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Measuring the Quality of Environmental Health in Recreational and Sports Swimming Pools with a Risk Management Approach (Case Study: Gilan Province)

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Abstract

The aim of this research is to measure the quality of environmental health of recreational and natural sports swimming pools with a risk management approach in Gilan Province. The study was descriptive - cross-sectional, and three selected sites were sampled. Microbial parameters, temperature and PH were measured. Microbial tests were carried out according to national standards in the laboratory. It was used to analyze data from standard tables related to pollutants and compare them to existing data. SPSS software was used to analyze data from experiments. Two William fine quantitative methods and the risk assessment table technique were used to assess risk. The results showed that the burden of microbial contamination in the Anzali swamp was higher than other sites. In other words, the most polluted sites in Gilan Province were the Anzali wetland, the Kiasar wetland and, at the end, the eyeglass wetland, respectively. Also, the average number of total cliform and cliform, respectively 375 and 109 MPN in 100 ml of samples, and Enterococcus of the rivers 7/17 CFU in 100 ml of samples were observed. The average pH was 89/7, which is within the standard range. On the other hand, the average water temperature measured in these natural swimming pools is 4/25 degrees Celsius, which is within the standard range. It was found that the type of risk outstanding, the level of aspect ultimate and the control required were appropriate control action and the necessity of corrective action.

Keywords: Microbial contamination, Health status, Natural swimming pools, Gilan province.

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1. Introduction

Swimming is one of the most suitable and enjoyable sports and entertainment for all people of different ages, it has many fans in the hot summer weather. Currently, in schools, dormitories, hotels, parks or institutions, public recreation often has such facilities by welcoming people to the pool. Such places need to be built and operated in such a way that the health of swimmers is not threatened and closely monitored and inspected by the relevant organizations so that they do not pose any danger to its users in any way and do not cause skin diseases, fungal diseases, intestinal disorders, diarrhea, eye and ear disorders and sexually transmitted diseases. However, we should try to keep the water in these places as clean and free of pathogens as possible. Swimming is a very fun sport, but natural swimming pools and swimming pools are good places to transmit diseases. The importance of water quality in aquatic environments chosen for swimming is more related to their microbial and chemical quality. Today, due to the poverty of Sports per capita as well as the dispersion of the Republic at the national level, some of the country's natural ecosystems are inevitably chosen as a place for sports and recreational activities. However, in special circumstances, it is possible that prominent athletes and national champions will also use such environments for the pre-professional preparation period and practice in them. Like the National Rowing Team, rafting, swimming and multiple competitions. Leisure time is another use of this type of natural ecosystem (National Standard of Iran 9412, 2024).

Lakes, wetlands, rivers, reservoirs and so on ... are used as natural places for recreational and sports activities. It is important to note that such spaces do not include time constraints in addition to not costing users much. But on the other hand, weather conditions as well as their physical, chemical and biological parameters can affect the health and safety of athletes and users (Asadi et al., 2017).

Natural swimming pools (rivers, springs, sea, dams) are generally used for swimming in the summer season, and every year many cases of swimmers drowning in the sea, rivers, and other neighborhoods are used, mainly due to neglect of safety precautions. Therefore, the fundamental issue in the use of natural swimming pools is to pay attention to the safety of swimmers. (Jafarinia et al., 2016). Along with the safety aspects, in terms of Health and hygiene, the water in these areas may contain microbial, chemical and physical pollutants. With the onset of the summer season and the presence of people in natural swimming pools, many cases of waterborne diseases are reported. Obviously, contact with water that has no certainty about the absence of bacteria, fungi, or iodine may cause digestive and skin diseases. Before using any water (drinking, swimming, recreation or any other), environmental pollution should be considered in addition to the health safety aspects in the personal and environmental health dimensions. Chemical pollutants (such as lead and Mercury) caused by wastewater discharge or sewage from factories upstream of rivers and watersheds may cause problems. (Islami et al., 2015).

From 1988 to 2004, 26 outbreaks of the disease with 1,363 people were reported to the Centers for Disease Control in the United States due to the use of water from recreational and swimming centers. Important pathogens in hot water pools include the bacteria sodomonas, Leptospira, Legionella, and the Norwalk virus. Discomfort in the eyes, ears, nose and throat, gastrointestinal disorders and skin irritations are the most common complications and problems caused by unsanitary pools. According to statistical data, swimming in Lake water with an average cliform content of 2,300 by 100 milliliters of water increases the incidence of the disease.

Swimming in river water, which has a median density of 2,700 per milliliter, causes a significant statistical increase in intestinal diseases, and if swimmers are between the ages of 5 and 19, there are more cases of disease. People who swim in a sea with unacceptable sanitary standards are more likely to develop digestive disorders than those who use relatively uninfected seas (Haqmorad Kursti yet al., 2015 and Dian & Hosmi, 2013). Microorganisms proposed as a possible indicator of swimming water quality include: Cliform, phycal cliform, phycal streptocoxy and sodomonas aeroginosa, cholesterodium perfergens that are somehow associated with human feces. In various studies, Clostridium perfergens, shigelas, and salmonella have been studied to determine the sanitary water quality for swimming on the seafront. But it should be noted that two specific types of bacteria, phical streptocoxy and Clostridium perfernogenesis, are considered the best indicators. The Clifford standard is the most common public health factor in judging the sanitary quality of recreational waters. Some researchers have reported cases of leptospirosis among people who have swam in water contaminated with domestic wastewater, wild animal waste, cattle, sheep, blue rats, and cattle, and have emphasized the lack of such water for swimming. The study attempted to examine the physicochemical and biological quality of water in the natural swimming pools of the northern provinces of the country (Gilan), which are known as sports and recreational environments. In other words, the researcher seeks to identify possible pollutants by determining the type and amount of compounds in the water of these places, and then to determine the level and degree of health risk (individual risk) and at the end, provide a risk management model.

2. Methodology

The present research is of a mixed type (Library and field) in terms of outputs, of a functional type and in terms of the method of data collection. The method of collecting data was based on laboratory form. The method of data analysis was also descriptive– analytical, and in terms of research time, it was also cross-sectional. Shown in Fig. (1) are the steps for implementing the research.

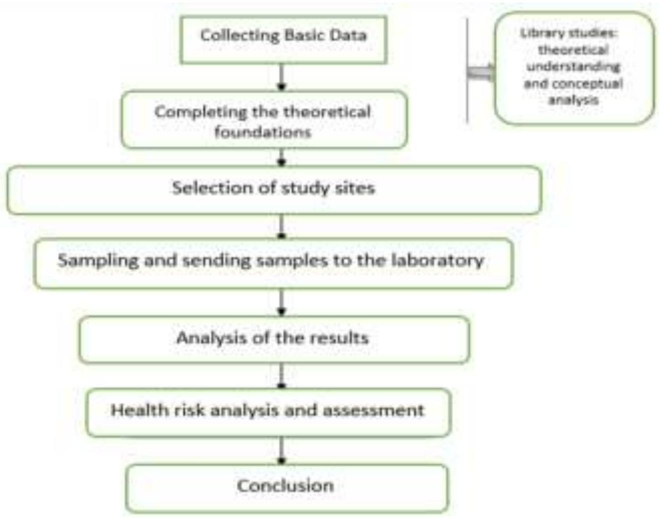


Figure 1. Flowchart of the steps and implementation of the research

The study community was the water resorts and natural swimming pools of Gilan Province, and three sites (Kiasar Beach, Anzali wetland and eyeglass wetland) were selected. In the upcoming study, the measurement and evaluation of health indicators was considered. Health indicators have a lot of variety and scope, all of which require a lot of time and money to study. On the other hand, such studies are defined in the form of national projects that require the cooperation of several specialized institutions and with the participation of a large number of experts. So, in this study, health indicators were limited to five parameters, three of which were microbial factors. The reason for selecting these parameters was also based on their degree of health risk and lack of research records in the past. The parameters measured in this study included: microbial contamination (total cliform, thermoplastic cliform, and intestinal Enterococcus), temperature, and PH. The research also used a risk management approach, part of which is risk assessment. On the other hand, risk management is also considered as one of the essential parts of the design of the safety, health and environmental management system (HSE). In Figure (2) the HSE-MS stages and the risk management position in it, and in Figure (3) the components and stages of risk management, and the risk assessment position are shown.

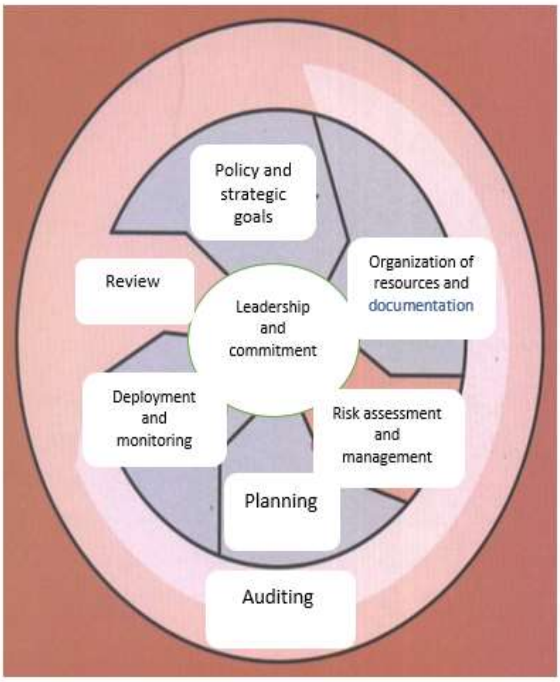


Figure (2). HSE-MS cycle stages and risk management position

The data collection tool included library studies for obtaining information and visiting authoritative and specialized internet sites and scientific centers for the editing of research bases. In the field studies department, the measurement stations in the study area were determined. Then, according to international guidelines, sampling and laboratory studies were carried out. According to the World Health Organization guidance, the sampling rotation for beach and recreational swimming pools has been determined based on the bacterial index for swimming seasons (3 samples), and for non-swimming seasons (2 samples) (at least an acceptable sample). Sampling was done in the spring and summer seasons, which are introduced as swimming seasons. It was used for sampling special, fully sterile containers. These containers are glass bottles that have a plastic cap and are sent into the sampling site by a circular rope or

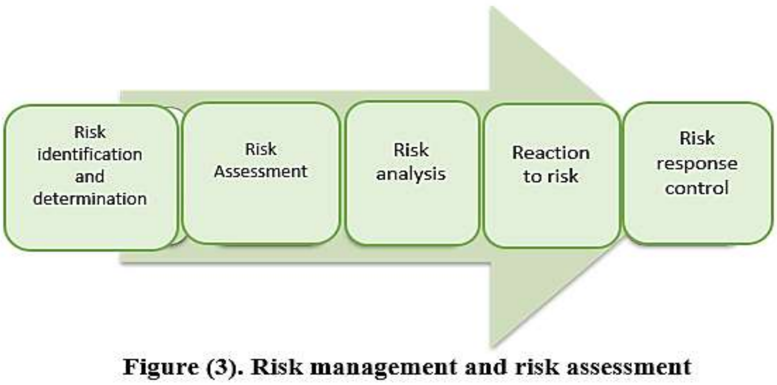


Figure (3). Risk management and risk assessment

transported to the desired depth by an expert (in certain cases by divers). On the sites in question, the maximum sampling depth was 5/1 meters above the water level (WHO, 2002). The distance from the beach or the banks on each site was determined by the expert's opinion. The samples were stored in a special box at a temperature of 3 ±5 ° C and were avoided freezing or being exposed to direct sunlight. The samples were transferred to the laboratory within less than 8 hours (the time proposed in the WHO directive). Sampling for swimming and non-swimming seasons was done according to the Poisson law. The sampling method, assuming the uniformity of the harvesting environment, is shown in Figures (3) and (5).

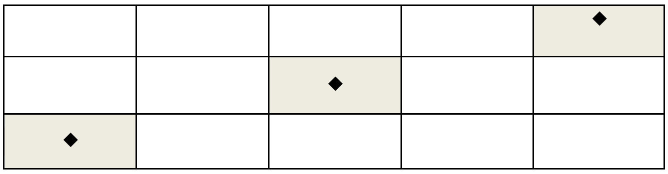


Figure 4. Distribution of samples on each of the study sites for swimming seasons

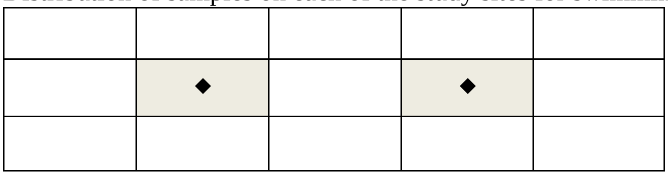


Figure 5. Distribution of samples on each of the study sites for non-known chapters

Finally, the samples were prepared in sterile glass containers and sent to the Environmental Protection Agency's accredited laboratory (dynamic environmentalists). Microbial tests based on national standard No. 3759 and 3620 were carried out in the laboratory (national standard of Iran, 1371). Finally, the hack-HQ40D was used to determine the temperature and pH at the sampling site. It was used to analyze data from standard tables related to pollutants and compare them to existing data. SPSS software and Pearson correlation coefficient were used to compare and analyze data from experiments. To assess the risk of various aspects and factors, the William fine method and the QRA Technique were used to measure and determine the extent of health safety risks in the region.

2.1. Quantitative Risk Assessment with the "risk assessment table technique"

The completion of the environmental aspects identification and evaluation form is carried out according to the following tables:

A) Effect intensity: (S) this column is completed according to the following classification:

Table 1. Determination of the severity of the work (class and rank of the work)

Effect intensity		
Class name	**Rank**	**Description**
Catastrophic	4	Irreparable destruction of resources, energy consumption more than 20% above the defined criteria, failure to take effective measures to reduce and control it, widespread pollution spread inside and outside the scope, violation of international law, frequent complaints from stakeholders Financial damage (to equipment and resources) of more than 100 million tomans
Important	3	Destruction of sources in a form that is amenable to the operation of a country's feet, an energy Bank between 20-100 monitoring of the intensity of the definition criterion, the spread of machines inside a limited area, the impact of an accident on the perimeter of a resource, the reversal of the laws of Financial loss between 100 million tomans to 10 million tomans
Cutoff	2	Natural resource consumption, energy consumption up to 10% above defined criteria and production of pollutants in part or in part within the range, severe visual pollution violation of other requirements Financial loss between 1 million and 10 million tomans
Minor	1	Natural resource consumption with savings, energy consumption less than the defined standards of pollutant production to a not very significant extent, the range of impact on the Department's surroundings, minor visual pollution Financial loss of less than 1 million tomans

Source: General Department of Environment and sustainable development of Tehran municipality, 2014

(B) Probability of occurrence (P): based on time intervals, the environmental aspect is selected and classified in the following order.

Table 2. Probability of occurrence (class and rank)

Probability of occurrence		
Description	**Rank**	**Class Name**
It happens frequently (every day or every week)	A	Repeated (above)
It occurs several times in the lifetime of a system.	B	Likely (average)
It occurs occasionally throughout the life of the system (once a year).	C	Occasionally
The probability of it occurring during the life of the system is very low (once every ten years)	D	Little (rare)
The probability of its occurrence over a lifetime is very small (over 10 years)	E	Insignificant

Source: General Department of Environment and sustainable development of Tehran municipality, 2014

c) Evaluation number: The number that is recorded in this column is the result of the following formula :

P × S = degree of aspect evaluation

Probability of occurrence × severity of effect = degree of aspect evaluation

t) The proposed criterion for evaluating the degree of aspect can be considered according to the following matrix:

Table 3. Aspect degree evaluation matrix

Intensity repeat		Catastrophic	Significant	Cutoff	Minor
		4	3	2	1
repeated (above)	A	4A	3A	2A	1A
likely (moderate)	B	4B	3B	2B	1B

occasionally	C	4C	3C	2C	1C
little (rare)	D	4D	3D	2D	1D
insignificant	E	4E	3E	2E	1E

The interpretation of this matrix will be as follows:

Table 4. Aspect degree interpretation matrix

Aspect evaluation degree	Kind	Aspect level	Control
4A-3A-4B-3B-4C	Obvious	maximum	Appropriate control action and the) (need for corrective action
2A-2B-3C-4D		High	control action/corrective action if) (needed
1A-2C-2D-3D-3E-4E	Onobtrusive	Average	(control action)
1B-1C-1D-1E-1E		Low	The possibility of issuing action (preventive)

(E) In the existing control column, measures taken to control each aspect or according to the scope of the degree of evaluation of its aspect and the proposed criteria for it can be recorded as such as the following.

1) If the level of environmental aspects is Ultimate or high, it is considered a prominent environmental aspect, which is necessary for the most prominent aspects with the ultimate level of corrective action, but if the environmental aspects are high level, it controls the desired aspect with appropriate control and corrective action is issued if necessary.

2) If the level of environmental aspects is medium or low, the environmental aspect is considered unprecedented, and appropriate control measures are defined for non-pronounced environmental aspects, and for aspects with a low level, if possible, preventive measures are also issued.

William Fine was also used in environmental and health aspects. In this method the risk is calculated by multiplying the following three parameters:

$$R = C \times E \times P$$

In this regard:

R = Risk Rating

C = implication rate

E = contact rate
P = probability rate
The following tables are a guide to calculating risk.

Table 5. Consequence rate (C)

Description of risk consequence	Score
Multiple deaths-irreparable environmental damage with long-term effects-high financial damage-excessive consumption of resources and energy - excessive concentration of pollutants (50% above the standard)	100
Death of one person-irreparable environmental damage with medium-term effects-relatively high consumption of resources and energy-high concentration of pollutants (30% higher than the standard)	50
Damage to a person's permanent disability-irreparable environmental damage with short-term effects-relatively high consumption of resources and energy-high concentration of pollutants (10% higher than the standard)	25
Long-term damage without permanent disability-compensable environmental damage with long-term effects-average resource consumption-average concentration of pollutants (5% more than standard)	15
Temporary damage-compensable environmental damage with short-term effects - low resource consumption-pollutant concentration less than 5% higher than the standard	5
Minor injury requires first aid (3 days less)- very low resource consumption-standard pollutant concentration	2
No need for further investigation-no environmental damage - no resource consumption-pollutant concentration to the standard level	1

Table 6. Contact rate classification (E)

Score	Description of contact and risk sequence
10	Steadily – several times a day-calls over 8 hours-continuous emissions of pollutants
6	Often – several times a week-calls between 6 and 8 hours-high emissions of pollutants
3	Occasionally-fish several times-contact between 4 and 6 hours a day-average emissions of pollutants
2	Unusually – several times a year-calls between 2 and 4 hours a day-abnormal emissions of pollutants
1	Rarely-once a few years-contact between 1 and 2 hours a day-low emissions of pollutants
0.5	In part-very little-contact less than 1 hour a day-exaggerated emission of contaminants
0.2	No contact-no frequency of occurrence - no emissions of pollutants

Table 7. Classification of the likelihood of risk (P)

Description of the probability of occurrence	Score
Often likely	10
The chance of occurrence is 50-50.	6
It can happen by accident (the chance of occurrence is less than 50%)	2
It probably won't happen until a few years after the call, but it's possible.	0.5
In practice, it is impossible (it never happens) to happen.	0.2

Table 8. Summary of risk rating and actions

Risk Level	Actions	Rank
High Risk Level	.Urgent reforms are needed to control risk	> 200
Moderate Risk Level	Emergency (necessary attention should be taken as soon as possible)	90-199
Low Risk Level	.The risk is monitored and controlled	< 89

3. Research findings

Extraction of health rules and standards of natural swimming pools

In the first step, according to the theoretical foundations and review of the research literature, it was started to identify and develop standards and health and environmental regulations related to natural swimming pools.

Table 9. Proposed standards for natural swimming based on international guidelines

Source	Permissible Limit	Indicator
WHO, 2010	Less than 40 (average number) per 100 ml	Enterococcus intestines
National standard of Iran No. 3759	Less than 100 by 100 milliliters.	Cliform grumpy
Iranian national standard number 5859 EPA, 2006	.Less than 460 by 100 milliliters	Clay form
WHO, 2010	Maximum 30 degrees for natural waters and maximum 40 degrees for hot waters	Temperature
Ministry of Health, 2016	7.2-8	PH

Source: Research findings

Sampling results and tests

A) Separate results of study sites in Gilan Province

The results of the sampling of the study stations are presented in Table 10.

Table 10. Microbial and physicochemical test results of natural water swimming pools in Gilan Province

Statistical index	Total coliforms (MPN/100 ml)	Endothermic coliforms (MPN/100 ml)	Intestinal enterococcus (CFU/100 ml)	Temperature (^{0}C)	pH
Total number of samples	15	15	15	5	5
Average	375	109	17.7	25.4	7.89
standard deviation	276.2	66	32	0.3	2.32
Minimum and maximum	1122-96	344-27	35-8	31.6-9.1	9-4
Number of items above the limit	8	6	3	-	-
The percentage of cases beyond the standard	66	48	24	-	-

In Figure (6), a comparative graph of the average pollution of study sites in Gilan province is presented to the total cliform. The average total cliform pollution load shows that the Anzali wetland has 1,100 MPN per 100 ml of sample, which is much higher than the standard. Also, Kiasar Beach also had a pollution load of 989 MPN per 100 milliliters of samples,which is also above the standard. While the eyeglass wetland has an average pollution load of 145 MPN per 100 milliliters of samples, which is below the standard.

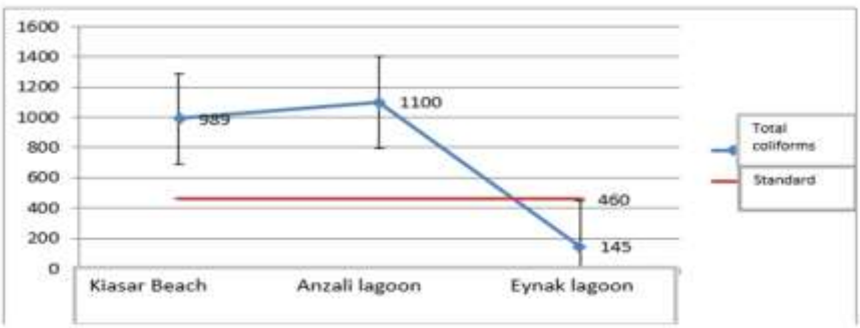
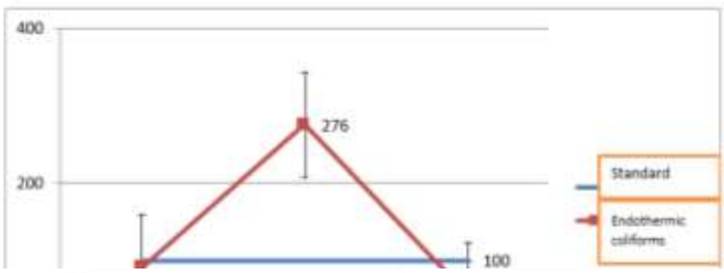


Figure 6. Average results of microbial contamination of natural reservoirs in Gilan Province relative to the total cliform (number in 100 ml of samples)

In Figure 7, a comparative graph of the average pollution of study sites in Gilan province is presented to cliform grampai. The average contamination load of the cliform grumpy shows that the Anzali wetland had 276 MPN per 100 ml of sample, which is above the standard. Also, the Kiasar beach and the eyeglass lagoon also had a pollution load of 91 and 55 MPN per 100 milliliters, respectively, which is below the standard.



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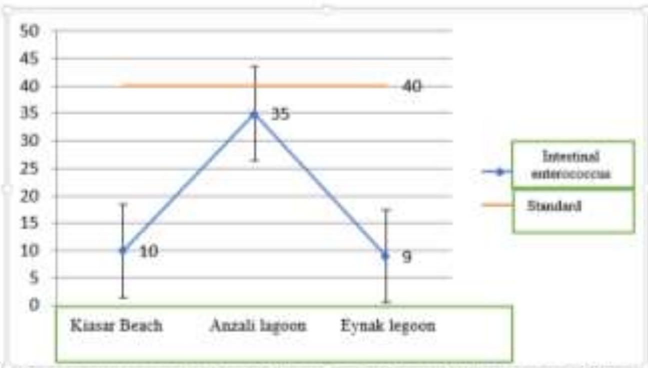

Figure (8). Average outcomes of microbial contamination with Enterococcus Rivers o swimming pools in Gilan Province (Number in 100 ml sample)

In Figure 8, a comparative graph of the average pollution of study sites in Gilan province compared to intestinal enterococcus is presented. The average load of intestinal enterococcal pollution shows that the Anzali wetland had 35 CFUs per 100 ml of sample, which is below the standard. Also, the Kiasar beach and the eyeglass lagoon also had a pollution load of 10 and 9 CFU per 100 milliliters, respectively, which is below the standard. In other words, it can be stated that the microbial factor of intestinal Enterococcus, although all

3 study sites in Gilan Province contaminated some of the contamination, did not exceed the standard.

As seen in the tables and graphs above, the results of Gilan province show that the average number of total coliforms and intestinal enterococcal coliforms in the investigated swimming pools were 375 and 109 MPN per 100 ml of sample, respectively. Intestinal Enterococcus 17.7 CFU was also observed in 100 ml of sample. This is while the situation of Mazandaran province is worse than that of Gilan. So that the average number of total coliform and faecal coliform was 463 and 155.6 MPN per 100 ml of sample, respectively, and intestinal enterococcus was also reported as 27.9 CFU.

On the other hand, the average water temperature measured in natural swimming pools in Gilan province was 25.4 degrees Celsius, which is within the standard range. In Mazandaran province, it was 24.2 degrees Celsius, which is also within the standard range. In Mazandaran province, it is 8/03, which is slightly beyond the standard.

Table 11. Relationship between microbial contamination load and temperature in study sites

		Temperature
The amount of microbial contamination	The correlation coefficient	0.118
	P-Value	0.002
	n	30

$p<0.05$

The positive correlation coefficient indicates that there is a direct (positive) relationship between the two parameters of microbial contamination load and temperature, and the value of 0.002, which is smaller than 0.05, indicates that there is a significant relationship between these two parameters .

Table (12) shows the results of Pearson's test to determine the relationship between pH and microbial contamination load**.**

Table 12. Relationship between microbial contamination load and pH in study sites

		pH
The amount of microbial contamination	The correlation coefficient	0.443
	P-Value	0.116
	n	30

$p<0.05$

According to the obtained significance level (P-Value=0.116<0.05), no significant relationship was found between these two parameters.

3.1. Risk analysis and assessment

According to the results and findings of the research, in this section, two separate methods are used to evaluate the health risk in the study sites and based on the environmental factor of water pollution.

4-1-3-1- Quantitative risk assessment with the "Risk Assessment Table" technique

The form for identifying and evaluating health aspects was completed according to the following tables.

A) The intensity of the effect :(S) This column was completed according to the information obtained and based on the classification below. According to the results of the research, considering that the average load of microbial contamination in all stations is beyond the standard and also the percentage of cases is determined to be higher than 20%, therefore; the intensity of the effect is evaluated in the category of "catastrophic" and the rank of "4".

Table 13. Determination of the severity of the work (class and rank of the work)

		Effect intensity
Class name	**Rank**	**Description**
Catastrophic	4	Irreparable destruction of resources, emissions of pollutants more than 20% above the defined criteria, failure to take effective measures to reduce and control it, widespread emissions of pollution inside and outside the scope, violation of international law, frequent complaints from stakeholders
Significant	3	Compensable resource destruction with control measures, emissions of pollutants between 20 and 10 percent above the defined criteria, emissions of pollutants within the range with the impact of the accident in the surrounding environment, violation of national laws
Cutoff	2	Pollution up to 10% exceeds defined standards and produces pollutants in part or in part within the range, severe visual pollution violates other requirements
Insignificant	1	Less pollution than defined pollutant production criteria to a not very significant extent, range of impact on the area, partial visual pollution

(B) Probability of occurrence (P): based on time intervals, the health aspect occurred in the following order.

According to the results of the study, the probability of microbial contamination is in the definite range, so the probability of water contamination in the study area is graded in the "frequent" category and the "A" rating.

Table 14. Probability of occurrence (class and rank)

Probability of occurrence		
Class name	**Rank**	**Description**
Repeated (above)	A	It happens frequently (every day or every week)
Likely (average)	B	It occurs several times during sports (once a month or once a month)
Occasionally	C	It occurs occasionally during sports (once a year)
Slightly (rarely)	D	The probability of its occurrence during a person's sports career is very low (once every ten years).
Insignificant	E	The probability of its occurrence over a lifetime is very small (over 10 years)

c) Evaluation number: The number that is recorded in this column is the result of the following formula :

P × S = degree of aspect evaluation

Probability of occurrence × intensity of effect = evaluation degree of the aspect

A × 4 = evaluation degree of the aspect

The proposed criterion for assessing the degree of aspect is as follows:

Table 15. Aspect degree evaluation matrix

Effect intensity		Catastrophic	Significant	Cutoff	Insignificant
		4	3	2	1
Repeated (above)	A	4A✱	3A	2A	1A
Likely (average)	B	4B	3B	2B	1B
Occasionally	C	4C	3C	2C	1C
Slightly (rarely)	D	4D	3D	2D	1D
Insignificant	E	4E	3E	2E	1E

As can be seen, the grade of this environmental aspect has been determined as A4, and the interpretation of this matrix will be as follows:

Table 16. Matrix interpretation degree aspect

Aspect evaluation degree	Kind	Aspect Level	Control
4A-3A-4B-3B-4C	Obvious	Maximum	Appropriate control action and the) (need for corrective action
2A-2B-3C-4D		High	control action/corrective action if) (needed
1A-2C-2D-3D-3E-4E	unobtrusive	Average	(control action)
1B-1C-1D-1E-1E		Low	The possibility of issuing action (preventive)

According to the obtained number, it is clear that the type of risk is "obvious", the aspect level is "ultimate" and the required control is "appropriate control action and the necessity of corrective action".

3.2. Quantitative risk assessment using William Fine method

Using William Fine's method guide, the health risk analysis of the study sites was also carried out. For this purpose, it is necessary to determine and evaluate the following three parameters .

In order to determine the outcome, table (17) was used as a guide. According to the research data, the score for the outcome was 50.

Table 17. Consequence rate (C)

Description of risk consequence	Score
Several deaths - irreparable environmental damage with long-term effects - high financial damage - excessive consumption of resources and energy - excessive concentration of pollutants (50% higher than the standard)	100
One person's death - irreparable environmental damage with medium-term effects - relatively high consumption of resources and energy - high concentration of pollutants (30% more than the standard)	50
	25

Damage leading to permanent disability of one person - Irreparable environmental damage with short-term effects - Relatively high consumption of resources and energy - High concentration of pollutants (10% more than the standard)	
Long-term damage without permanent disability - compensable environmental damage with long-term effects - average consumption of resources - average pollutant concentration (5% more than the standard)	15
Temporary damage - compensable damages to the environment with short-term effects - low consumption of resources - pollutant concentration less than 5% higher than the standard	5
Minor damage requiring first aid (less than 3 days) - very little consumption of resources - pollutant concentration within standard limits	2
No need for further investigations - no environmental damage - no resource consumption - pollutant concentration within the standard limit	1

Also; In order to determine the amount of contact, the guide in table (18) has been used. Based on this, a score of 3 was obtained for this parameter.

Table 18. Contact rate classification (E)

Description of the call rate and the risk ratio	**Score**
Steadily – several times a day-calls over 8 hours-continuous emissions of pollutants	10
Often – several times a week-calls between 6 and 8 hours-high emissions of pollutants	6
Occasionally-fish several times-contact between 4 and 6 hours a day-average emissions of pollutants	3
Unusually – several times a year-contact between 2 and 4 hours a day-abnormal emissions of pollutants	2
Rarely-once a few years-contact between 1 and 2 hours a day-low emissions of pollutants	1
In part-very little-contact less than 1 hour a day-detoxifying emissions of pollutants	0.5
No contact-no frequency of occurrence - no emissions of pollutants	0.2

The following guide was also used to determine the likelihood of risk, with a score of 10.

Table 19. Classification of the likelihood of risk (P)

The Descrption of probability of occurrence	Score
Often likely	10
The chance of occurrence is 50-50.	6
It can happen by accident (the chance of occurrence is less than 50%)	2
It probably won't happen until a few years after the call, but it's possible.	0.5
In practice, it is impossible (it never happens) to happen.	0.2

This factor was evaluated by William fine as follows :
Contact rate × risk consequence × risk probability
3 × 50 × 10 = 1500

Table 20. Summary of risk rating and actions

Risk Level	Actions	Rank
High risk level	Urgent reforms are needed to control risk.	200 <
Average risk level	Emergency (necessary attention should be taken as soon as possible)	199-90
Low risk level	The risk is monitored and controlled.	89 >

Finally, according to table 5-4, it can be stated that the risk rating is 1500, which indicates the emergency situation and the "high risk level" and it is necessary to pay the necessary attention as soon as possible.

4. Discussion

According to the bacteriological guideline of the water of natural swimming pools of the Center for Environmental and Occupational Health of the Ministry of Health, Treatment and Medical Education, the maximum allowable coliform total and coliform grampai are respectively 460 and 100 MPN per 100 ml of sample and the intestinal enterococcal contamination index is less than 40 numbers per 100 ml of sample was determined.

The results of the present research showed that, in general, bacterial (microbial) contamination was higher than the standard in all cases. so that in the case of the total form, 66%; In the case of gram-negative coliform, 48% and 24% in the case of intestinal enterococcus were higher than the standard. The results of the present research are consistent with most of the studies that have been done in the past in Iran and in the natural swimming pools of the whole country. For example: the results of this research, in the general section of the general form, with the study of Asrari and Gardhan (2019); Asadi et al. (2017); Mothaq et al. (2017) and Nowrozi Karbasdehi et al. (2014) are consistent (Asrari and Negahban, 2019; Asadi et al., 2019; Mosheth et al., 2017; Nowrozi Karbasdehi et al., 2014) Because in this research, the pollutant level was higher than the standard. However, in the intestinal enterococci section, the results have been contradictory. So, in the research of Mosheth et al. (2017) and Asrari and Gardani (2019), this amount was within the standard range (Asrari and Negahban, 2019; Mosheth et al., 2017).

The results of microbial analysis in this research are in agreement with some of the researches that have been conducted in indoor environments such as swimming pools, and they are not in agreement with some of them. This issue indicates that in open environments, the possibility of contamination and its spread is much higher, which seems obvious and logical, because there is no possibility of periodic monitoring and continuous monitoring in such environments. The results of this research are consistent with studies conducted by Zakariai et al. (2014) and Naimi et al. (2012). Because in their research, they emphasized the high microbial load of natural swimming pools in the northern provinces of the country (Zakariai et al., 2013; Naimi et al., 2012). Although, in Naimi et al.'s study, all the investigated variables had a significant relationship, which contradicted the results of the present study. Because there was no significant relationship between the load of microbial contamination, temperature and PH. In general, the results showed that in Gilan province, Anzali lagoon had a higher microbial pollution load than Kiasar beach and Eynak lagoon.

The lack of efficient treatment systems and as a result the discharge of domestic and urban and sometimes industrial raw sewage into rivers is one of the most important factors in increasing the load of microbial pollution in the water ecosystems of the northern provinces of the country and the study areas. The results showed that Aynak lagoon has the highest level of pollution and Kiasar beach has the lowest rate (Daneshyar et al., 2023). However, none of the stations measured were standard, so swimming in all study areas can be dangerous for swimmers. The water quality of the swimming pools can be well regulated by using a set of sanitary inspections and microbial water quality control (Chong et al., 2020 and Verla et ., 2018). Therefore, to ensure public health and reduce the health risks of swimming and recreational activities, it seems important to pay attention to the essential points. On the other hand, there was a positive and meaningful relationship between the load of microbial pollution and the temperature of the measured sample, which shows that as the temperature increases, the load of pollution also increases. This indicates that the prevalence of microbial contamination will be higher in the summer season, which is the swimming season and certainly the number of swimmers and tourists is increasing. Since there have been no studies on this, it is not possible to compare the results of the research.

Also, the results showed that there was no significant relationship between the PH parameter and the load of microbial contamination. In other words, the change in acidity or alkalinity of the aquatic ecosystem has not had a significant effect on bacteria. Based on the results of previous researchers ' studies and actual research, it can be said that the stations examined on the coast of Gilan Province are in a bad situation. One of the reasons can be the presence of tourists and swimmers in the warm seasons and the lack of protection of the entry of untreated sewage, human, domestic, agricultural and livestock sewage. As previously presented, the purpose of identifying risks in the health risk management process in sports and recreational environments is to reduce the likelihood of risks and increase health safety for users. That is, in addition to reducing and controlling the level of risk, if faced with it, the system can be restored to its original state in the shortest possible time (Zazouli et al., 2013).

The risk management process is used for this reason to ensure that all identified risks are documented and their likelihood of occurrence has increased or decreased. Risks are characterized by the definition that

any event that is likely to have a negative impact on the project's ability to achieve predetermined goals. According to Glaser (2003); the risk management process of recreational projects includes the following steps:
*Risk identification
*Quantitative and qualitative risk analysis
*Risk response planning
*Risk monitoring and control
* Risk management planning (Glaesser, 2003)
The results of the risk assessment research show that based on both The recreation system in natural spaces is mainly of the type of open systems, and any change in one component is a factor affecting other components that are interconnected with each other and interconnected with local, national, regional and international systems (Glaesser, 2003; Ritchie, 2009; Ghasemi, 2010). Also, sports and recreation activities in natural environments have a high percentage of "risk-taking" and "complexity" (Aschauer, 2010) and have characteristics of being ambiguous and uncertain (Su and Lin, 2006). Controlling and planning these systems is also more difficult and complex than simple and algebraic systems (such as indoor environments). As a result, their less certainty and prediction of their results rely more on probabilities, and risks not only damage the infrastructure of a tourist destination, but also seriously threaten the image of the destination, economic, political foundations, etc. (Aschauer, 2010). Therefore, risks cannot be completely eliminated, but can be managed in a better way to reduce their vulnerability. Such an approach often leads to the foundation of an approach called risk assessment and management to reduce the elements and factors of risk or vulnerability to human societies and their property (Ritchie, 2009). methods used, the level of health risk on study sites is high and the risk aspects are prominent. According to the results, most study sites in both provinces have a high microbial pollution load, which is worrying. The presence of tourists and users who intend to visit this species of aquatic and natural ecosystems can lead to the emergence and transmission of diseases that are mainly contagious. Intestinal enterococcus is a very dangerous factor for the health of swimmers and even people who have come into limited contact with the water source.

Practical suggestions

Practical suggestions for improving the status quo include :

*Temporary closure of the water resorts studied in order to implement health plans

*Avoid domestic and municipal sewage entering waterfalls with sports and recreational use to prevent the spread of pathogens

*Continuous monitoring and measurement of studied aquatic ecosystems and other recreational sites and aquatic areas

*Monitoring the protection of aquatic ecosystems and surrounding areas

*Informing swimmers and other natural swimming users about the consequences of pollution

* The need to treat wastewater that enters natural water resources.

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