



Abstract. *Children's concept of biological phenomena differs from scientific thought in many aspects. The revelation of wrong concepts contributes to better education, especially when that information is described in a specific field of science. Not only children, but also adults often use anthropomorphic and theological explanations to express their ideas, which confirm their lack of understanding of biological phenomena.*

A great deal of research has proved retaining of children's misconceptions in the fields of zoology and botany. How accurate, however, are their ideas about organisms of a microscopic size? The aim of the research was to find out the influence of selected factors (perceived vulnerability, grade, gender and type of group) on concepts about diseases among lower secondary school students. The research sample consisted of 400 students of lower secondary education from Slovakia. Data were collected through Likert type questionnaires. The correlation was found between perceived vulnerability to diseases, age and concepts about diseases. The statistically significant difference in the results between boys and girls was not confirmed. The higher impact should be aimed at their importance for humans and nature for a better understanding of this concept.

Keywords: *concepts about diseases, lower secondary school students, perceived vulnerability, quantitative research approach.*

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THE INFLUENCE OF SELECTED VARIABLES ON LOWER SECONDARY SCHOOL STUDENTS' CONCEPTS ABOUT DISEASES

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Introduction

People have been aware of the value of health from ancient times. There are many factors, which can influence the health of people. The most frequent are bacteria and viruses. Bacteria are originators of many diseases such as cholera, typhus, tuberculosis and others. Children have many wrong ideas about bacteria, which are perceived as a negative part of nature, but in many ways, bacteria also have a positive effect on human life. Many industrial activities are connected with the use of bacteria for human benefits (e.g. preparation of food, preparation of medicaments) (Blaser, 2014). Viruses are able to cause many diseases in humans, more than any parasites. This research has worked with the concept of disease. The concept of "disease" is a synonym for the viruses and bacteria and was used in this research.

The current state of the research studies regarding concepts of microbes and viruses. Boschhuizen, and Brinkman (1991) focused, for example, in their study on the issue of health concepts among lower secondary school students. The researchers have quoted many common ideas about health, bacteria and viruses. Simonneaux (2000) assumed that students' conceptions are themselves conditioned by the status given to diseases, by a hygiene-oriented culture, by lay and school knowledge, personal experiences, socio-cultural mediation and linguistic confusions. Onyango-Ouma, Aagaard-Hansen, and Jensen (2004) reported that students can modify and broaden their concepts of health and illness through action-oriented health education. Myant and Williams (2005) confirmed that children of all ages represent cold weather as the main cause of colds. According to the researchers, the idea is explained by the children that there is a higher tendency to catch cold in the winter than in the summer. Another finding was that children often hear from their parents that they will catch cold if they go out without having some protection for cold weather (sweater, warm clothes). The researchers also detected the significant effects of age for an understanding of specific illnesses with explanations becoming more sophisticated and accurate with development. Fernandes, Liamputtong, and Wollersheim (2015) examined how children of refugees (1st - 4th year of primary school) perceive health and disease.

Most children placed a major emphasis on the environment as a potential “guilty” disease. Children recognized the need for warm clothing on cold days, as well as the importance of sun protection. They had an explanation problem, however, as they did not know why the environment (especially the weather) was causing the disease. In addition to the environment, children also mentioned the following causes of illness: lack of hygiene, sneezing of strangers, eating at McDonald’s, overly sweet and savory meals. Mouratidi, Bonoti, and Leondari (2015) found that older pupils have better concepts about illness and health than younger pupils, while the youngest pupils had difficulties with representing the two concepts clearly. Piko and Bak (2006) demonstrated statistically insignificant difference between boys and girls regarding concepts of illness and that children’s past experiences (e.g. trivial infections) could play an important role in their concepts of disease causation. The gender differences were examined in the study of Diaz, Soriano, and Belena (2016), but with the focus on germ aversion, which was higher at girls. Flood et al. (2011) found a better understanding of influenza among older pupils. It is also possible to find older research studies, for example Opie (1935), who realized that the people who suffered from tuberculosis have correct concepts about this disease in comparison with people without previous experience. Pidgeon (1985) also determined the amount of wrong ideas about diseases among pupils and their occurrence was influenced by the age of respondents. Shiloh, Wade, Roberts, Alford, and Biesecker (2013) found out many findings, the most interesting of which are: there are significant differences in risk perceptions and concern about diseases; there are significant gender differences in risk perceptions and concern about common diseases. Similar results were possible to find in the studies of Duncan, Schaller, and Park (2009), Fukukawa, Oda, Usami, and Karahito (2014), Hill, Boehm, and Prokosch (2016), Larki, Tahmasebi, and Reisi (2018) and Oda (2017). The similar research was done by Welling, Conway, Bebruine, and Jones (2007) with the result, that men and women who perceived themselves to be vulnerable to disease have stronger preferences for apparent health in dynamic faces than individuals who perceive themselves to be relatively less vulnerable to disease.

Problem of the Research

The literature review revealed that the surveys which assessed participants’ ideas about diseases cover different age groups, from primary school students (i.e. Fernandes, Liamputtong, & Wollersheim, 2015) till adult population (i.e. Shiloh, Wade, Roberts, Alford, & Biesecker, 2013). The lower secondary school students as research sample are rare in the published studies. At this age, students create their final concepts about different phenomena, so it is important to find out, which topics are problematic for them and in the next step, try to eliminate the wrong ideas. This is the reason why students from lower secondary schools were selected. The second reason is the lack of information about bacteria and viruses in the biology curriculum at Slovakian lower secondary school. The biological curriculum includes only fragments of information about diseases of organ systems. On the basis of this, students have got wrong ideas about diseases and their originators. The bacteria are more mentioned than viruses, not only in textbooks, but also in the media like TV and internet and it can influence better concepts about bacteria among students. The third reason why this kind of research is important is the lack of research in the educational environment about this topic and published studies did not adequately explain this phenomenon.

Research Focus

Research was focused on finding out the factors, which can influence concepts about diseases. The aim of the research was to find out the influence of selected factors (perceived vulnerability, grade, gender and type of group) on concepts about diseases among lower secondary school students.

Research Methodology

General Background

The research was conducted in June 2018. The research design was quantitative, due to generalizing of the findings and also to explain the examining phenomenon. The questionnaire was administered to all participants in selected classes irrespective of the students’ concepts about diseases. Data analysis focused on interpreting students’ responses considering their understanding of the diseases.



Research Sample

The research was conducted in June 2018 at four lower secondary schools in Slovakia. For the purpose of the research, a non-random sample selection method was applied. Selection of participants was not intentional but was based on teachers' willingness to participate on the research in the accessible school in which researchers had personal contacts with the director. Participants ($n = 400$), students of lower secondary education (202 girls and 198 boys), attended fifth ($n = 92$), sixth ($n = 59$), seventh ($n = 75$), eighth (86) and ninth (88) grades. The age of the students ranged from 10 to 14 years old, with the mean age 12.91 ($SD = 1.80$).

Procedure

Anonymous questionnaires were administered in the last month of the school year 2017-18 by classroom teachers during regular biology lessons. The management of the schools, the director and deputies, were informed about the entire realization and agreed with the research. Students were randomly divided into two separate groups: the first group with statements about bacterial disease, the second group with viral disease. They completed the questionnaire in approximately 20 minutes.

Instruments

The questionnaire consisted of 45 5-point Likert type items (Cronbach's alpha $> .70$) and were divided into two parts:

1. Perceived vulnerability to disease scale (PVD) (Duncan, Schaller, & Park, 2009) was used to assess the respondents' self-perceived vulnerability to disease. This scale consisted of 15 items (Cronbach's alpha = .75); one subscale assesses beliefs about one's own susceptibility to infectious diseases (Perceived Infectability [PVD-PI] with 7 items); the second subscale assesses emotional discomfort in contexts that suggest an especially high potential for pathogen transmission (Germ Aversion [PVD-GA] with 8 items). Items were rated on a five-point Likert scale from 1 (strongly disagree) to 5 (strongly agree). Negatively worded items were scored in reverse order. The PVD-PI subscale was used to assess inter-personal differences in perceived vulnerability to infectious diseases (item example: In general, I am very susceptible to colds, flu and other infectious diseases). The PVD-GA subscale assesses some behavior and emotional avoidance of some pathogen-relevant stimuli (item example: I prefer to wash my hands quite soon after shaking someone's hand).
2. The second part was focused on students' concepts about viral or bacterial diseases (example item: "Transmission of the disease occurs through physical contact with the infected person"). The items (30) were in a positive and negative meaning. Negatively worded items were scored in reverse order. Students had to decide and indicate to what extent they agreed or disagreed with a particular statement. The questionnaire was created by the authors of research. All items were preparing in the concordance of the curriculum. The content validity was determined by the teachers of biology ($n = 4$), who commented also language level of the items. The reliability of the questionnaire was determined by the Cronbach's alpha coefficient, which value was sufficient ($\alpha = .65$) for the first used questionnaires (Huizingh, 2007).

Demographic variables (gender, age of the respondents and also the incidence of illnesses) were obtained in the introductory part of the questionnaire. Reported experiences with illnesses of respondents were asked: "How many times have you been sick (not have a cold) from September up to the present?" (a) ever, b) 1-2 times, c) 3-4 times, d) 5 or more times). The students were also asked about specific diseases that they overcame between September 2017 and June 2018.

Data Analysis

Age did not correlate with the incidence of illnesses ($r = .04$), which eliminated the prediction that younger students were more likely to be ill and therefore the results would be affected by the frequency of the disease.

Since Perceived Infectability was positively correlated with the incidence of illnesses ($r = .30; p < .05$), the mean disease susceptibility score was used in further analyses. The reliability of the measurements has been confirmed.

Through a correlation analysis, the positive correlation was confirmed between pathogenic resistance (Germ



Aversion) and perceived infectability ($r = .40; p < .05$), thus disease susceptibility was excluded from further analysis to prevent multicollinearity of data.

The analysis of covariance (ANCOVA) was used, in which the dependent variables were the concepts of diseases, the categorical variables were gender and the type of group and the continuous variables were grade and perceived vulnerability.

Research Results

The concepts of the disease score were significantly influenced by grade, perceived vulnerability to diseases, type of group and gender (Table 1). The interaction term between the type of group and gender was not significant (Table 1).

Table 1. Results of ANCOVA on concepts of diseases.

	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>p</i>
Intercept	1	38.85	38.85	543.60	< .001
Grade	1	1.54	1.54	21.54	< .001
Perceived vulnerability	1	.74	.74	10.41	< .001
Type of group	1	2.23	2.23	31.26	< .001
Gender	1	.40	.40	5.60	0.02
Type of group*Gender	1	.04	.04	.51	0.48
Error	394	28.16	.07		
Total	399	33.79			

Specifically, students more vulnerable to infectious diseases showed better concepts of diseases than their less disease vulnerable counterparts ($F = 10.41, p < .001$) (Figure 1). Respondents who did not have frequent disease experiences had imperfect concepts of disease.

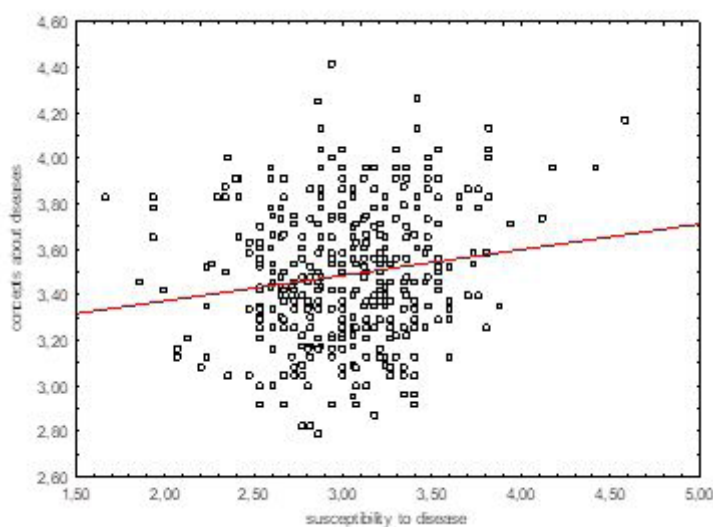


Figure 1. Positive correlation between PVD and students' concepts of diseases.

Bacterial diseases were better understood than viral diseases ($F = 31.26, p < .001$) (Figure 2). Bacterial diseases received higher mean scores in concepts about diseases questionnaire.



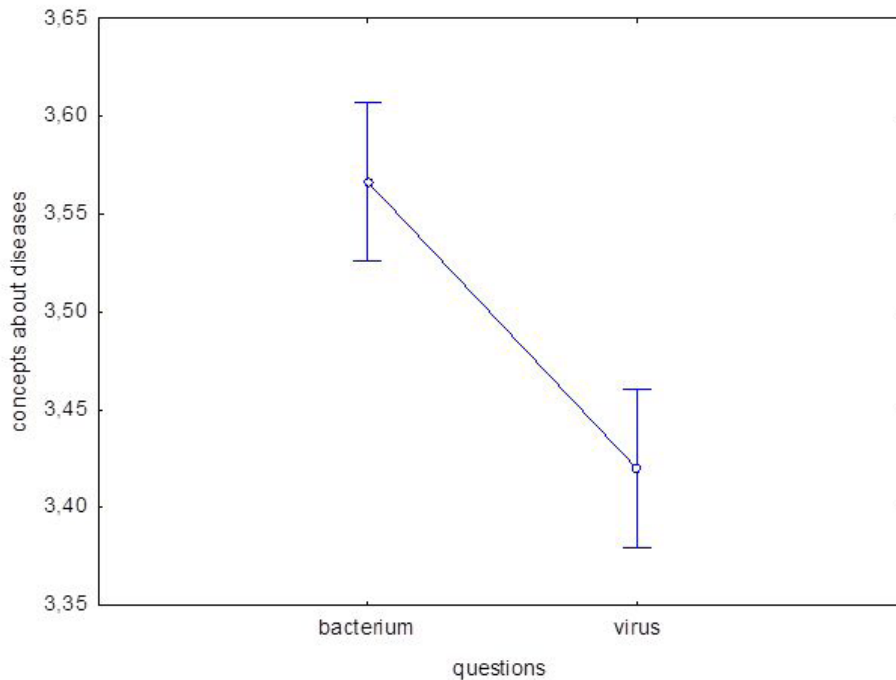


Figure 2. Differences in mean scores of concepts of bacterial and viral diseases.

Girls manifested higher mean scores of concepts of diseases than boys ($F = 5.60, p < .05$) (Figure 3). Girls scored significantly better in the concepts about diseases questionnaire.

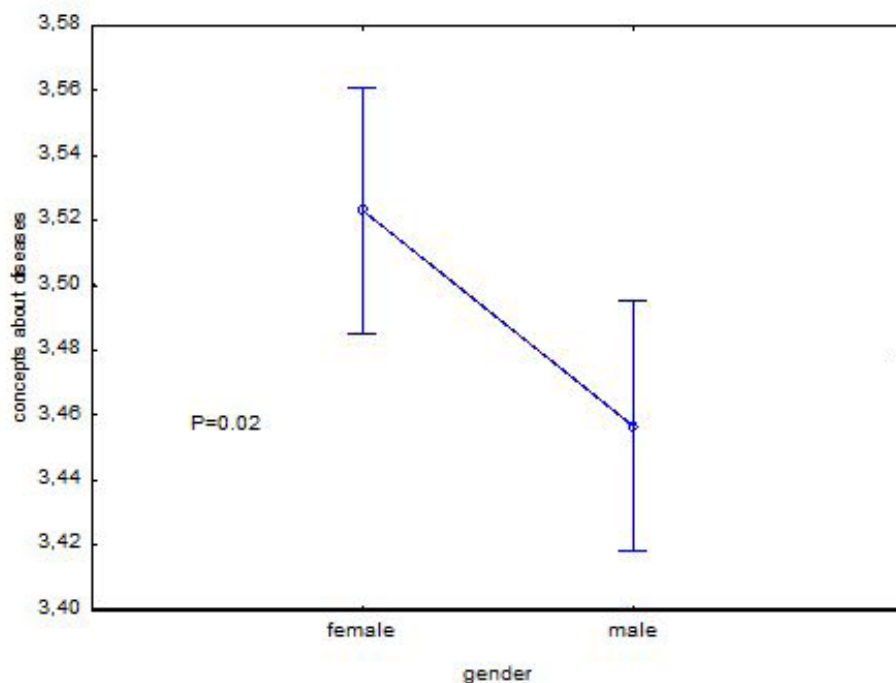


Figure3. Differences in mean scores of concepts of diseases between males and females.

Older students showed a better understanding of diseases than younger students ($F = 21.54, p < .001$) (Figure 4). The results look like consistent according to the grade of study, however, in the 7th grade was the decrease of the score in comparison with the 6th grade.

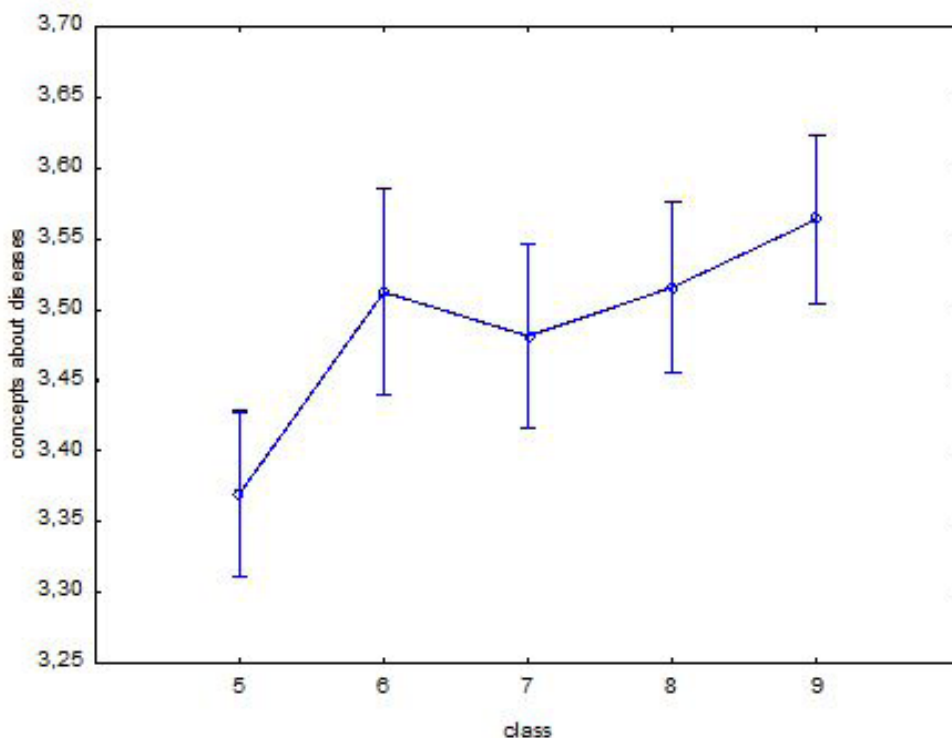


Figure 4. Changes in concepts of diseases with respect to the students' grade.

Discussion

This research examined relatively unstudied topic focused on the lower secondary school students' concepts about diseases and tried to find out the influence of selected variables on the students' concepts about diseases. The first variable was perceived vulnerability and there was the effort whether perceived vulnerability to diseases should be associated with students' concept of disease. This suggests that people with greater worries about pathogen transmission also have greater concerns about diseases and know more about bacteria and viruses. The logic of this association lies in the sensitivity of the behavioral immune system that protects humans against disease threat (Schaller, 2006). People with more perceived vulnerability to disease should have fewer wrong ideas about viruses and bacteria. Findings supported this assumption. Similar results could be found in the study of Duncan (2009). The indirect influence on perceived vulnerability to disease and the concept level was confirmed in other studies (e.g. Gerrard, Gibbons, & Bushman, 1996; Prokop, & Kubiato, 2014; Prokop, Usak, & Fancovicova, 2010; Timmermans et al., 2008). It can be assumed that people who have a perceived vulnerability to disease are more interested in diseases, in the origin of every disease, have more knowledge about bacteria and viruses and also about every possibility of being endangered by diseases in outside as also inside environment. The perceived vulnerability is connected with the incidence of illnesses. The respondents, who had more experiences with diseases, also had better ideas about diseases. The amount of wrong ideas was less in the more experienced respondents with diseases. This can be explained by the increased interest in their problems and on the basis of this fact, the wrong ideas were eliminated.



The other variable was gender and findings revealed no differences in concept about diseases with respect to gender. They are supported by additional research (e.g. Piko & Bak, 2006). Differences were identified in some cases, while girls had fewer incorrect ideas about diseases. Thandar et al. (2019) found out, for example, that women had better knowledge and fewer wrong ideas about diseases. Similar results were shown in the research of Suzuki et al. (2019), where female had a better knowledge of papillomavirus-related disease and also about prevention of it. The inconsistency between research and other results could lie in the sample size, more concretely in the age of the sample size. The age was relatively low in our study thus, the girls could not realize the effect of diseases on their health and also on their potential children. Protectionistic behavior, which is typical for woman, was not developed among younger girls who were attending secondary school. This assumption is supported by the arguments of Draper, and Belsky (1990) concerning the development of maternal care about children.

The assumption that students have better concepts about bacteria in comparison with viruses was confirmed. The difference was statistically significant. This result was in all probability caused by the fact that students positively evaluate different objects, which are pleasant, useful or which have some importance for humans. Bacteria are mentioned, not only as harmful, but also as useful organisms for humans. These suggestions are confirmed by other researchers (i.e. Hummel & Randler, 2012).

The grade of the respondents was another examined variable and our research confirmed that grade did have a significant effect on the results. The youngest respondents had the highest amount of wrong ideas about diseases and the oldest ones had fewer numbers of wrong ideas. Similar results could be found in the study of Mouratidi, Bonoti, and Leondari (2015) and also Myant, and Williams (2005). Pidgeon (1985) also stated that children's knowledge of specific illnesses increases significantly during the school-age years. It appears that children's concepts of illnesses are a mixture of real knowledge and imaginative deformations. The concepts of children, not only about diseases, are more complex with the higher age and include a low amount of wrong ideas. This statement was also confirmed by Pidgeon (1985), who confirmed that there is, in the school-age years, an increasing differentiation between external and internal explanations of illness.

Conclusions

The presented research found out the influence of selected factors (perceived vulnerability, grade, gender and type of group) on concepts about diseases among lower secondary school students. Respondents vulnerable to disease and also those students, who had more experience with diseases, had fewer wrong ideas about diseases. This could have been caused by the low contact of students with the bacteria and viruses, which caused the various diseases. The research fills the gap in this field of study, the number of research studies is low, as it was mentioned in the theoretical background. It is possible to continue with the other variables, which could influence the concepts about diseases.

The low understanding of diseases could be caused by the formal style of teaching, which is prevailing in the Slovak educational system. Students do not have the possibility to understand the importance of bacteria and viruses and it is difficult for students to understand how these microorganisms work. The higher the amount of the mediated laboratory class, where students can see the life process of bacteria and viruses and also their importance for humans and nature, the better the understanding of this concept. It is also significant to emphasize the positive effect of bacteria on the human life and to advert on the influence of the antibiotics, which are also eliminating useful bacteria.

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