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Suicide rates amongst adolescents A mental health practitioner's perspective in Poland and a global, Big Data context

Abstract: The paper contributes to mental health studies of children and youth's suicide and suicide attempts. Inspired by early sociological concepts such as Durkheim's contribution to understanding suicide through social anomie, we ran statistical analysis of worldwide suicide rates and tested for correlation between suicide rates amongst children and youth and "Big Data" on social, educational, economic and environmental factors around the world. Amongst them we considered 88 variables including Human Development Index (HDI) and its indicators, rates of religious observance and denomination, and even the hours of sunlight and the average temperature in each country. The statistical section of the paper is preceded by the results of analysis from the anonymised mental health records of adolescents with suicidal and self-harming tendencies. The data came from a Polish psychotherapist and was accompanied by in-depth analysis of contributing factors from purposely selected, attempted suicide cases, in order to enrich the statistical perspective with biological, individual, environmental and situational factors. Finally, we identify trigger factors and protective indicators, derived from both the statistical and the empirical part of our study.

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Introduction

Suicides are deliberate acts, that purposely lead to one's own death (c.f. WHO 2001; Bohaterewicz et al. 2020). According to World's Health Organization, WHO (2014), suicides are amongst the top three causes of teenage deaths. Lee et al. (2020) define adolescents as people age 10–19, a particularly vulnerable group in society, which remains under the guardianship of adults and under the special protection of international conventions (The Convention on the Rights of the Child) and local laws (country specific regulations against domestic violence), that should protect them from any form of violence or harm. Therefore, suicides of children and youth are particularly tragic, as they demonstrate a grand failure of the state protection system. Choi and Lee (2020) provide a comprehensive list of risk factors connected to suicide, including socioeconomic, cultural, general health and mental health factors. Similar factors may be found in the unrelated review from Sulski & Sumika (2006), who list difficult family situations (mental health issues, neglect, addiction, domestic violence), stressful situations, mental illness, traumatic life events, low socio-economic status, lack of education and social isolation. Social isolation as a factor was also confirmed in the study by Searles et al. (2014) who observed that in the US, people in rural, more remote locations are more likely to commit suicide and they linked it to social isolation in this particular study. Obuchowska (2006) highlighted a lack of feeling safe and the 'cruel world syndrome', where children and adolescents perceive life as dangerous and alienating. A similar approach to social factors was discussed as early as in 1897 by the French sociologist Emile Durkheim, who suggested that suicides apart from immanent psychological and emotional aspects may be also connected to societal factors and especially to a lack of or a low level of social integration, leading to social anomy (Obuchowska 2006). He also developed a typology of suicides as anomic, altruistic, egoistic and fatalistic. The anomic is connected to either too little or too much social control and the insufficient feelings of belonging triggered by it. Joiner's theory (2005) (*Durkheim 1897*) on reasons for committing suicides, is coherent with Durkheim's, confirming the increased sense of burden and obstructed, unfulfilled need for belonging as significant contributing factors. Durkheim's theory gained many opponents (Danigelis & Pope 1979; Hodwitz & Frey 2016) but remains one of the leading points of reference in sociological studies (Selvin 1958; Howard et al. 2005). Another, more recent study by Joiner et al. (2009), confirmed the impact of two psychological states that are often a trigger for suicide: a perceived burdensomeness and a sense of low belongingness or social alienation. The feeling of belonging amongst children and adolescents

may come from the closest social environment – family, peers, subcultural social networks and neighbourhoods. The connection between the absence of belonging and suicidality has been confirmed in diverse populations. Importantly, it included adolescents, upper secondary school students, the elderly and psychiatric patients (c.f. Joiner 2005, p. 3). Amongst deviation mechanisms characteristic to anomie, one may find weak social ties, weak social control, increased conflict between aspirations and a lack of opportunity to achieve aspired goals (cf. Durkheim 1897). These elements, together with individual factors, were explored in-depth by our team's psychologist and psychotherapist, who analysed individual cases from her professional practice. Inspired by Durkheim, we wanted to reach out beyond individual and familial factors and decided to approach the problem from the "Big Data" perspective, to investigate if there may be overarching societal factors that precede individual ones. We tested correlation between global statistics on suicide rates amongst adults and adolescents, and purposely selected data containing factors that might be statistically relevant, considering the literature. We choose the variables for theoretical reasons forming a hypothesis that selected global factors (country specific aggregates) correlate with suicide rates. This hypothesis was then confirmed in number of cases in others it was falsified. To know with more certainty if such correlation is not coincidental, we would need to compare data from several years and identify masking factors.

Suicide attempts in classification systems

The International Statistical Classification of Diseases and Related Health Problems ICD-10 classifies suicide under the category of external cause of death. More precise descriptions connected to behaviours aimed at ending one's own life can be found in the category of purposeful self-harm X60–X84, which lists over 20 ways of ending one's own life. In the classification of psychiatric disorders prepared by the American Psychiatric Association (American Psychiatric Association: Desk Reference to the Diagnostic Criteria from DSM-5, 2013), suicidal behaviour disorder (SBD) is diagnosed by 5 criteria: suicide attempt in the last 24 months, action that is not NSSI (non-suicidal self-injury), the diagnosis does not cover suicidal thoughts or preparation, action was not carried out during disturbed consciousness, the person had no political or religious motif (Gmitrowicz 2014). Thus, suicide is deliberate self-harm with the intention of taking one's own life by various means. The following concepts are notable when analysing this issue in relation to children and youth: Suicide is a deliberate and independent life-threatening act; A suicide attempt is an action taken with the intention of taking one's own life, without the participation of third parties and without a tragic end, but may lead to injury; Suicidal thoughts are automatic thoughts and ideas about suicide, planning to self-harm, visualising the suicide and a strong desire to implement these thoughts (Makowska & Gmitrowicz 2018). Presuicidal syndrome

is a term introduced by the Viennese psychiatrist Erwin Ringel, who conducted qualitative research on 700 patients who survived a suicide attempt. He diagnosed a set of signals that may indicate a person's willingness to commit suicide, including: situational narrowing, narrowing of interpersonal relations, narrowing the world of values (Macho 2017). Self-mutilation without suicidal intent is an auto-aggressive behaviour and may include cutting, burning, choking, scratching or overdosing in order to cause a reaction from the environment to gain social benefits (peer recognition) and is not aimed to end one's life (Makowska & Gmi-trowicz 2018).

Materials and Methods

From a practitioner's perspective

The cases included in the case study were selected purposefully from a sample of patients who have used psychotherapeutic support at the NZOZ Mental Health Clinic. It is important to emphasize that the study cannot be classified as research using live participants, since the data was selected retrospectively from the existing, anonymised patients' records. All patients' details were coded, and personal information was removed. They were analysed as a data set of files with no possibility of tracing a file to the actual person. All names used in the description of the results are fictional. The facility provides psychological and psychiatric help to people showing symptoms of mental issues and behavioural disorders (mainly the nosologically derived diagnosis ICD-10 F00–F99). Annually, an average of 200 people benefit from the support of this clinic but in this study only files of the adolescent patients with suicidal attempts were analysed. The clinic specializes in supporting clients with depression, behavioural disorders, disorders of habits and drives, personality disorders, eating disorders, psychoactive substance addiction syndrome and alcohol addiction syndrome. When selecting files for the case study, the following selection criteria were used: age 14–18, period of support 2018–2020, patients with a confirmed attempt to self-harm with the intention of taking their own lives. The cases were anonymised and therefore the names of patients used in this paper are fictional. The cases were analysed using the potential suicide triggers divided into 4 recurring categories: biological, environmental, individual, and situational and this division was made due to following reasons. The reason for such distinction starts with the multifactor approach, including global factors (sociological perspective) and individual factors (psychological and psychiatric perspective) (Chanlder 2019). According to Spröber et al. (2012) in the psychological perspective, biological factors including genetic and personality traits, together with environmental factors (family and peers), somatic (co-existing illnesses) and situational (traumatic events) are amongst the

main risk factors. The intra-psychological perspective may also include individual competencies in stress management and coping with adversity, feeling of agency, ability to influence oneself and the environment (salutogenesis, resilience) (c.f. Antonovsky 1990; Bender & Lösel 2007). The multifaceted, comprehensive, multifactorial approach to self-harming amongst children and youth is shown in the diagram below. It is important to emphasize the interaction of individual groups of risk factors and protective factors. It is important to note that protective is not the same as preventative and we consciously chose to use the word protective. Self-harm behaviours are a result of the mutual influence of individual predispositions (biological and individual factors), triggers in the immediate environment (family, peer group) and situational triggers (stressful / traumatic situations). Literature suggests that global factors may also have a contributing impact. However, the psychotherapeutic process does not take them into account due to the specificity of the therapy's interpersonal approach, but that does not mean they do not exist.

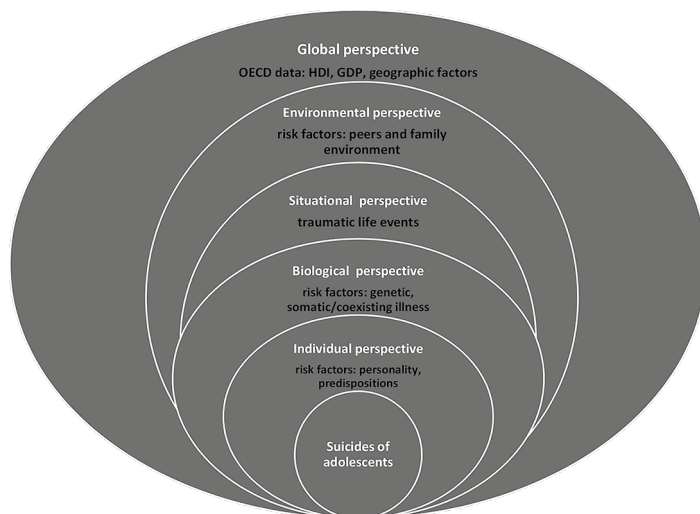


Diagram 1: Complex multifactorial approach to suicide of adolescents

Source: self-generated.

From the biological perspective, a significant role is played by coexisting illnesses, including depression, personality disorders and behavioural disorders, addiction to alcohol and other psychoactive substances, dominant amongst adolescent boys and in adolescent girls, personality and eating disorders. These disorders are connected to abnormalities in functioning of the central nervous system and in particular with the serotonergic system dysfunction (decreased serotonin concentration) and hypothalamic-pituitary-adrenal axis disfunction (Steele & Doey 2007).

Individual/personal risk factors relate to character traits such as readiness to feel fear, strong anger, hostility, aggression, impulsivity, lack of control, low self-esteem and disturbed protective mechanisms. They also relate to deficiency in competences to manage emotions, lack of strategy to deal with problems, rigidity and schematic thinking, tendency to cognitive distortions (negative perception of reality or situations), disturbed attachment styles and mechanisms of building interpersonal relations (anxiety, sticky and dependent behaviour).

Environmental risk factors are focused on quality of relations with the social environment, especially with the close family and peers of the young person. Increased suicidal inclination can be found in children and adolescent from families with increased level of conflict, fragmented, with disturbed child-caregiver relations (lack of support or readiness to show emotions, strict boundaries or lack of thereof, emotional cold, indifference, emotional confusion, emotional dependency), modelling pathogenic modes of behaviour (alcohol and psychoactive substances abuse and suicide attempts or suicides in family). Violent behaviours within a family or amongst peers are also a strong predictor for self-harm (psychological, physical or sexual violence, economic, social or virtual abuse) (c.f. Gmitrowicz 2014).

Most suicide attempts are triggered by a critical crisis. The child/adolescent perspective and interpretation of events and situations differs from that of an adult. External (situational) triggers amongst children and youth are usually not permanent and chronic (with the exception of experiencing long-term violence). Amongst temporary triggers one may find family conflicts, the break-up with a girlfriend or a boyfriend, unplanned pregnancy, school or sport failure or the suicide of a close friend or role model.

In summary, from the individual, environmental, situational and biological perspective, an increased tendency to commit suicide would occur amongst children and adolescents who: regularly abuse drugs or alcohol, display high impulsivity, neurosis, a lack of emotional stability, have coexisting illnesses, including personality disorders, have had a suicide attempt in the last year, or suicide or suicide attempt in their close environment or experience current negative critical life events.

Results

Individual perspective

For the practitioner's perspective part of our study, we selected typical case studies of young patients who attempted suicide in the last 2 years (2018–2020). Furthermore, we provide the relevant summary of analysis, where risk factors are broken down by categories and shown in Table 1 below. In all these cases, the

surviving youth took a conscious decision about ending their own lives to deal with reality, escape from reality, from suffering, deal with a lack of agency, internal pain, emptiness and to resolve problems (high level of unpaid debts).

Table 1. Selected case studies

Meg, age 17, Underlying illness: behavioural disorders F91
Coexisting illnesses: mental disorders and behavioural disorders caused by the use of psychoactive substances – harmful use of substances F19.1
Family situation – full family, single child, higher education of parents, dominant parental style – indifferent
Reported problems – self-harm (cutting of skin on hips, abdomen and arms), suicide attempt (drug overdose) leading to 3 months' treatment in a psychiatric hospital, abuse of alcohol and other psychoactive substances (mainly mephedrone), difficulty in following the rules and social regulations (difficulties at school), difficulties in building interpersonal relations (frequent conflicts with peers, provocative behaviour, lack of loyalty, especially in relation to women in order to take their partner), multiple sexual contacts with men (also much older than the patient), difficulties in building stable or long term relations, high level of compulsivity.
Suicide attempt as a form of escape from oneself, patient declared being 'tired of herself and her own behaviour' and that 'nobody cares about it anyway'
Aetiology of problems – relations with parents, rebellious behaviours as a form of drawing parental attention, behaviours caused secondary rejection by her peers, established pattern of self-deprecation, self-humiliation and self-punishment; in relation to others dominant pattern of alienation and isolation (lack of feeling of belonging to primary system – family and to peer system, feeling of being an outsider).
Tom, age 16, Underlying illness: mental disorders and behavioural disorders caused by the use of psychoactive substances – harmful use of substances F19.2
Coexisting illnesses: family history of alcohol abuse Z81.1
Family situation – broken family, divorce when the boy was 12, 4 years older sister, father suffering from alcohol addiction, used violence: psychological, physical, economic (psychological and economic towards mother and sister, physical and psychological towards the boy), father with medium level of education, mother with higher education.
Reported problems – after divorce escape into psychoactive substances (initially cannabinoids and alcohol), alcohol initiation at the age of 12, drugs at the age of 13, at the age 15 at mother's request directed by a family court to the addiction treatment centre, with compulsory treatment, where he stayed for a year. After treatment, a suicide attempt after trigger (argument with the father) – whilst under heavy influence of alcohol and mephedrone – suicide attempt through hanging (belt broke) – 6 weeks in psychiatric hospital.
Aetiology of problems – rejection by his father, father convinced he is not his son, until divorce physical and psychological violence, mainly due to alcohol abuse – strangling, name calling, humiliation, jerking, kicking. After the divorce contact initiated mainly by the boy.
Father cut the contact with the boy, but maintains contact with the daughter and compares son and daughter.
Bart, age 16, Underlying illness: other disorders and drives F63.8 (Internet addiction syndrome)

Coexisting illnesses: family history of alcohol abuse Z81.1
Family situation – broken family, divorce when the boy was 10, only child, lack of contact with biological father, suffering from alcohol addiction, emotional neglect by the father, passive attitude, submissive towards the mother, mother with medium level of education, father with higher education.
Reported problems – difficulty in family relations, patient feels greater emotional bond (closeness) with the father and wants to live with his father, currently the matter is in court. Addiction to the Internet as a form of dealing with stress, tension, escape from reality. Tendency to escape into compulsive behaviours, such as betting. Mother is a nurse and spent 1 year in Germany. The boy was staying at that time with his maternal grandparents. On her return he lost a large sum of money earned by his mother. He wanted to win back a small loss but fell into a cycle of investments, losses and willingness to make up for losses. In result a suicide attempt followed as an escape from consequences (overdose of grandmother's sleeping tablets).
Aetiology of problems – passive aggressive mother criticised the father in front of the boy, evoked guilt from having contacts, shifted the blame for breaking of her relationship onto the father. Evoked feelings of inferiority in the boy comparing him to his friends from full families, idealizing their fathers. Compared son to his father, reinforcing a model of a man who is hopeless, unreliable and unable to look after his family, responsible for the low economic status of the family. The boy desperate to gain mother's acceptance, often received rejection instead. Trapped between loyalty towards mother and desire to compensate for her suffering caused by the father, and a feeling of closeness and emotional bond with the father and desire to live with him. Escape into VR as a way to build a new identity and self-worth. Betting as a form of compensation and escape to the world, formed an illusion aimed at awarding his mother for her suffering through quick financial gain.
Olivia, age 16, Underlying illness: Recurring depressive disorders F33
Coexisting illnesses: Anorexia Nervosa F50.0
Family situation – full family, many siblings, twin brother, younger sister 10 years old, older brother age 19, parents with higher education, very comfortable material status, business owners.
Reported problems – lack of self-acceptance, fixed pattern of depreciation, criticism and self-humiliation, fixed pattern of auto aggressive behaviour (self-harm, cutting her abdomen and hips, using pins to enter the skin, biting inner lips, starving herself), lack of acceptance for her own femininity, seeing it as dirty and being convinced that 'men have it better'. Difficulties in building interpersonal relations, tendency to withdraw from relations, very high level of neurosis and introversion (measured by NEO-FFI P-R test), increased resignation thoughts, lack of motivation to continue, emotional emptiness, feeling 'lack of sense', lack of vision for the future and during a reoccurring depression episode, a suicide attempt (overdose of sleeping medication).
Aetiology of problems – disturbed relationship with the mother, overcontrolling, authoritarian, interfering with privacy, control as a form of protecting daughter and ensuring her safety (conditioned by her own experiences from the past – victim of rape). Negating the physical attractiveness of the daughter, interfering with her outfits, the way she dresses, the way she spends her spare time and her interests. Tendency to downplay her daughter's mood swings. Providing psychological and psychiatric support only after the suicide attempt. Upbringing based on pressure and coercion resulting in the girl using starvation as a form of escape and the only area where the mother had no ability to completely control her, where the girl had some control. Self-harm as a form of regulating emotions, escape from internal pain (after arguments with the mother) in the later phase of depression as the only way to be able to feel anything at all.

Table 2. Case studies of adolescents and 4 groups of triggers

Sex	Age	Biological risk factors	Environmental risk factors	Individual risk factors	Situational risk factors	Type of self-harming behaviour
M	19	F19.2	Broken family, lack of contact with biological father, psychological violence from mother's partner, dominant parenting style: indifferent	Impulsivity, aggression, tendency to risk behaviour	Expulsion from a closed addiction treatment institution for breaking the rules (sexual abstinence)	X62 intentional self-poisoning with psychoactive substances
M	17	F 60.31 F19.1	Relations with the mother: emotional confusion, dependency, lack of boundaries, frequent conflicts, histrionic pattern of relations, Psychological violence, verbal abuse both from mother and the son. Relation with the father: emotional absence, withdrawal, inactive, indifferent, emotionally cold.	Impulsivity, emotional instability, difficulty in controlling emotions, inadequate methods of solving problems (abuse of psychoactive substances, behaviours leading to self-destruction)	Conflict with girlfriend	X78 use of sharp object
F	17	F91 F19.1	Dominant parental style: indifferent, rejection from peers, lack of social acceptance	Self-depreciation (self-deprecation) scheme, self-humiliation, punishment, lack of belonging to primary setting (family) and peer group. Difficulty in following rules and social regulations, difficulty in building interpersonal relations, multiple sexual male partners, compulsive behaviour, hostility, impulsivity	Using Messenger app, a 'friend' revealed a photo of the patient under influence of psychoactive substances (revenge for 'stealing' her partner);	X63 overdose of neurological medicine
M	16	F19.2 Z81.1	Father's alcohol addiction; physical, psychological, economic violence at home, directed at patient, his siblings and his mother, conflicts with the father, rejection by the father, lack of support from sister and mother	Compulsive behaviour, difficulty in controlling emotions, disturbed ways of dealing with problems, (tendency to addiction); set pattern of self-criticism, depreciation and low self-esteem	Argument with the father	X70 hanging

Sex	Age	Biological risk factors	Environmental risk factors	Individual risk factors	Situational risk factors	Type of self-harming behaviour
M	16	F63.8 Z81.1	Fragmented family, lack of contact with biological father, father addicted to alcohol, emotional neglect & passive attitude from the father, submissive towards the mother. Passive aggressive mother-critical of the boy in front of the father, evoking sense of guilt for contacts with the father, shifting blame and responsibility for the end of her relationship, made his son feel inferior by comparing him to boys from full families and idealizing their fathers.	Impulsivity, lack of emotional stability, disturbed patterns of dealing with stress/difficulty (escape into VR, compulsive behaviours); rigidity of thinking and acting; low self-esteem, high self-criticism;	Gambling: loss of large sum of money belonging to his mother	X61 use of professional drugs for sleeping or calming down
F	16	F33 F50.0	Disturbed relationship with the mother, controlling, authoritarian, disrespectful of privacy. Critical of the daughter, lack of acceptance for her sexuality. Upbringing through control, emotional blackmail, evoking guilt. Withdrawn from relations with peers – social isolation.	Very high level of neurosis and patterns of self-deprivation, criticising and self-deprecating, auto-aggressive behaviour, (self-harm – cutting of the abdomen and hips, pushpins, self-starvation) resignation thoughts, rigidity of thinking, catastrophic thinking, low self-esteem, lack of acceptance for her own sexuality	None identified	X61 use of prescribed sleeping or calming medication

Source: Self-generated.

Big Data Approach

Statistical approach

In this part of the study, we use Big Data approach. Big Data as a method of analysis uses mathematical assessments and inductive statistics to extrapolate certain patterns from large sets of data to seek relationships and dependencies (Bollier 2010). This approach slowly gains terrain in healthcare science (cf. Raghupathi & Raghupathi 2014). The difference between Big Data methodology and

the Big Data approach is that you start by harvesting and storing data and then look for patterns between the large data sets, often without a specific question in mind; although, you should be aware of the broad drivers for measuring, such as a desire to monitor and to better understand impact. For our statistical analysis we used SPSS 25.

To test the correlation between the number of suicides committed by boys and girls age 10–14, 15–19 and the socio-economic indicators, we used the Pearson correlation coefficient. In the second stage of analysis we calculated the rates of regression.

For the statistical part of our study we used so called “Big Data”, in our case these were the indicators from the Global Health Observatory, which is the WHO’s data base of 1000 indicators from 194 countries. The most up to date global statistics available in September 2020 were the ones published 8/08/2018 and pertaining to year 2016².

We focussed on mental health indicators and suicide rate estimates for cohorts 15–29 and 30–49 (crude and age-standardised) and distinguished suicide data for children and adolescents age 10–14, 15–19, divided into male and female categories. In the next step, applying a sociological approach, we created a database of potential global factors in all 194 countries including: general socio-economic factors, suicides in older generations, educational factors, gender factors, technologies factors, healthcare factors, religion factors and climate and weather factors. The data sources included: United Nations Development Programme. Human Development Reports³, WHO statistics⁴, religious observance data⁵ and average temperatures and climate zones based on multiple national data sources (our data base is available on request). We used 2016 data from all these sources, apart from data on religion from 2011, as no complete worldwide data sets were available for a more recent period. There was another limitation: not all countries report their data to WHO, which created small gaps in the available data. Our data base covered all countries of the world according to UN⁶.

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² <https://apps.who.int/gho/data/node.home>; <https://apps.who.int/gho/data/node.main.MHSU-ICIDESYEARAGEGROUPS?lang=en>.

³ <http://hdr.undp.org/en/data>.

⁴ <https://www.who.int/data/gho>.

⁵ See: <https://www.nationmaster.com/country-info/stats/Religion/Religions>.

⁶ <https://www.un.org/en/member-states/index.html>.

Results for the Big Data Approach

Human Development Index and other global indicators

For this part of the analysis we used data from the Human Development Index (HDI), which aims to “emphasize that people and their capabilities should be the ultimate criteria for assessing the development of a country, not economic growth alone”⁷. It measures average life expectancy at birth, the expected years of schooling and standard of living (GDP/GNI). We tested correlation between the overall HDI, suicides of children and youth, and between the suicides and individual components of HDI for factors related to education, economy, healthcare, and inequality. Lastly, global rates of religious affiliation and global factors related to climate were also considered. We grouped these factors into categories creating hundreds of records for cross-testing. Results were obtained from 40,000 tests using Bayesian descriptive statistical models of Pearson correlation (suicide rate per 100000 per country, distinguished by age and gender, cross-examined with 88 selected variables as country specific aggregates). At this stage we could not answer the question if the correlating variable may be treated as a coexisting risk factor for suicide in certain age cohorts, but we eliminated possible collinearity testing linear regressions. To make the procedures clearer in Table 3 we present categorised data that tested positive.

Table 3. Crude and adjusted teenagers' suicide rate estimate (per 100 000 population in world's countries) global correlates for social, economic, religion, climate factors (Pearson's correlations)

	Age 10–14		Age 15–19	
	Female	Male	Female	Male
General socio-economic factors				
HDI	-.071 p=.431	-.172 p=.021	-.167 p=.025	.095 p=.204
Labour force participation rate (% ages 15 and older)	.114 p=.134	.150 p=.048	-.010 p=.894	.077 p=.312
Labour force participation rate (% ages 15 and older), female	.094 p=.218	.194 p=.010	-.030 p=.690	.139 p=.068
Labour force participation rate (% ages 15 and older), male	.162 p=.032	.037 p=.628	.042 p=.580	.006 p=.937
Coefficient of Human Inequality	.049 p=.555	.125 p=.135	.174 p=.036	-.125 p=.133

⁷ See: <http://hdr.undp.org/en/content/human-development-index-hdi>.

	Age 10–14		Age 15–19	
	Female	Male	Female	Male
General socio-economic factors				
Inequality in income (%)	.003 p=.973	.080 p=.333	.172 p=.037	.091 p=.270
Working poor at PPP \$3.20 a day (% of total employment)	0.27 p=.760	.171 p=.052	.048 p=.588	-.161 p=.068
Estimated gross national income per capita, female (2011 PPP\$)	-.152 p=.044	-.090 p=.236	-.153 p=.042	.124 p=.100
Estimated gross national income per capita, male (2011 PPP\$)	-.109 p=.153	-.168 p=.027	-.193 p=.011	.050 p=.518
Educational factors				
Education Index	-.060 p=.426	-.107 p=.151	-.132 p=.078	.162 p=.030
Gross enrolment ratio, tertiary (% of tertiary school-age population)	-.032 p=.722	-.166 p=.064	-.164 p=.067	.238 p=.007
Mean years of schooling (years)	-.049 p=.515	-.100 p=.184	-.116 p=.120	.159 p=.033
Mean years of schooling, female (years)	-.046 p=.552	-.089 p=.207	-.136 p=.081	.196 p=.011
Mean years of schooling, male (years)	-.036 p=.647	-.107 p=.171	-.129 p=.098	.174 p=.025
Gross enrolment ratio, pre-primary (% of preschool-age children)	-.006 p=.941	-.157 p=.058	-.165 p=.046	.097 p=.241
Inequality in education (%)	.012 p=.883	.080 p=.317	.124 p=.119	-.217 p=.006
Gender factors				
Gender Inequality Index	.103 p=.196	.154 p=.051	.238 p=.002	-.048 p=.547
Gender Development Index	.045 p=.570	-.048 p=.550	-.023 p=.772	.214 p=.006
Adolescent birth rate (births per 1,000 women ages 15–19)	.123 p=.098	.178 p=.017	.128 p=.087	-.036 p=.626
Share of employment in non-agriculture, female (% of total employment in non-agriculture)	.097 p=.200	.150 p=.047	.008 p=.913	.282 p<.001
Share of graduates of STEM programmes in tertiary education who are male (%)	.219 p=.040	.202 p=.059	.193 p=.072	.123 p=.252
Total unemployment rate (female to male ratio)	-.039 p=.608	.036 p=.640	-.091 p=.234	-.170 p=.024
Women with account at financial institution or with mobile money-service provider (% of female population ages 15 and older)	-.051 p=.535	-.121 p=.135	-.135 p=.095	.157 p=.052

	Age 10–14		Age 15–19	
	Female	Male	Female	Male
Technologies factors				
Internet users, total (% of population)	-.106 p=.158	-.129 p=.087	-.209 p=.005	.065 p=.389
Healthcare factors				
Psychiatrists working in mental health sector, per 100,000	-.025 p=.769	-.047 p=.580	-.088 p=.298	.227 p=.007
Suicides in parent's generation				
Suicide rate estimates female age 30–39 (per 100 000 population)	.266 p<.001	.207 p=.005	.614 p<.001	.485 p<.001
Suicide rate estimates male age 30–39 (per 100 000 population)	.290 p<.001	.383 p<.001	.447 p<.001	.703 p<.001
Suicide rate estimates female age 40–49 (per 100 000 population)	.147 p=.050	.196 p=.008	.449 p<.001	.362 p<.001
Suicide rate estimates male age 40–49 (per 100 000 population)	.267 p<.001	.385 p<.001	.348 p<.001	.600 p<.001
Religion factors				
Muslim % followers	-.152 p=.130	-.109 p=.278	-.074 p=.463	-.315 p=.001
Climatic and weather factors				
UV radiation	.093 p=.218	.060 p=.426	.097 p=.196	-.162 p=.031
Average temperature in the capital	.048 p=.519	-.031 p=.681	.132 p=.075	-.221 p=.003

General socio-economic factors

Increasing levels of HDI correlated negatively with the suicide rate estimates for males, age 10–14 years (r -Pearson = $-.172$ $p=.021$). The analysis of regression also brought a statistically significant result with Beta β = $-.171$ $p=.022$. Increasing levels of HDI correlated with the suicide rate estimates for females, age 15–19 years (per 100000 population) (r -Pearson = $-.167$ $p=.025$). The analysis of regression also brought a statistically significant result: β = $-.165$ $p=.028$. This indicates that with higher HDI, less suicides are committed amongst youth and it is more so for the group of boys. We ran the same analysis for the population of these children's parents 30–39 and 40–49. The only statistically significant correlation was found amongst males 40–49, but it gave the opposite result to the one for children, with a positive link between higher HDI and higher suicide rate (r -Pearson = $.216$ $p=.004$; regression: β = $.216$ $p=.004$). Amongst statistically significant correlations with components of the HDI, we found connection between males, age 10–14 suicide rate and the labour force participation rate (% ages 15

and older) (r -Pearson = .150 p =.048), labour force participation rate for girls (r -Pearson = .194 p =.010). Finally, a weak positive connection between male 10–14 suicides and the working poor at PPP \$3.20 a day (% of total employment) (r -Pearson = .171 p =.052). Interestingly, these factors had no statistical significance in the group of females age 10–14, nor 15–19. For females in this last group inequality indicators are playing a role. For instance, the suicide rate estimate for female 15–19 years correlates with the growing coefficient of Human Inequality (r -Pearson = .174 p =.036) and with increased inequality in income (%) (r -Pearson = .172 p =.037). Amongst general socio-economic factors the estimated gross national income per capita, for female and for male (2011 PPP\$) correlates negatively with the suicide rate estimate for females 15–19 (r -Pearson = -.153 p =.042). This means that the higher the income in a country the lower the suicide rate. Regression analysis of this aspect confirm it (β = -.152 p =.044), however the correlation does not repeat in the older groups of women. Similarly, estimated gross national income per capita for males (2011 PPP\$) shows negative correlation with suicide rate estimates amongst males 10–14 years (r -Pearson = -.168 p =.027), which means that the higher the income of men in a country, the lower the suicide rate of boys 10–14. The analysis of regression confirms it with a strong result (β = -.168 p =.027). The higher income of males translates into lower suicide rates amongst young females 15–19 years (r -Pearson = -.193 p =.011), confirmed by analysis of regression showing a connection between the two factors (β = -.193 p =.011). This correlation can be also found in older groups of men and women age 30–39 and 40–49. This means that youth and children are as sensitive to the level of income as the adult population. However, it is interesting from a policy perspective that the youth unemployment rates and youth not in school or employment rates (% for ages 15–24), did not correlate with suicide rate in any of the age groups.

Educational factors

In general, there was no correlation between educational factors and suicide rates for youth 10–14 regardless of their gender. However, the following indicators correlated positively with suicide rates amongst males 15–19: gross enrolment ratio, tertiary (% of tertiary school-age population), mean years of schooling for male and female together and separately (years). The inequality in education (%) correlated negatively with the suicide rate amongst males in this age group. These results are controversial, as they indicate that more years spent in education has a statistical link to more suicides amongst males 15–19 and the greater the inequalities the lower the suicide rate in this group. For females 15–19, suicide rates were lower when the preschool gross enrolment ratio was higher in a given country. The analysis of regression for all educational factors treated as potential predictors of suicide rates brought no statistically significant results. We also te-

sted PISA results and gross enrolment ratio for secondary schools (% of secondary school-age population) and there was no statistical correlation found with suicide rates amongst adolescents.

Gender factors

Using Gender Equality Index GEI and Gender Development Index, we established that there were no universal gender factors relevant to male and female groups 10–14 and 15–19. However, gender specific factors did have an effect. Positive correlation (r -Pearson = .238 p =.002) between greater levels of inequality and higher rates of suicide amongst females 15–19 was found. The analysis of regression confirmed this connection (β = .236 p =.003). The connection ceased to exist in the older groups of females. Does it mean that they are more resistant to gender inequality at older age? We also tested Gender Development Index. There was no statistical correlation with the suicides of girls, but the Gender Development Index had a positive correlation with suicides of males 15–19. Analysis of regression confirmed the statistical significance of this correlation in case of young males (β = .207 p =.009). The correlation between Gender Development Index predictor and the suicide rate estimate for males age 30–39 (β = .222 p =.005) and 40–49 (β = .281 p <.001) was also statistically significant. This indicates a growing anomaly amongst men in countries with greater gender equity. This comes together with confirmed correlation between female share in employment in non-agriculture and increased risk of suicide amongst younger males, for 10–14 r -Pearson = .150 p =.047 and for 15–19 r -Pearson = .282 p <.001. This correlation is also confirmed by analysis of regression for both groups β = .151 p =.046 for 10–14 and β = .275 p <.001 for 15–19. The predictor remains significant in older groups of men with β = .277 p <.001 amongst 30–39 and β = .358 p <.001 for 40–49 age cohort. This may indicate that women working away from home is a risk factor for male suicide and the female to male ratio of unemployment confirms this claim, showing that higher rates of the employment of women, is connected to higher rates of suicide amongst men. Males age 15–19 r -Pearson = -.170 p =.024; β = -.167 p =.028, which was also confirmed in older groups of men with β = -.178 p =.019 for 30–39 age group and β = -.234 p =.002 for 40–49 age group. The share of seats in parliament held by women, access to contraception and employment rates for young men and women, had no statistical correlation with suicide rates amongst adolescents.

Use of ICT

We tested the number of mobile telephone subscriptions and the number of internet users against suicide rates and the only correlation found pertains to females age 15–19, whose suicide rate is lower in countries with higher accessibility

of the internet. In this case, the higher the rate of internet users, the lower the rate of suicides: $r\text{-Pearson} = -.209$ $p=.005$; $\beta = -.207$ $p=.006$. Access to telephones alone had no statistical significance.

Healthcare factors

The number of hospital beds per 1000 inhabitants, the number of psychiatrists, nurses, social workers and psychologists employed in mental health sector per 100000 inhabitants did not correlate with suicide rates amongst children and adolescents, with the exception of $r\text{-Pearson} = .227$ $p=.007$ for suicide rates amongst males 15–19 when correlated with the number of psychiatrists per 100000. Moreover, this correlation was also found amongst the older population. Furthermore, we tested alcohol consumption per capita with suicide rates, and for children and youth this indicator did not correlate. However, it proved to be a statistically significant predictor for the adult population, amongst males 30–39 ($r\text{-Pearson} = .168$ $p=.025$; $\beta = .168$ $p = .025$), females 40–49 ($r\text{-Pearson} = .184$ $p=.014$; $\beta = .184$ $p = .014$) and males 40–49 ($r\text{-Pearson} = .262$ $p<.001$; $\beta = .262$ $p <.001$).

Suicides in older generations as an enabling model of behaviour

At first glance, the connection between suicide rates in older and younger generations can be found. In fact, it is the strongest correlation found. However, the analysis of regression shows that it is not as simple as it looks. For females age 10–14, statistically significant predictors of dependent variable are suicide rate estimates for females age 30–39 (per 100 000 population): $\beta = .514$ $p=.003$ and age 40–49 (per 100 000 population) $\beta = -.430$ $p=.010$. Male suicides have no significant connection, which may indicate that girls identify with their own gender 'pattern' of behaviour. There is also a difficult to explain negative connection between the lowering of the suicide rate in the 40–49 group and the increase in suicide rate amongst the younger group. Does it indicate an intergenerational conflict? This is not something we can answer based only on statistical data. Suicide rate estimates for females age 15–19 include suicide rates estimates for females age 30–39, $\beta = .766$ $p<.001$, males age 30–39, $\beta = .476$ $p=.007$. There are no statistically significant predictors for male suicides in the age group 10–14 in relation to suicides in the older population, but this changes in the 15–19 group, where the following predictors can be confirmed: suicide amongst males age 30–39: $\beta = .817$ $p<.001$; amongst females age 30–39: $\beta = .395$ $p=.002$ and amongst females age 40–49, $\beta = -.332$ $p=.007$, whilst suicides in the 40–49 group of males is not a predictor. Summarising suicides committed by females and males in the age group 30–39 are a strong predictor for suicide rates amongst youth age 15–19.

Religion as a factor

Despite, the ecological fallacy in Durkheim's original findings on religion and the extensive limitations only having access to 2011 data that covers all countries⁸ we managed to find and confirm a singular strong correlation for males age 15–19. A high percentage of Muslim population correlates with lower number of suicides in this age group (r -Pearson = $-.315$ $p=.001$; $\beta = -.315$ $p=.001$). It correlates in the same direction for females 30–39 (r -Pearson = $-.336$ $p=.001$; $\beta = -.336$ $p=.001$), males 30–39 (r -Pearson = $-.346$ $p<.001$; $\beta = -.346$, $p<.001$); females 40–49 (r -Pearson = $-.434$ $p<.001$; $\beta = -.434$ $p<.001$) and males 40–49 (r -Pearson = $-.434$ $p<.001$; $\beta = -.433$ $p<.001$). In these age groups the more Muslims in each country the lower the suicide rate. We tested all the largest religions (Christian tested as a combined variable and separately as: Roman Catholic, Protestant, Anglican, Russian Orthodox; then Buddhist, Muslim, Jewish, Hindu). We also tested people who declared another religion and the part of each population with no religious affiliation at all, but the only confirmed correlation was found for the Muslims.

Climate and weather factors

We found a negative correlation between higher UV radiation level and suicide levels for males age 15–19 (r -Pearson = $-.162$ $p=.031$), which means that the sun has a positive effect on the mood of adolescents. This was only confirmed for men. This is linked to another factor we tested, the average temperature in each capital city, where males 15–19 were less likely to commit suicide when the temperature was higher (r -Pearson = $-.221$ $p=.003$). This correlation was also confirmed for adults in a group of males age 30–39 (r -Pearson = $-.319$ $p<.001$) and age 40–49 (r -Pearson = $-.401$ $p<.001$). Furthermore, we tested the relation between the suicide rate amongst boys and girls 10–14 and 15–19, and the climate zone: equatorial, tropical, subtropical, temperate climate. Using average values for each climate zone, we used F (ANOVA). The climate zone was treated as an independent nominal variable, which using ANOVA was proven to diversify the number of suicides amongst girls age 10–14 ($F=2.427$ $p=.05$) and boys age 15–19 ($F=5.159$ $p=.001$.) In the equatorial zone, girls were much more likely to commit suicide ($M=1.307$) than in tropical zones ($M=.708$) subtropical zones ($M=.792$) or in temperate climates ($M=.914$). It is necessary to add that the presented means are per 100000 inhabitants. In the case of adolescent men, a temperate climate led to more suicides ($M=13.175$), when compared with the equatorial zone $M=8.528$, tropical $M=8.014$ and subtropical $M=6.739$. F (ANOVA)

⁸ <https://www.nationmaster.com/country-info/stats/Religion/Religions>.

for adults (female 30–39, 40–49 and male 30–39 & 40–49) also confirmed the connection to the climate zone.

Table 3. Suicides rate estimate per 100 000 population

	Female 30–39	Male 30–39	Female 40–49	Male 40–49
Climate zone effect	F=4.438 p=.002	F=8.263 p<.001	F=3.973 p=.004	F=13.488 p<.001

Source: Self-generated.

Furthermore, we found that in a temperate climate, on average there were more suicides committed by men and women age 30–49 than in other climate zones. Therefore, from a statistical perspective, there is a link between climate zone and the number of suicides.

Discussion

When analysing individual cases, the importance of individual factors emerged. Adolescents who attempt to commit suicide are very generally highly impulsive, unstable, and unable to manage their emotions. A review of factors pertaining to suicide amongst children and youth often points out to the issue of immaturity and insufficient emotional support, when facing a problem or traumatic experience that lasts for some time (c.f. Conrad 1992; Bagley 1975; Zametkin et al. 2001; Dervic et al. 2008). In our chosen cases, the issue of depression was observed and bipolar disorder was identified in some of the cases, but was not a central factor, although literary sources link bipolar disorder with greater inclination to commit suicide amongst adolescents (Crescenzo et al. 2017). Familial issues had a great impact on the behaviour of the teenagers described in our study, which is in line with the influence of parental style identified as a trigger by multiple researchers (Flouri & Buchanan 2001; Morano et al. 1993; Prinstein et al. 2000) as has the impact of long-term unresolved family conflicts (DeVille et al. 2020). Domestic violence was amongst the environmental factors relating to a recent Polish report on DV and its links to the suicide of children and youth (*Diagnosis of the Scale and Conditions of Childs' Maltreatment*, 2018). Not only neurological, immanent factors (Pandey 2011) but also alcohol abuse (Pirkola et al. 1999) and substance abuse were reported in the presented cases (Pirkola et al. 1999; Qin & Nordentoft, 2005). In the majority of cases, psychological support was provided after the attempted suicide, but in a few a was already ongoing.

Links between gender, religiosity and attitudes towards suicide were reported in a study of cultural differences between Eastern and Western Europe (Mäkinen & Södertörn 2006), where positive correlation was confirmed between

suicide rates amongst women and the social attitudes towards suicide in given society. Moreover, personal level of religiosity was a predictor of acceptance for suicides amongst women in Western Europe, but had no significance amongst women from Eastern Europe. In the review by Klonsky et al. (2016) high-income countries have higher suicide rates than others, but the low and middle-income countries account for over 75% of all suicides due to their population size. Klonsky confirms that gender and age are a factor. Although overall rates of suicide are lower in children and young adults, suicide accounts for a disproportionately large number of deaths in these age ranges. Such generic outcomes gave us hope that we may be able to identify global factors that relate to rates of suicides amongst adolescents. Our statistical findings confirmed a connection between global factors and suicide rates, especially amongst adolescents, but only amongst specific age and gender configurations and for a limited number of factors. We tested many more possible connections and they were not statistically significant; therefore, we did not mention them in the process of analysis. Age and gender are indeed important diversifying factors as found in previous studies that point to being older age and being male as a confirmed risk factor (cf. Klonsky et al. 2016; Cheong et al. 2012).

Our research results show that a high level of HDI is a protective factor for young boys 10–14 and for girls 15–19, but was identified as a risk factor for males 40–49.

Participation of children in the labour force was a risk factor for boys and girls 10–14. Amongst protective economic factors for girls, age 15–19 and boys 10–14, were higher GDP, lower inequality of income and lower coefficient of human inequality in general. This is relevant when contrasted with other studies, which confirmed that lower income, social strata and lower level of education are risk factors for suicides amongst the general population (cf. Crump et al. 2014; Lee et al. 2017; Qin et al. 2014). Global tendencies in this respect were also confirmed by Patton et al (2009). They found that in general in high-income countries, middle-aged men are more likely to commit suicide than in low and middle-income countries, whilst young adults and elderly women have higher suicide rates in the low and middle-income countries.

For girls age 10–19, higher rates of suicide amongst females age 30–39 is a risk factor but interestingly, the higher rates of suicide amongst males age 40–49 is a protective factor. For boys in age group 15–19, increased suicide rates for females 30–49 and males 30–39 is a suicide predictor, so this is a risk factor for them, whilst increased rates of suicide amongst males age 40–49 has no statistical significance. We found no statistically significant educational factors for the 10–14 group. Controversially, for boys 15–19, increased years spent in education correlated as risk factors and increased inequality in education as a protective factor. For girls 15–19, greater nursery enrolment ratio was a protective factor. Decreased gender inequality is a protective factor for girls 15–19. However, the higher the

Gender Equality Index in a country, the greater risk of male suicide amongst boys 15–19. Higher unemployment rates amongst women, is controversially a statistically significant protective factor for boys 10–19. These findings are contrasted by the Nock et al. (2008) study of who found that suicide attempts were generally more prevalent amongst females than males.

Although, there are many studies linking suicide with the over or misuse of the internet (c.f. Vickers 2012), from a statistical perspective confirmed in our study, a higher rate of internet use may be a protective factor for girls 15–19. An interesting correlation was found between high numbers of psychiatrists and high rates of suicides amongst boys 15–19. Perhaps the high number of psychiatrists is the indicator of the need, due to the increased number of psychiatric issues. This comes hand in hand with the higher rate of suicide in countries with a mild temperate climate, which are usually highly developed and have a large number of psychiatrists, but this did not reflect in the number of other medical staff or hospital beds available per capita. The analysis of religious denomination was the most exciting part of our project, as it dived deeply into Durkheimian tradition, although he only compared Protestants and Catholics. There were no significant correlations found in our study, apart from one that pertains to boys age 15–19. Being a Muslim is a protective factor for this group. Moreover, exposure to UV light and living in a hotter climate zone is also a protective factor for this group. The climate zone, number of sunny days and high temperatures go hand in hand with the studies of vitamin D deficiency amongst patients and its links to depression (Shaffer et al. 2014, Spedding 2014). For instance, a study of depressed women in the winter period (Shipowick et al. 2009) was linked to the lack of vitamin D. A study of depressed youth was also linked to a deficiency of this vitamin (Hällström et al. 2012). However, living in the equatorial zone proved to be a risk factor for young girls, whilst living in a tropical or subtropical zone was a protective factor, which clearly shows that the issue is more complex and related to global North-South divisions.

Conclusions

Whilst a suicide is a personal tragedy and a loss for society, the protective measures for adolescents remain a priority and require deep understanding of the complexity of this issue. Whilst Nock et al. (2008) found that suicide attempts are statistically more prevalent amongst adolescents than adults, psychologists point to the biological, individual, environmental, and situational factors (Patton 2009), which was also the case in the individualized part of this study. In relation to children and youth, practitioners point to a set number of individual factors, confirmed with psychoanalytical experiences from Poland. However, the sociological perspective remains under researched and the experimental “Big Data” perspective

for these age cohorts reveal some preliminary correlations. Operating on publicly accessible global data sets from OECD, we treat this study as a first-stage scouting expedition, with data sets based on the latest available figures and we intend to continue when more, recent information becomes available. Although these initial results require further testing and provision of more complex statistical models to account for the masking factors, the latter points to particular risk factors and protective factors, which are only relevant to certain populations, distinguished by age and gender. This is important because suicide is the second leading cause of death among 15 to 29 years olds, and the leading cause of death among girls 15 to 19 (Wilkinson et al. 2011). The question remains open, are the global aggregate statistics capable of providing reliable predictors that coexist with the individual ones?

The sole fact that the statistically justifiable connections between suicide rates and a number of global indicators was confirmed only in selected age cohorts and for a particular gender, increases the difficulty to tailor widespread social solutions just to the needs of these particular groups. These findings may be helpful though, when considering migration and socio-demographic policy, they also enrich the picture of multifaceted factors relevant to the issue of teenage suicide.

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