

What do Parents Know about the Environmental Health Literacy in relation to Children's Health?

ABSTRACT

Background and Objective: Parents are the main target group for environmental health literacy (EHL), because most children under 7 years of age spend a lot of awake time under the care of parents. Children are exposed to toxic contaminants in the home and society, and yet little evidence is known about what parents know about the effect of the environmental contaminants on the children's health in their care. Therefore, this study tried to better understand how parents conceptualize "environment health literacy" and its impact on the health of children in their care. We also seek to understand what parents' attitudes, and knowledge regarding the source and effect of environmental pollution that affect their children's health.

Materials and Methods: The qualitative content analysis method was conducted on 35 eligible parents from kindergartens throughout Mashhad, Razavi Khorasan province, Iran. A semi-structured interview based on open-ended questions from topics was conducted to better understand what parents know about the effect of EHL on their children's health. The results were classified into them and contents.

Results: parents identified physical environment, social and emotional environment, and intellectual and learning environment as the main characteristics for EHL and they had limited information on the EHL terminology and characterization. Majority of parents had a low level of understanding about source and effect of toxic exposures that affect their children's health.

Conclusion: This study highlights the need to raise parents' knowledge and awareness toward environmental exposure that influences health of children. Such knowledge and awareness are critical starting point to facilitate movement a continuum of EHL and improve level of action in each community to protect human health, specially children.

Paper Type: Research Article

Keywords: Environment pollution, Health literacy, public health, health promotion, health education, children's health.

► **Citation:** Tavakoly Sany B. What do Parents Know about the Environmental Health Literacy in relation to Children's Health?. *Journal of Health Literacy*. Winter 2022; 6(4): 77-87.

Seyedeh Belin Tavakoly Sany

* Department of Health Education and Health Promotion, School of Health, Mashhad University of Medical Sciences, Mashhad, Iran. (Corresponding author): belintavakoli332@gmail.com
Social Determinants of Health Research Center, Mashhad University of Medical Sciences, Mashhad, Iran

Received: 18 August 2021

Accepted: 29 November 2021

Doi: 10.22038/jhl.2021.61586.1240

Introduction

Toxicant chemicals contaminate in environment such as heavy metals and organic compounds that have been evidenced to have adverse long-lasting effects on human health, specially contributing to asymptomatic diseases until adulthood (1, 2). Children especially the fetus and young child are more vulnerable to contaminants exposures in their environment than adults (1, 3). A childhood is a period of rapid development and growth of children's brains, organs, and immune and metabolic systems. Children breathe, drink, and eat more per kilogram of body weight compared with an adult, thus, increasing the level of contaminants they have to toxicants in their environment(2). Likewise, developmental behaviors, such as crawling and mouthing, put children at higher risk for toxicants exposure (4, 5).

The adverse effect of heavy metals toxicant on children's health has recently been known(1, 6). There is significant evidence that linking heavy metals exposure in childhood, especially lead, to behavioral problems, and neurological and mental damage during young adulthood (7, 8). These are found in several sources, including drinking water, food products, soil, dust, air, imported toys and jewelry, and deteriorating lead-based paint (9, 10). Other toxic pollutants that can adversely affected children's health are anthropogenic organic chemicals pollutants (such as bisphenol A and phthalates)(2, 11), which associated with adverse health outcomes, ranging from early onset of puberty, learning problems, developmental delays, respiratory problems, cancer, cognitive and behavioral problems, asthma, autism, and reproductive problems (12, 13). Children can be exposed to these contaminants from everyday items, such as drink and food, products with fragrance, personal care products, and children's toys (14, 15). Multiple toxic contaminants are commonly

observed in a mixture within one exposure source, such as air, drinking water, and food pollution (3, 7). Specific contaminants found in different medias changes between locations but frequently includes toxicants, such as heavy metals, persistent organic compounds (POPs), and volatile organic compounds (VOCs). Exposure to air and food contaminations have been associated with adverse health outcomes, including learning deficiencies, cardiovascular and respiratory disease, and preterm birth outcomes (14, 16, 17). Air and water pollution are specifically listed by Healthy People 2030 as main health social determinants that can lead to health disparities (2).

Among the objectives of active agencies that study on children's health outcomes from exposures to environmental health risks, is to involve societies to promote knowledge and awareness of exposures and to teach them on how to decrease exposures to environmental contaminants(18). This effort is the main part of environmental health literacy (EHL) as an emerging concept that draws from environmental sciences, health literacy, and communication(1). Healthy People organization 2030 identified the adequate health literacy as a high-priority public health issue (3, 19). The general accepted definition was not defined for EHL [32], but it is evidence that EHL contain a wide range of knowledge, a core set of skills, domains, and health promoting behaviors associated to environmental exposures and human health(19). Building on this convergence, EHL is defined "as an emerging and evolving multidisciplinary field that seeks to better understand how individuals and communities make sense of and act on health-related information about environmental hazards"(3). Based on this definition, EHL needs basic scientific knowledge about exposure

pathways, contaminants sources, and human health. Likewise, individuals with adequate EHL require to understand the uncertainties, responsibilities, and complicated roles associated with implementing information to environmental health decisions and solution about human health risk assessment(2).

Several studies reported that improving parents' EHL by providing training program on the source of contaminates exposure, their adverse effect, and methods that can be used to decrease toxicant exposure effects(20). Previous studies have more examined effect of education program on childcare providers and health care professionals (3, 20). Parent are also critical target population to protect children from environmental exposures, because all of children spend a more time with their parents (3, 20). Socio-ecological models showed that parents have a critical effect on children's health through promoting children's socio-emotional development, physical activity, and nutrition quality (20, 21). Thus, it is reasonable to consider parents as main target group for educational program to improve their knowledge regarding environmental exposure during the childhood.

Although, there is a growing body of studies indicating that children in home are exposed to variety of environmental toxicants, there is little is qualitative studies were conducted on parent's perception and knowledge about effect of environmental toxicant on their children's health (1, 6). According to the previous studies, qualitative methods are practical to garner information on knowledge and attitudes about EHL because this method can provide comprehensive background for further studies to promote health promotion strategies and health literacy statues. This qualitative method allowed us to obtain parents' insight on perceptions of risk, behavior, practice, and other approaches. Therefore, this

study tried to better understand how parents conceptualize "children's environment health literacy" and its impact on the health of children in their care. We also seek to understand what parents' attitudes, and knowledge regarding the source and effect of environmental pollution that affect their children's health.

Materials and Methods

Study design and Participants

We performed a qualitative study on parents whose children are being trained in kindergartens throughout Mashhad, Razavi Khorasan province, Iran. Several children under seven years old are being trained at these kindergartens. Therefore, kindergartens were suitable places for us to provide the opportunity for collecting data.

We provided the list of potential respondents based on the available information in kindergartens that related to parents' characteristics. Eligible parents were selected from this list, and a member of the study group contacted them sequentially for an in-depth phone interview. Parents were included if they have children (infant or age 1 to 6 years), able to perform interview, and lived in Mashhad. Finally, 35 parents agreed to complete the interview, at which point it was determined that we had reached theoretical saturation. We used the purposive sampling method to select participants and the sample size is determined based on theoretical saturation. A semi-structured interview was conducted to ask participants based on open-ended questions from topics. This method is practical because it allows participants to discuss and elaborate further important topics. The results were classified into themes and content.

Interview process and measures

A PhD level researcher specialist in environmental health conducted the phone interviews. This interview is conducted based on the semi-

structured conversation and an open-ended question that develop conversational dialogue between the parents and the interviewer. This interview is designed to ensure that parents were comfortable and free to talk about their experience and knowledge about environmental exposures and their effects on their children's health. Interviews scheduled according to the parent's availability during the summer 2021, and lasted about one hour.

A variety of topics were examined during the interviews process including general questions about the concept of environment and type of contaminants, health questions related to specific knowledge of chemicals pollutants, environmental exposures, source and toxins of exposure, and

the questions were followed up with the parents' experiences; for example, they were asked to explain their experience related to kinds of environmental pollutants that they have experienced during raising your child. During interview, the main focus on questions that clarify parents' knowledge status about the concept of environmental health among children and about specific sources and effect of environmental exposure.

All interviews were recorded with the consent of the selected parents. The audio interview files were transcript by a professional transcription service. A semantic approach to thematic analysis were used to analyze all transcriptions, which allows us to summarize, identify, and interpret the exact meanings of the information. The major themes were identified in a subset of transcripts by a mixed and qualitative methods and the primary coder (by the research who conducted the interviews). Likewise, initial content categories were created by highlighting and identifying individual statements in similar subset. We developed a coding structure from

the selected categories and systematically coded the remaining transcripts based on the indenting coding structure that includes new emerged codes. We manually reviewed all themes and codes to reach agreement, and discussed on all discrepancies until they reached final consensus.

In this study we provided a list of toxicant exposure in environment and read it for parents, then we asked them whether they considered this toxicant exposure as a treat for their child's health or not. Also, we asked parents to clarify whether they felt the exposure is a not a problem, moderate problem, a very serious problem, or if they did not know (Table 3).

Rigor

The interviews were repeatedly listened to and checked by the principal investigator and the transcript data were also checked with the participants soon after the interview to resolve the ambiguities. To ensure data credibility, all concepts were noted during the interview and both peer and member checking were also used to assess data dependability. The main results of this research along with the primary categories and codes were identified to some parents, and their idea was obtained. We asked another person, who was not engaged in the study, to analyze some part of the data. Peer checking helps us to find the similarities with the current results. Likewise, opinions from other researchers, and documentation, and evidence from other surveys were effective to improve the confirmability. In addition, by including a comprehensive explanation of the participants, topics, analysis procedures, data collection, and limitations of this survey, we tried to promote transferability in this study.

Results

Participant's characteristics

Parents demographic characteristics are

presented in Table 1. In total, 20 mother and 15 father completed the study. Their mean age was 25.57 ± 6.56 kg/m² years. Most of the eligible participants were housewives (84.9%), a moderate-income (60.81%), and were diploma (26.30%) or bachelor's degree (27.48%) level of education (53%) (Table 1).

Table 1. Subject demographic characteristics

Characteristics (n= 35)	Sub-characteristics	Values
Age, years, mean \pm SD	Range: 23-47	35.05 \pm 9.4
Gender, , n (%)	Male	15(43)
	Female	20 (57)
Education level, n (%)	\leq Diploma	5 (14)
	Bachelor	20 (57)
	\geq Master	10 (29)
Employment status, n (%)	Un-Employed	10 (29)
	Employed	25 (71)
Income, n (%)	Low	10 (29)
	Moderate	22 (63)
	High	3 (9)
Age of children, n (%)	Infant (4 weeks to 1 year)	6 (17)
	Toddler (Ages 12 -24 months)	10 (29)
	preschooler (Ages 2–7 years)	19 (54)

\pm : Showing mean score (standard deviation); n: number of eligible participants;

Meanings of Environment

At first time of the interview, we asked parents about "What do you think about the environment means?" Parents mainly responded this question based on three categories including social–emotional environment, intellectual–learning environment, and physical environment (Table

2). The majority of parents (97%) referred the physical environment, such as the spaces or places child use every day to grow, eat, play, nap; the outdoor (yard or garden, park, and street); and the society where child resided.

Table 2: Content of Environmental Health Quality Themes

	Themes	Contents
1	Physical environment	spaces or places child use every day to grow, eat, play, nap; the outdoor (yard or garden, park, and street); A clean and healthy environment and the society where child resided; clean air and good quality drinking water; the cleanliness and beauty of the environment; easy access natural areas and public spaces.
2	Social and emotional environment	safe sense of feeling, warmth and accepting environment to learn and develop, having close relationships with their parents, and knowing they will be supported by the parents and other family members to develop their independence and life skills
3	Intellectual and learning environment	the spaces and time child use for learning, testing idea, and demonstrating their theories in practice, such as educational materials and program

"To me, an environment is a space for the daily use of children in which children grow and do their physical activities." (participants# 2).

"Environmental is an outdoor place such as park, garden, and the street that should be safe and clean." (participants# 4).

Lower half (32%) covered aspects of the social and emotional environment, including safe sense of feeling, warmth and accepting environment to learn and develop, having close relationships with their parents, and knowing they will be supported by the parents and other family members to develop their independence and life skills.

“The warmth and supportive environment are the main factor that should be considered in each place (home or school) to promote quality of life among children” (participants# 30).

In this study only 22 % of participants gave responses that related to the intellectual and learning environment including the spaces and time child use for learning, testing idea, and demonstrating their theories in practice, such as educational materials and program.

“An ideal environment is one that helps the child develop skills and creativity” (participants# 30).

Meanings of Children’s Environmental Health literacy

We asked parents “What does the term ‘children’s environmental health literacy’ mean to you?” Over half (58%) told they had never heard the term, and majority of parents only talked about the physical environment. They specifically mentioned clean and safe place (e.g., keeping them free from harm and sickness/acute sickness), getting outside enough, and poison control.

“In my opinion, children’s environmental health means keeping children in an environment that does not harm them in terms of health and safety” (participants# 1).

«Environmental health would be like being able to keep children safe from both accidents and harm or from the germ “ (participants# 22).

«To me, that means that you need to keep a healthy environment, cleaning up the home every day, you have to keep home clean especially the carpets or the hardwood floors need to be clean every day. So they’re not sharing dirt “ (Participant #18).

Close to half (42%) talked about the child’s physical health including shots, well checks at the doctor, appropriate nutrition and physical activities.

“To me, an environmental health literacy for children is related to an environment in which

health indicators are at the desired level and the child has a healthy diet, as well as appropriate places for physical activities is considered “ (participants# 24).

“To me, that means that a healthy environment for children is a place where they can easily access health and leisure services and this service is provided to them for free or at a low cost « (participants# 30).

Close to one third of participants talked about social and emotional factors are essential to considered for children’s environmental health such as close relationships between parents and children, positive interaction between children and others kids, home environment, parents and family member ‘s mental health, and a safe place to express their feelings over a range of emotions.

“So environmental health is would be the kids being able to close relationship with your parents and others people (such as clos family member, kindergarten teacher, and baby sister) around them to express their feelings, and also children need warmth, friendly, and safe place or home to better learn life skills and experience their independence»(participants# 30).

«To me, environmental health literacy for children related to a situation where the child can easily communicate and play with other kids, and if the child has a problem, he can easily ask people for help from their parent or another people such as clos family member, and kindergarten teacher. Also these people should healthy and encouraging» (Participant #10).

Effect of environmental exposure on children’s health

Only 35% of parents talk about quality of air, water, and food, and environmental contaminates. These parents mentioned air dust, smoke, chemical contaminations in food product, toys, rugs and furniture, water quality, and radon testing. We asked parents “Do you feel that the environment

Table 3: parent's knowledge about sources of toxicant exposures in their own childcare environment

pollutants sources	Do not know	No adverse effect	Moderate adverse effect	Serious adverse effect
drinking water pollution	5%	91%	3%	1%
Air pollution inside	17%	53%	25%	5%
Air pollution outside	3%	25%	28%	44%
Heavy metals	15%	75%	5%	5%
Asbestos	22%	88%	-	-
Pesticides	2%	68%	-	30%
Chemicals in art supplies	15%	80%	2%	3%
Chemicals in rugs and furniture	22%	68%	-	10%
BPA	22%	68%	3%	7%
PBDEs	31%	53%	6%	10%
PFCs	33%	59%	8%	-
Chemicals in personal care products	7%	90%	3%	-
Chemicals in children's toys	2%	96%	2%	-
PBBs	29%	61%	2%	8%
hormones in food	11%	69	12%	8%
antibiotics in food	5%	73%	2%	20%
Pesticides and heavy metals in food	2%	65%	15%	18 %
Dust	5%	37%	28%	30%
Triclosan	42%	28%	17%	13%
Phthalates	55%	25%	20%	

BPA:bisphenol A; Polybrominated diphenyl ethers (PBDEs) and polybrominated biphenyls (PBBs); Perfluorochemicals (PFCs)

has any effect on health of your children?" in case of this question in the interview, we encouraged parents to think about environmental toxic contaminates, instead of other aspects of environment. The most frequent response related to adverse effect of air quality on health. These parents were concern regarding negative effects of vehicle smoking, radon, outdoor air quality (dusts and smoke), seasonal allergies, strong cleaners, and chemicals from crops and toys.

"In my opinion, air pollution is a serious threat to our children because children play and run in this air, and without a doubt, the toxins in the polluted air harm them more than adults"(Participant #15).

"Many media outlets talk about the effect of lead in polluted air on human health, and its effects on children's health are worrying. My

wife and I do not allow our children to leave the house when the weather in the city is unhealthy" (Participant #11).

A few (19%) parents were concerned about food quality, water quality (contaminated surface water, well water, and old pipes), and chemical pollutants, but a majority of parents were not concerned about water quality and food quality.

"According to the treatment system, municipal water is not polluted and its use does not harm the health of children. So I can't really worry about that" (Participant #33).

"I can't really worry about the quality of food, water, or chemicals pollutants because you can't do anything about it anyway. So, why do I have to have concerns about it? when in this day, there are too many problems in life to worry" (Participant #35).

"I trust the food product in the market because those prepared are based on the guidelines, so I don't really have any concerns about that." I'm assuming they're [a food products] good" (Participant #18).

In addition, according to the list of toxicant exposure, majority of parents were either unaware about toxicant exposure in environment. They indicated that these toxicant exposures were not a problem and only some participants consider those pollutants as moderate problem or serious problem (Table 3).

Discussion

Based on our knowledge, in Iran, this is the first study that was conducted on parents based depth interviews to examine parent's knowledge regarding children's environmental health and their level of concern about adverse effect environmental exposures on health of children.

Our finding showed that parents in Iran were more concerned with physical environment than social-emotional environment and intellectual-learning environment. Parents believed that the clean and safe spaces or places child use every day to grow, eat, play, nap, is main aspect of environment that may influence their child's health. Second priority for parents related to social and emotional environment such as safe sense of feeling, warmth and accepting environment to learn and develop, having close relationships with their parents and others people such as close family members, baby sister or kindergarten teacher. It seems that the intellectual and learning environment had lowest priority for parents in this study. This could be due that a variety of factors have been associated with individual's approaches regarding EHL such as awareness and knowledge, attitude, and socio-demographic factor(2, 3). Numerous studies show that parents who have

a high level of awareness and positive attitude regarding EHL not only care their child's physical environment but also pay more attention to also other aspects of the environment including intellectual and learning environment and social-emotional environment for their child's learn and develop(1, 21). Our result is also consistent with study that was conducted by Brenda et al., in 2021 on implications for environmental health literacy efforts among American childcare providers and parents(2). They reported that most of the childcare providers and parents (around 92%) gave responses that related to the physical environment and over half (58%) mentioned aspects of the social- emotional environment, and only 28% of participants addressed the intellectual and learning environment as main aspect of environment for child's health(2).

Likewise, over half the parents indicated that were unsure about meaning of the term children's environmental health literacy or they had never heard it that was consistent with several studies(1, 19, 21) in world because EHL is a new sub-discipline that is recently developing to combines key principles and main health elements from the fields of health literacy, safety culture, communications research, environmental health, and risk communication(19, 21). Since, people have limited information on the EHL terminology and characterization of EHL, defining the term EHL is critical to greater action to protect environmental health and human health.

In case of effect of environmental exposure on children's health", parents were mostly concerned with adverse effect of air quality as environmental exposures and considers air pollution as a significant risk factor to the health of their children. The most frequent response related to air quality focus on negative effects of vehicle smoking, radon, outdoor air quality (dusts and smoke), seasonal allergies, strong

cleaners, and chemicals from crops and toys. Likewise, most of the parents were not concerned about environmental toxicants that related to quality of water and food product and they did not consider these types of pollutants as posing a critical risk for the health of their children (Table 3). This finding is consistent with the study of Brenda et al. and Kathleen M. Gray in USA that found the confusion around EHL terminology and individual' perceptions toward risks posed by toxicant exposure in environment (2, 20, 22). They reported that the low knowledge regarding EHL is a serious complication that may affect community health. Therefore, to better understand the susceptibility and threat to a toxic chemical pollutant exposure in their environment, a person would need to have a basic knowledge and awareness of the concept of EHL science(1, 21).

The main point in this study is the inadequate level of parent's knowledge regarding potential risks posed by toxic chemicals in environment. This is a serious implication for health risk in each community(20, 21). Therefore, to understand the threat and susceptibility to a toxicant exposure in environment, parents would need to have basic information related to environmental toxic exposure and their pathways into human body. In fact, parents need to be aware with the basic information related to EHL that affect human health as follows: (1) toxic chemical pollutants in environment media such as air, soil, and water, can harm health; (2) aware of exposure's pathways to human body (e.g., dermal, aspiration and oral); (3) their adverse effect on human health; (4) informed action and decisions to control or reduce their adverse effects(10, 21).

We faced some limitations during this study. We could not be able to address the cultural context influences EHL and the parent's action linked to EHL during this study because of the COVID

lockdown. Therefore, examining the effect of cultural context and parent's action through a cross-sectional study is essential to assess the cultural knowledge that is associated with EHL. Our finding may not be representative for entire communities because this study was only done in a metropolis of Iran. Although, we tried to decrease these biases by conducting the interviews without rush, giving appropriate time to study populations.

Conclusion

In this study, parents were more concerned with physical environment than social-emotional environment and intellectual-learning environment. Our finding showed that limited information on source and effect of toxic exposures that affect their children's health, and they did not consider these aspects of environment as a threat to the health of children in their care. Likewise, parents have limited information on the EHL terminology and characterization of EHL. Therefore, this study highlights the need to raise parents' knowledge and awareness toward environmental exposure that influences health of children. Such knowledge and awareness are critical starting points for EHL to promote community health if combined with self-efficacy for specific behaviors, seeking information abilities, and decision-making skills. We suggest that individuals in each society need to move along a continuum of EHL, which links understanding of how environmental pollutants can harm human health with community and individual activities, by clearly combining self-efficacy and health protective decision-making skills. These efforts can effectively facilitate movement along a continuum of EHL and improve level of action in each community to protect human health, especially children.

Acknowledgements: We would like to thank

all the vice president of research in Mashhad University of Medical Sciences.

Funding: This study was supported by grants from the Mashhad University of Medical Science, Iran.

Conflict of interest: All authors declared that they have no conflicts of interest in this work.

Ethics approval and consent to participate:

This study was conducted with consideration of Helsinki Declaration in all phases of the study. Confidential data treatment was guaranteed. Written informed consent was obtained from the participants. At the beginning of the interview, the participants acquainted themselves with the purpose of the study, method of interviewing, privacy, and confidentiality of the study. The interviews were set up individually, at a place suggested by the interviewees at an agreed time. The interviewees were allowed to leave the study at any time. Availability of data and materials Data from this study will not be openly available until planned publication outputs have been completed.

References

1. Finn S, O'Fallon L. The emergence of environmental health literacy-from its roots to its future potential. *Environmental health perspectives*. 2017;125(4):495-501. <https://doi.org/10.1289/ehp.1409337> PMID:26126293 PMCID:PMC5382009
2. Koester BD, Sloane S, Fujimoto EM, Fiese BH, Su LY-F. What Do Childcare Providers Know about Environmental Influences on Children's Health? Implications for Environmental Health Literacy Efforts. *International journal of environmental research and public health*. 2021;18(10):5489. <https://doi.org/10.3390/ijerph18105489> PMID:34065537 PMCID:PMC8160689
3. Davis LF, Ramirez-Andreotta MD, McLain JE, Kilungo A, Abrell L, Buxner S. Increasing environmental health literacy through contextual learning in communities at risk. *International journal of environmental research and public health*. 2018;15(10):2203. <https://doi.org/10.3390/ijerph15102203> PMID:30304865 PMCID:PMC6210322
4. Khorasani MY, Langari H, Sany SBT, Rezayi M, Sahebkar A. The role of curcumin and its derivatives in sensory applications. *Materials Science and Engineering: C*. 2019;103:109792. <https://doi.org/10.1016/j.msec.2019.109792> PMID:31349416
5. Jafari Y, Vahedian-Shahroodi M, Tehrani H, Haresabadi M, Shariati M. The relationship between caregivers' health literacy and the behavior of women with multiple sclerosis. *Iranian Journal of Obstetrics, Gynecology and Infertility*. 2018;21(7):71-64.
6. Sany ST, Monazami G, Rezayi M, Tajfard M, Borgheipour H. Application of water quality indices for evaluating water quality and anthropogenic impact assessment. *International journal of environmental science and technology*. 2019;16(7):3001-12. <https://doi.org/10.1007/s13762-018-1894-5>
7. Sany SBT, Hashim R, Salleh A, Rezayi M, Safari O. Ecological quality assessment based on macrobenthic assemblages indices along West Port, Malaysia coast. *Environmental earth sciences*. 2015;74(2):1331-41. <https://doi.org/10.1007/s12665-015-4122-3>
8. Rezayi M, Heng LY, Abdi MM, Noran N, Esmaeili C. A thermodynamic study on the complex formation between tris (2-Pyridyl) methylamine (tpm) with Fe 2, Fe 3, Cu 2 and Cr 3 cations in water, acetonitrile binary solutions using the conductometric method. *Int J Electrochem Sci*. 2013;8:6922-32.
9. LaVeaux D, Simonds VW, Picket V, Cummins J, Calkins E. Developing a Curriculum for Change: Water & Environmental Health Literacy in a Native American Community. *Progress in community health partnerships: research, education, and action*. 2018;12(4):441.
10. Hashemi M, Sadeghi A, Saghi M, Aminzare M, Raeisi M, Rezayi M, et al. Health risk assessment for human exposure to trace metals and arsenic via consumption of hen egg collected from largest poultry industry in Iran. *Biological Trace Element Research*. 2019;188(2):485-93. <https://doi.org/10.1007/s12011-018-1437-4> PMID:30019208
11. Tehrani GM, Rosli H, Sulaiman A, Sany BT, Salleh A, Owfi F, et al. Petroleum hydrocarbon assessment in the wastewaters of petrochemical special economic zone and sediment benchmark calculation of the coastal area-northwest of the Persian Gulf. *Iranian Journal of Fisheries Sciences*. 2014;13(1):119-34.
12. Sany SBT, Narimani L, Soltanian FK, Hashim R, Rezayi M, Karlen DJ, et al. An overview of detection techniques for monitoring dioxin-like compounds: latest technique trends and their applications. *RSC advances*. 2016;6(60):55415-29. <https://doi.org/10.1039/C6RA11442C>
13. Tajfard M, Tavakoly Sany SB, Avan A, Latiff LA, Rahimi HR, Moohebbati M, et al. Relationship between serum high sensitivity C-reactive protein with angiographic severity of coronary artery disease and traditional cardiovascular risk factors. *Journal of cellular physiology*. 2019;234(7):10289-99. <https://doi.org/10.1002/jcp.27945> PMID:30548615
14. Sany BT, Sulaiman A, Monazami G, Salleh A. Assessment of Sediment Quality According to heavy metal status in the West Port of Malaysia. *World Academy of Science, Engineering and Technology*. 2011;74:639-43.
15. Alami A, Tavakoly Sany SB, Tehrani H, Lael-Monfared E, Hosseini Z, Jafari A. The effect of educational intervention on iron and vitamin

- D consumption based on the theory of planned behaviour in Iranian adolescent girls: a quasi-experimental study. *International Journal of Health Promotion and Education*. 2019;57(6):316-31. <https://doi.org/10.1080/14635240.2019.1632732>
16. Afshari A, Eslami A-a, Mostafavi F, Moazam E, Golzari M, Etmnani R. Self-assessment for implementation of health promotion standards in hospitals, in medical education centers of Isfahan city. *Iranian Journal of Health Education and Health Promotion*. 2020;8(3):249-60. <https://doi.org/10.29252/ijhehp.8.3.249>
 17. Olyani S, Peyman N. Health Literacy and Health Outcomes in Iranian Adolescents: A Systematic Review. *Journal of Health Literacy*. 2021;6(3):78-85.
 18. Qi S, Hua F, Xu S, Zhou Z, Liu F. Trends of global health literacy research (1995-2020): Analysis of mapping knowledge domains based on citation data mining. *Plos one*. 2021;16(8):e0254988. <https://doi.org/10.1371/journal.pone.0254988> PMID:34370749 PMCID:PMC8351965
 19. Marsili D, Pasetto R, Iavarone I, Fazzo L, Zona A, Comba P. Fostering Environmental Health Literacy in Contaminated Sites: National and Local Experience in Italy From a Public Health and Equity Perspective. *Frontiers in Communication*. 2021:175. <https://doi.org/10.3389/fcomm.2021.697547>
 20. Gray KM. From content knowledge to community change: A review of representations of environmental health literacy. *International Journal of Environmental Research and Public Health*. 2018;15(3):466. <https://doi.org/10.3390/ijerph15030466> PMID:29518955 PMCID:PMC5877011
 21. Finn S, O'Fallon LR. *Environmental health literacy*: Springer; 2018. <https://doi.org/10.1007/978-3-319-94108-0>
 22. Mahdifar M, Ghavami V, Vahedian-Shahroodi M. Health Literacy and Body Image Concern Among Healthcare Employees in Binaloud, Iran. *Journal of Health Literacy*. 2021;6(1):31-40.