

## Psychosomatic Health Status of Children Exposed to the Chernobyl Accident

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Childhood victims were investigated focussing on the psychosomatic disorders. The subjects were some of the 3834 children who evacuated from the Chernobyl zone to Kiev (evacuees) and 200 children who have been living in Kiev since prior to the accident (comparison group). A psychological test administered to 504 evacuees aged 12-14 years at the time of the accident and the comparison group indicated that the frequencies of neuroticism, high level of anxiety and conflicts were significantly higher in the evacuees than in the comparison group ( $p < 0.001$ ). Another psychological test administered at puberty to the 504 evacuees and 200 other evacuees exposed to the accident at 4-6 years of age indicated that the psycho-emotional portrait of evacuated teenagers significantly changed with time since the accident. The effects of the Chernobyl accident on the health of the vegetative dystonia observed in 1987-1990 and 1990-1995 were higher in the evacuees than in the comparison group, although they were not statistically significant. Furthermore, a significant ( $p < 0.001$ ) association of the vegetative dystonia with peptic and cardiovascular disorders was observed. The present study indicates that the vegetative dystonia is still highly prevalent among childhood victims and deems to support that the vegetative dystonia may be a precursor of several diseases such as cardiovascular and peptic disorders. It should be emphasized that a health promotion program to produce a change in psychological and social problems after the Chernobyl accident is necessary to decrease the health impact among Ukrainian people.

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**Key words:** Chernobyl accident, epidemiology, psycho-social problem, somatoform autonomic dysfunction, vegetative dystonia

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### Introduction

Investigations of the health effects of the Chernobyl accident have been conducted since a few days after the accident. Observations of children exposed to the Chernobyl accident indicate a decrease of healthy children and an increase of the children with chronic diseases in decompensation. The annual prevalence of all diseases increased dramatically in the period of 1995-1997 as compared to that in the period of 1986-1987.

A high prevalence of general health disorders among Chernobyl victims has been reported in the relationship with psychological factors.<sup>1, 2)</sup> Several cross-sectional studies conducted among affected adult populations have demonstrated a relatively high prevalence of psychological distress as compared to non-affected control groups.<sup>3, 4)</sup> Furthermore, a relatively high prevalence of psychosomatic disorders especially autonomic dysfunction is reported among the exposed adult groups.

The autonomic dysfunction, which has also been called vegetative dystonia for a long time, is still now regarded as a primary disease among psychosomatic ones by Russian-speaking scientists, who use the term of vegetative dystonia frequently. Although the ICD-9 (the ninth revision of the International Classification of Diseases)<sup>5)</sup>, the recent international system for classifying diseases, classifies the autonomic dysfunction en bloc to the category of psychological malfunction arising from mental factors (code: 306), and subclassifies cardiovascular system (code: 306.2), gastrointestinal tract (code: 306.4), respiratory system (code: 306.1) and genito-urinary tract (code: 306.5), we use the term vegetative dystonia in the present study because of its frequent use among Russian-speaking scientists. A main role in the imbalance of the autonomic nervous system could be related with damage of thyroid gland by radioactive iodine in the first days

before evacuation. The vegetative dystonia may be a precursor of several diseases, especially cardiovascular disorders such as hypertension and atherosclerosis and gastrointestinal disorders such as peptic disease.

The objectives of the present study are (1) to level psycho-social status of children who evacuated from Chernobyl zone; (2) to evaluate the risk of vegetative dystonia and some factors associated with the Chernobyl accident; and (3) to evaluate vegetative dystonia as a risk factor for developing such outcomes as peptic disorders and cardiovascular disorders.

## Subjects and Methods

The Scientific Center for Radiation Medicine (SCRM) at Kiev identified 3834 children (1933 boys and 1901 girls) who evacuated from the Chernobyl zone to Kiev using National Registry of Ukraine and has followed them up since 1987. For the two studies, i.e. (1) leveling psycho-social status of children who evacuated from the Chernobyl zone; and (2) evaluation of the risk of vegetative dystonia, 504 of those children (256 boys and 248 girls) and 200 children (100 boys and 100 girls) who have been living in Kiev since prior to the accident were selected as a target and a comparison group, respectively. (Evacuation from the Chernobyl zone to Kiev was completed in 36 hours after the accident and the contamination level during the period was 100-500 mGy/h in the Chernobyl zone while that was 1-5 mGy/h in Kiev.) They were aged 12-14 years at the time of the accident, having lived in the same region of Kiev and attended the same school. Another 200 children (100 boys and 100 girls) aged 4-6 years at the time of the accident were also selected from the above-mentioned cohort of the 3834 children to investigate the temporal effects on the psychological and emotional status in evacuated children. For the study (3) to evaluate vegetative dystonia as a risk factor for developing

such outcomes as peptic disorders and cardio-disorders, the study subjects were 1163 children (574 boys and 589 girls) who have been followed up through 1990 to 1995.

The subjects for the first two studies underwent physical examinations, biochemical and hematological analyses, and ultrasound examination of thyroid gland and abdomen in 1987, 1990 and 1995. They also underwent psychological tests (Spielberger trait-state anxiety scale, Eysenk neuroticism scale and Sentence Completion Test) in 1987 and 1995. The necessary medical information for other subjects were obtained from Clinical Registry of SCRM and district hospitals. The vegetative dystonia was determined with clinical examinations, ECG and cardiointervalography. Evaluation of vegetative dystonia as a risk factor for developing such outcomes as peptic disorders and cardio-disorders was conducted by the case-control method: peptic disorders and cardiovascular disorders were taken as outcomes while taking vegetative dystonia as exposure. The statistical analysis was conducted with EpiInfo-6.

## Results

### *Psycho-social status of children*

The results of the psychological tests administered to 504 evacuees and 200 children of comparison group in 1987-1988 are presented in Tables 1 and 2. A significantly higher frequency ( $p < 0.001$ ) was observed in evacuees than in comparison group for neuroticism, high level of anxiety and conflicts. Evacuated teenagers exhibited clear conflicts in the relationship with their family especially with their mother; women's maladaptation to their profession was predisposed as they were not able to find appropriate employment after evacuation irrespective of their high level of education. They also showed a suffer related with the ac-

**Table 1.** The results of the psychological tests administered in 1987-1988 to children at puberty (13-15 years of age) in the evacuees and comparison groups.

Group	Number of subjects	Psychological status <sup>a</sup>		
		Neuroticism	High level of anxiety	Conflicts
Evacuees	504	226 (45%)	156 (31%)	342 (68%)
Comparison	200	14 (7%)	22 (11%)	56 (28%)

a) Neuroticism was based on Eysenk neuroticism scale; high level of anxiety was based on Spielberger trait anxiety scale; and conflicts were based on Sentence Completion Tests.

**Table 2.** Psychological status of evacuated children tested at puberty (13-15 years of age) one year and nine years after the accident.<sup>a</sup>

Psychological status <sup>c</sup>	Year of test <sup>b</sup>	
	1987	1995
	(504)	(200)
A high level of anxiety	78%	76%
Worried about health effects	97%	20%
Feel as a Chernobyl victim	100%	2%
Feel fatal mood about Chernobyl	78%	12%
Conflict with mother	62%	0%
Evacuation is the most prominent memory	98%	20%
Do not remember evacuation	0%	72%

a) Percentage of subjects with respective psychological status.

b) Number of subjects tested in parentheses.

c) The first one (a high level of anxiety) was based on the Spielberger state anxiety scale while the others were based on Sentence Completion Tests.

**Table 3.** Prevalence and incidence of vegetative dystonia in the two groups of children who evacuated from the Chernobyl zone to Kiev (Group I) and who have been living in Kiev since prior to the accident (Group II)

Year of observation	Group	Prevalence			Incidence		
		Subjects	Cases	Per 1000	Subjects without vegetative dystonia	New cases in the consecutive two years	Per 1000
1987	I	504	65	129.0	439	13	29.6
	II	200	23	115.0	177	2	11.3
1990	I	504	78	154.8	426	15	35.2
	II	200	25	125.0	175	2	11.4
1995	I	504	93	184.5			
	II	200	27	135.0			

cident and evacuation. Almost all the evacuated teenagers (97%) were afraid of probable negative health consequences (mostly cancer diseases) and 78% of them felt fatal mood about the accident (Table 2).

The results of the temporal effects on psychological

and emotional status in evacuated children of puberty age are presented in Table 2. Except for one item, a significant difference was observed in the responses of the two tests. The psycho-emotional portrait of evacuated teenagers became much closer to that of control

group in 1995. No one exhibited the conflicts with his or her mother; the subjects who had a fatal mood about the accident and a worry about their health were rather small (12% and 20%, respectively); and many of them (72%) did not remember evacuation.

#### Risk of vegetative dystonia

Table 3 presents the prevalence and incidence of vegetative dystonia among 504 evacuated children and 200 children of the comparison group. The prevalence was based on the cases observed in 1987, 1990 and 1995 while the incidence was based on the new cases found in the two periods of 1987-1990 and 1990-1995. The effects of exposure (a complex of factors associated with the Chernobyl accident including ionizing radiation, emotional stress, and psycho-socio problems) estimated by risk ratio and risk difference were suggested, although they were not statistically significant ( $p=0.18$  for 1987-1990 and  $p=0.11$  for 1990-1995) as shown in Table 4.

#### Vegetative dystonia as a risk factor of developing diseases

The 1163 evacuated children who have been followed up through 1990 to 1995 were classified by the prevalence of vegetative dystonia, peptic disorders and cardiovascular disorders (Table 5). The odds ratios calculated on the basis of the prevalence in 1995 were 5.3 and 2.1 for peptic disorders and cardiovascular disorders, respectively, and indicate a significant ( $p<0.001$ ) association of the vegetative dystonia with the two disorders.

#### Discussion

It has been pointed out<sup>6,7)</sup> that man-made disasters (serious accidents) and natural disasters will cause several psychological aftereffects among victims. However, the number of detailed findings available is not large, and the scientists who encountered victims of such disasters should conduct a well defined long-term follow-up study on them to establish a guideline to cope with aftereffects which will probably be found

**Table 4.** Estimated effects of exposure as measured by the ratio and difference of vegetative dystonia risks among the children who evacuated from the Chernobyl zone to Kiev ( $r_1$ ) and who have been living in Kiev since prior to the accident ( $r_0$ )

Observation period	Risk ratio $r_1/r_0$	Risk difference $r_1-r_0$ (per 1000)	Risk difference percent $(r_1-r_0)/r_1$
1987-1990	2.6	18.3	61.8%
1990-1995	3.1	23.8	67.6%

**Table 5.** Classification of 1163 evacuated children by the prevalence of vegetative dystonia, peptic disorders and cardiovascular disorders in the followup period from 1990 to 1995.

Vegetative dystonia	Peptic disorders			Cardiovascular disorders		
	Yes	No	Total	Yes	No	Total
Yes	252	223	475	255	220	475
No	121	567	688	248	440	688
Total	373	790	1163	503	660	1163
Odds ratio	$\psi=(252 \times 567) \div (223 \times 121)=5.3$			$\psi=(255 \times 440) \div (220 \times 248)=2.1$		

among victims. Psychological aftereffects in juvenile victims will include not only the retardation in psychological development after disasters<sup>8)</sup> and occurrence or frequent occurrence of apparent mental disorders but also the occurrence of neurotic diseases (including post-traumatic stress disorder) with anxieties as main symptoms and psychosomatic disorders. The present study has mainly focused on the last two and we will discuss the results in the following.

A significant contrast between the two responses of 1987 and 1995 to the test for motivation anxiety suggests that evacuated teenagers in 1987 emphasized to be the Chernobyl victims because of the expected social privilege while those in 1995 tended to hide being belonged to the suffered population and had a fear to be discriminated in education, work and marriage. Although the Chernobyl accident is becoming less important as a source of anxiety, anxiety is still very common among childhood victims.

A relatively higher frequency of psychosomatic disorders, especially vegetative dystonia, has been reported for adult victims (clean-up workers, residents in contaminated areas and evacuees).<sup>9)</sup> The present study indicates that the vegetative dystonia is still highly prevalent among people exposed to the accident in their childhood. The vegetative dystonia, though not commonly used in western medicine, is a term describing disturbances in blood pressure, cardiovascular and gastrointestinal dysfunction, and emotional problems. Komarenko<sup>10)</sup> suggests that the vegetative dystonia constitutes a range of premorbid conditions characterized by various manifestation of autonomous nervous system dysfunction which corresponds to the ICD-9 category of unspecified disorders of the autonomic nervous system (code: 337.9) and the ICD-10 category of somatoform autonomic dysfunction (code: F45.3).<sup>11)</sup> The vegetative dystonia may be a precursor of several diseases, especially cardiovascular disorders such as hypertension and atherosclerosis

and gastrointestinal disorders such as peptic disease. The results of the present study deem to support this hypothesis.

It should be emphasized that a health promotion program to produce a change in psychological and social problems after the Chernobyl accident is necessary to decrease the health impact among Ukrainian people.

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