% of adolescents sought medical help due to attempts [3].

It is assumed that against the background of the spread of coronavirus infection, suicide rates will increase from 1% to 145% [4, 5]. The need for a more sparing attitude to financial and labor resources with the

continuing difficult epidemiological situation highlights the relevance of research aimed at finding risk factors and protective factors [6, 7]. Adequate target audience research has the potential to help segment vulnerable populations for appropriate targeted interventions. This resource-saving approach optimizes the activities of crisis services and increases the prevention effectiveness.

The aim of this work is to form a general idea of the demographic characteristics of persons hospitalized in a psychiatric hospital with suicidal behavior, as well as to identify the age intervals of the risk of specific types of suicidal behavior.

Materials and methods

As part of the study, a retrospective analysis of the archival medical records of the Kaluga Regional Psychiatric Hospital (hereinafter: KRPH) for the period of 2017–2018 was conducted. In total, 435 Medical Records of an Inpatient were processed. The sample size was calculated using the method of K. A. Otdel'nova at t=2.0; p=0.95 [8]. All admissions were divided into two groups: admissions with suicidal ideation (hereinafter referred to as SI) and admissions with suicidal attempts, including self-harm with specified suicidal intentions (hereinafter referred to as SA).

Results

Of the total number of hospitalizations for 2017–2018, manifestations of suicidal behavior and self-harm were found in 435 cases. The ratio of patients with SA and SI is practically 1:1, 218 and 217 cases, respectively.

When analyzing the gender composition of patients who were treated at the KRPH for the specified period, it was found that 46% of those who were admitted with attempts were males and 54.5% were females. On the opposite, in the group of patients with SI, 54% were males and 45.5% were females (Fig. 1).

However, this ratio was not stationary during the period under study. Thus, a natural assumption arises: to put forward a hypothesis of hospitalizations with one form or another of suicidal behavior being independent of the gender of the suicidal person, that is, there is no quantitative advantage in one group or another (Hypothesis — H_0) against the alternative H_1 (Table 1).
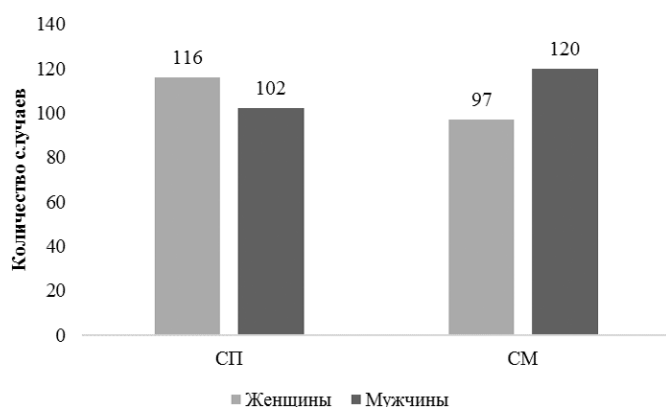

Fig. 1. Gender differences in groups of admissions with SA and SI, 2017–2018, number of cases.

Table 1

A contingency table for determining the influence of gender on the type of suicidal behavior

Type of suicidal behavior	Gender	
	Male	Female
SA	116=a	102=b
SI	97=c	120=d

Table 2

Design data for calculating the value of the Pearson's test χ^2

Type of suicidal behavior	Observed (O)		Expected (E)		
	Female	Male	Total	Female	Male
SA	116	102	218	106.74	111.2552
SI	97	120	217	106.26	110.7448
Total	213	222	435	213	222

We shall determine the Yule's coefficient of association.

$$C_{as.} = \frac{ad - bc}{ad + dc} = \frac{116 \cdot 120 - 102 \cdot 97}{160 \cdot 120 + 102 \cdot 97} = \frac{4026}{23814} = 0.169$$

On the Chaddock scale, the connection is characterized as very weak.

We shall determine the Pearson's contingency coefficient.

$$C_{C.} = \frac{ad - bc}{\sqrt{(a+b)(b+d)(a+c)(c+d)}} = \frac{116 \cdot 120 - 102 \cdot 97}{\sqrt{218 \cdot 222 \cdot 213 \cdot 217}} =$$
$$= \frac{4023}{47296.0} = 0.085$$

On the Chaddock scale, the connection is characterized as absent.

Based on the analysis of this table, it can be concluded that there is no influence of gender on the form of suicidal behavior. However, in order to be completely satisfied, we shall calculate the value of the Pearson's chi-squared test χ^2 (Table 2).

Calculating the observed value $\chi^2_{obs.} = \sum \frac{(o_{ij} - E_{ij})^2}{E_{ij}}$ or

$$\chi^2_{obs.} = \frac{(116 - 106.74)^2}{106.74} + \frac{(102 - 111.26)^2}{111.25} +$$
$$+ \frac{(97 - 106.26)^2}{106.26} + \frac{(120 - 110.74)^2}{110.74} = 3.125$$

The critical value of the Pearson's chi-squared test is 3.841 at a significance level of p=0.05 and the number of degrees of freedom

$$f = (r - 1) \times (c - 1) = (2 - 1)(2 - 1) = 1.$$

We compare the value of the χ^2 test with the critical value for the number of degrees of freedom f. The obtained χ^2 test value is lower than critical; thus, the gender does not affect the type of suicidal behavior with a probability of 0.95 and there are no quantitative advantages in one group or another. When using the built-in EXCEL function, CHITEST, to calculate the probability of a competing hypothesis, we obtained the following: CHITEST=0.0758>0.05.

Preliminary study of the age composition of suicides

For a preliminary analysis, we shall calculate the statistical characteristics of the samples of SA and SI (Table 3).

Finding the characteristics of the samples:

Mean (mean age of suicide for samples SA (X) and SI (Y))

$$\bar{X} = \frac{1}{n}\sum_{i=1}^{17} X_i n_i = 38.72; \quad \bar{Y} = \frac{1}{N}\sum_{i=1}^{17} Y_i N_i = 32.51$$

Unbiased sample variances

$$s_X^2 = \frac{1}{n-1}\sum_{i=1}^{17}(X_i - \bar{X})^2 n_i = 400.829;$$

$$s_Y^2 = \frac{1}{N-1}\sum_{i=1}^{17}(Y_i - \bar{Y})^2 N_i = 400.899$$

The marginal errors for the confidence intervals of the general mean will be the same. Both samples are not normally distributed (the hypothesis is verified by the Pearson's test χ^2); however, they do not contradict the norm by the conditions of the entry of a sample part into the corresponding intervals.

Analysis and testing of hypotheses about the means in the SA and SI groups

Assuming that there is a mean age in the SA group, we will test the hypothesis of equality of the means. H_0: $M(X) = M(Y)$, against the alternative hypothesis: H_1: $M(X) > M(Y)$

The statistical criterion for testing this hypothesis is the normalized random variable

$$Z = \frac{M(X) - M(Y)}{\sqrt{\frac{D(X)}{n_1} + \frac{D(Y)}{n_2}}}$$

Calculating the observed value of the criterion

$$z_{obs.} = \frac{\bar{x}_B - \bar{y}_B}{\sqrt{\frac{s_x^2}{n_1} + \frac{s_y^2}{n_2}}} = \frac{38.72 - 32.51}{\sqrt{\frac{400.82}{218} + \frac{400.90}{217}}} = 3.2362.$$

The critical region is right-sided, respectively, z_{cr} is defined as the argument of the Laplace's function, at which $\Phi(z_{cr}) = \frac{1-2\alpha}{2}$ and the critical region is determined by the inequality $Z > z_{cr}$.

$$\Phi(z_{cr}) = \frac{1-2\alpha}{2} = 0.450.$$

According to the Laplace's function tables

$$\Phi(t) = \frac{1}{\sqrt{2\pi}}\int_0^t e^{-\frac{t^2}{2}} dt,$$

we find z_{cr}=1.645.

Since $3.24 = z_{obs} > z_{cr} = 1.65$, we reject the hypothesis H_0 and accept H_1: the general means differ significantly, i.e. there is a significant difference in admissions in the SA and SI groups depending on the age cohort.

Thus, there are significant differences in the admissions of patients with suicidal attempts and ideations in different age cohorts.

For both features (SI and SA), we shall perform an interval estimation of the mean values with a reliability of 0.95. We shall estimate the general mean $M(X) = a$ according to sample statistics $\bar{x}$ and S using the theory of confidence intervals for the normal distribution. Since σ is unknown, we use the Student's distribution.

The confidence interval for the true value $M(X)=a$ with a reliability of γ=0.95 is found by the formula:

$$\bar{x} - \frac{s_x}{\sqrt{n}} \cdot t_\gamma < a < \bar{x} + \frac{s_x'}{\sqrt{n}} \cdot t_\gamma.$$

Where $t_\gamma = t(1 - \gamma, n - 1)$, quantile of the Student's distribution with n=218 is found by the table or by the built-in EXCEL function TINV (0.05; 217)=1.971.

Confidence interval:

$$38.72 - \frac{20.02}{\sqrt{218}} \cdot 1.971 < a < 38.72 + \frac{20.02}{\sqrt{218}} \cdot 1.971$$

Thus, the mean age in the SA group will be within the range (36.048; 41.393). The confidence interval is more reliable according to the t-test (the marginal error is 2.672 versus 2.658 according to the CONFIDENCE function (0.05; 20.02; 218)=2.658) than according to the Laplace's normal distribution criterion, although it is less accurate.

The same works for Y. The confidence interval for the true value $M(Y)=b$ with a reliability of γ=0.95 is found by the formula:

$$\bar{y} - \frac{s_y}{\sqrt{n}} \cdot t_\gamma < b < \bar{y} + \frac{s_y}{\sqrt{n}} \cdot t_\gamma$$

Table 3

Design data for a preliminary analysis of the statistical characteristics of the samples of SA and SI

Variant	Frequency, SA	Variants	Frequency, SI	Counting SA, X		Counting SI, Y	
age	n_i	x_i, y_i	N_i	$x_i n_i$	$(x_i - \bar{X})^2 n_i$	$Y_i N_i$	$(y_i - \bar{Y})^2 N_i$
1	2	3	4	5	6	7	8
5–9	2	7	16	14	2012.3	112	10409.6
10–14	27	12	49	324	19277.1	588	20606.1
15–19	22	17	20	374	10378.9	340	4809.3
20–24	11	22	9	242	3075.2	198	993.6
25–29	16	27	13	432	2197.8	351	394.2
30–34	23	32	11	736	1038.7	352	2.8
35–39	21	37	15	777	62.1	555	302.8
40–44	15	42	15	630	161.4	630	1351.8
45–49	16	47	23	752	1096.9	1081	4831.1
50–54	11	52	9	572	1939.9	468	3419.8
55–59	14	57	9	798	4678.1	513	5399.2
60–64	14	62	17	868	7587.3	1054	14787.3
65–69	11	67	4	737	8797.2	268	4759.1
70–74	3	72	3	216	3322.6	216	4679.1
75–79	5	77	1	385	7326.7	77	1979.6
80–84	5	82	2	410	9365.7	164	4899.1
85+	2	87	1	174	4661.9	87	2969.5
total	218	x	217	8441	86980	7054	86594
mean		x		38.720	398.991	32.51	399.052

Здоровье и общество

Confidence interval:

$$32.51 - \frac{20.02}{\sqrt{217}} \cdot 1.971 < a < 32.51 + \frac{20.02}{\sqrt{217}} \cdot 1.971 .$$

Thus, the mean age in the SI group will be within the range (29.828; 35.186). The confidence intervals for the SI and SA groups do not overlap; this implies that the age samples do not belong to the same general population, therefore, they cannot be considered as rigidly related.

Analysis and testing of hypotheses about the probability of admission with SI and SA for certain age cohorts

For both features (SI and SA), we shall perform an interval estimation of the proportion of observation units with the values of the feature in different cohorts, assuming the estimation reliability is 0.95.

Now we consider the first three cohorts of 5–9, 10–14, and 15–19 years in the SA sample. Since the proportion of observation units with the values of the feature in these cohorts for the sample w=(2+27+22)/218=0.2339 is the relative frequency (Table 3), the error of mean of the proportion for the sample is found by the formula:

$$\mu_{\bar{w}} = \sqrt{\frac{w(1-w)}{n}} = \sqrt{\frac{0.2339 \cdot 0.7661}{218}} = 0.0287$$

Marginal error of the proportion:

$$\Delta_w = t_\gamma \cdot \mu_w = 1.971 \cdot 0.0287 = 0.0565$$

Where $t_\gamma = t(1 - \gamma, n - 1)$, quantile of the Student's distribution with $n = 218$ is found by the table or by the built-in EXCEL function TINV (0.05;217)=1.971. Confidence interval:

$$w - t_\gamma \cdot \mu_w < p_x < w + t_\gamma \cdot \mu_w \Leftrightarrow 0.2339 - 0.0565 < p_x < 0.2339 + 0.0565$$

or $0.1774 < p_x < 0.2905$

Accordingly, the proportion of attempts in the age range of 5–19 years, with a reliability of 0.95, should be in the interval ($0.1774 < p_x < 0.2905$) for the entire population of 5–19 years.

Now we consider the first three cohorts of 5–9, 10–14, and 15–19 years in the SI sample. Since the proportion of observation units with the values of the feature is higher than the obtained mean for the sample w_y=(16+49+20)/217=0.3917 — the relative frequency (Table 3), the error of mean of the proportion for the sample is found by the formula:

$$\mu_w = \sqrt{\frac{w(1-w)}{n}} = \sqrt{\frac{0.3917 \cdot 0.6083}{219}} = 0.0331 .$$

Marginal error of the proportion:

$$\Delta_w = t_\gamma \cdot \mu_w = 1.971 \cdot 0.0331 = 0.0653$$

Where $t_\gamma = t(1 - \gamma, n - 1)$, quantile of the Student's distribution with $n = 10$ is found by the table or by the built-in EXCEL function TINV (0.046; 9)=2.313. Confidence interval:

$$w - t_\gamma \cdot \mu_w < p_x < w + t_\gamma \cdot \mu_w \Leftrightarrow 0.3917 - 0.0653 < p_x < 0.3719 + 0.0653$$
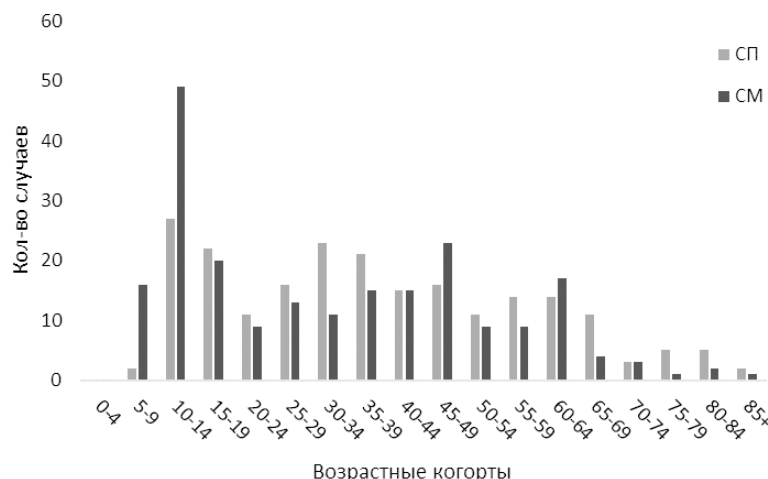
or $0.3264 < p_y < 0.4570$

Fig. 2. Age distribution of hospitalized patients in the KRPH depending on the type of suicidal behavior, number of cases.

The proportion of admissions with SI in the age range of 5–19 years, with a reliability of 0.95, should be in the interval (0.3264; 0.4570) for the entire population of 5–19 years.

Confidence intervals do not overlap, which means that the probability of admission with suicidal ideation is much higher for these cohorts than the probability of hospitalization with suicidal attempts and self-harm. To substantiate this assumption, we will test the hypothesis H_0: $p_y = p_x$ with a competing hypothesis H_1: $p_y > p_x$

The observed value of the criterion is calculated by the formula:

$$U_{obs.} = \frac{\frac{m_y}{n_y} - \frac{m_x}{n_x}}{\sqrt{\tilde{p} \cdot (1 - \tilde{p}) \cdot \left(\frac{1}{n_y} + \frac{1}{n_x}\right)}} = \frac{0.3917 - 0.2339}{\sqrt{\frac{136}{435}\left(1 - \frac{136}{435}\right) \cdot \left(\frac{1}{217} + \frac{1}{218}\right)}} = 3.5489$$

Where $\tilde{p} = \frac{m_y + m_x}{n_y + n_x} = \frac{136}{435} = 0.3126$ is the best point estimation of the probability when the null hypothesis is valid.

Plotting the critical region:

with a competing hypothesis H_1: $p_1 > p_2$, u_{cr} for the right-sided critical region is found from the condition $\Phi(u_{cr}) = \frac{1 - 2\alpha}{2}$, and the critical region is as follows:

$U > u_{cr}$, $\Phi(u_{cr}) = \frac{1 - 2 \cdot 0.05}{2} = 0.45$ consequently, $u_{cr} = 1.645.$

$$U = 3.55 > u_{cr} = 1.645.$$

Therefore, the hypothesis is not accepted, and it can be assumed that in the entire general population for these cohorts, the probability of hospitalization with suicidal ideation is greater than the probability of hospitalization with suicidal attempts and self-harm.

The rest of cohorts in various combinations are considered in the same way. For the age ranges of 25–29, 30–34 and 35–39 years, the probabilities, in general, are p=0.275 in the SA group and p=0.180 in the SI group. For 30–34, 35–39 and 40–44 years, the probability was

Table 4

Design data for determining age differences depending on the type of suicidal behavior

Joint cohorts	SA	SI	Relative proportions		$\tilde{p}$	Uobs.
			SA	SI		
5–19	51	85	0.2339	0.3917	0.3126	3.5489
25–39	60	39	0.2752	0.1797	0.2276	-2.3754
30–44	59	41	0.2706	0.1889	0.2299	-2.0249
65–79	19	8	0.0872	0.0369	0.0621	-2.1735

Note: the + sign in Uobs. means the prevalence of SI, "–" means the prevalence of SA.

$p=0.271$ in the SA group and $p=0.188$ in the SI group. Thus, admissions with SA in the named cohorts prevail over admissions with SI; hypotheses are tested in the same way (Fig. 2, Table 4).

For cohorts 65–69, 70–74, 75–79, 80+, the probability of hospitalization is lower both in the SI group and in the SA group in general, while maintaining the ratio within the cohorts: SA prevail over SI and hypotheses are tested in the same way.

Discussion

The lack of clear prevalence of the male or female gender in the sample presented requires further study with the expansion of the cohort of respondents and the use of materials from emergency care facilities. Significant differences in the structure of psychiatric diagnoses in hospitalized patients depending on the profile of the hospital have been previously described [9, 10]. The incompleteness of the "gender paradox" highlights the relevance of nonselective prevention, which includes community outreach and more open dialogue on suicide and stigmatization reduction. The most important component of suicide prevention is the availability and accessibility of crisis assistance, which implies increased funding for services not only in the field of prevention and health promotion, but also treatment of mental disorders [11]. Resources should be aimed both at training practitioners and increasing their competence in assessing suicidal risk and at increasing public awareness of the warning signs of suicide and possible ways of providing help [11, 12]. Support groups of depression and suicide survivors can be helpful [13].

The age intervals of risk determined in this study indicate the sequence of changes in the stages of the suicidal continuum: from hospitalizations with SI in the range of 29.8–35.2 years to admissions with SA in a cohort of 36.0–41.4 years.

The maximum number of cases with SI in a cohort of adolescents allows us to draw indirect conclusions about the prevalence of this phenomenon in the population. It is appropriate to indicate the data of M. I. Cherepanova obtained in the course of studying suicidal behavior of young people in Altai Krai: 10% of schoolchildren and 14% of students expressed the opinion that by depriving oneself of life it is possible to "solve important problems for oneself". Besides, according to the author, 7% of schoolchildren and 13% of students who an-

swered vaguely can also be attributed to the suicidal risk group [14].

Suicide prevention among youth may include student conferences/summits on suicide prevention, training for law enforcement officials, teachers, mental health caregivers, countering child abuse [13] and bullying, funding for fight against substance abuse, and strengthening of mental health [15].

Previously, a number of initiatives were highlighted that have proven their effectiveness along with existing activities: the introduction of 24-hour crisis teams, observation/supervision of patients for the next seven days after discharge, support for patients with severe mental disorders after discharge with special attention to noncompliant [16], informational support for "survivors" [17].

Conclusions

With economic pressure on the general population, the pandemic is making the development of crisis services more urgent than ever [18]. The resolution of the issues on the implementation of activities that have demonstrated obvious progress within the framework of well-known national strategies can be called timely. Broad communication, public awareness and educational strategies are needed to improve understanding of suicidal behavior and remove barriers to requesting help. The cornerstone in initiating interagency cooperation is raising the awareness of officials of the need for strategies to prevent suicide, their level of knowledge, and clear indicators of the evidence-based effectiveness of preventive measures [19].

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