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THE RELATIONSHIP BETWEEN BAD OBSTETRIC HISTORY AND THROMBOPHILIA

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Abstract: *The aim was to evaluate the relationship of recurring miscarriages and in utero mort fetus cases over 20 weeks of pregnancy (except for those caused by a systemic disease or a known pathology) with thrombophilic conditions. Our study was conducted on the patients who were admitted to our clinic with for follow ups or investigation of recurring pregnancy losses. The included patients had had at least 2 fetal losses over 8 weeks into their pregnancy or at least one loss over the 20th gestational week and gave histories of hypertensive pathologies of pregnancy such as preeclampsia or eclampsia. The control group comprised 81 patients who had at least one pregnancy without any complication or fetal loss histories. In our study, the ratios of Factor V Leiden mutation in the study group (106 cases) and the control group (81 cases) were %12 and %1.3 (p=0.01) respectively. In the patient group, the MTHFR homozygous mutation was seen 3.3 times as much and Factor V Leiden heterozygous gene mutation was determined to be seen 8.3 as much as the control group. There was a significant difference between the study and control groups in terms of Protein C and S activity (p<0.0001 ve p<0.001). In the study group, the detection rate of Protein C levels <65 was 5.2 times more (OR 5.2 2.7-12.49), and the Protein S activity was 12.17 times higher than the control group. Thrombophilic cases may play many roles in the pathologies which arise during pregnancies.*

Key words: *thrombophilia, recurring miscarriages, bad obstetric history*

1.Introduction

Habitual abortion is one of the issues which is mostly falling short in the determination of etiological and prognostic factors in obstetrics. Sixty eight percent of the recurrent early pregnancy losses are idiopathic. It may be thought that hemostatic mistakes lead to obstruction in placental bed vessels and the changes in the coagulation factors during pregnancy may lead to abortion. For a successful course of pregnancy, an effective uteroplacental circulation is a must and this circulation may be affected by hemostasis disorders. Thus, maternal thrombophilia (Factor V Leiden, Factor II

mutations, MTHFR {methylenetetrahydrofolate reductase} deficiency of Protein C, Protein S) are important pathologies in terms of obstetrics [1].

The tendency to start investigating the reason of recurring miscarriages after the second miscarriage is getting more prevalent. Recurring loss of pregnancy is defined as at least three spontaneous abortions after either the 10th or the 8th gestational week, depending on the source. The reasons are various.

Due to the fact that thrombophilic events are seen in some of the thrombophilic women and not all of them, hereditary thrombophilia is believed to be a multiple gene disease. This may occur due to antithrombin III, protein S or C deficiency or factor V Leiden mutations as well as acquired thrombophilias such as the antiphospholipid syndrome [2]. Lately, thrombophilia has been frequently mentioned as the key reason of HELLP syndrome, abruptio placenta, intrauterine growth retardation, inexplicable stillbirth and recurring loss of pregnancy [3].

The aim was to evaluate the relationship of recurring miscarriages and in utero mort fetus cases over 20 weeks of pregnancy (except for those caused by a systemic disease or a known pathology) with thrombophilic conditions

2. Materials and Methods

This study was done on 106 women with bad obstetric histories who were admitted to our polyclinic at Haseki Training and Research Hospital Obstetrics and Gynecology Department. between 1st June 2009 and 31st December 2012 Bad obstetric history was defined as at least two abortions (loss of pregnancy under the 20th gestational week), at least one in utero mort fetus case over the 20th gestational week or history of preeclampsia. A detailed anamnesis regarding their previous pregnancies was obtained from the patients. Those with any kind of systemic disease, anatomical or organic pathologies regarding the genital system and a known karyotype anomaly were excluded from the study. 81 similar ages patients with at least one history of live birth following a problem-free pregnancy and without any systemic disease, anatomical or organic anomalies of the genital system, history of fetal loss and preeclampsia or a known karyotype anomaly were included in the control group. The patients were informed about the study as well as the benefits regarding the diagnostic and treatment steps. After obtaining their written consents, tests regarding thrombophilia were ordered from the patients. Protein C activity, protein S activity, antithrombin III, factor V Leiden mutation, prothrombin gene mutation and MTHFR gene mutation were evaluated. Antithrombin III, Protein C and S activities and lupus anticoagulant tests were done with biotech branded, AMAX 200 full automatic coagulation equipment. The reference values of Antithrombin III activity, protein C activity and protein S activity were accepted to be %70-125, %70-130 and % 55-160 respectively.

In our study, Medcalc statistical program was used for the statistical analyses. In the evaluation of the data, in addition to the descriptive statistical methods (mean, standard deviation), independent t-test, one way variance analysis were used in the comparison of the binary groups; chi-square and odds ratio were used in the comparison of the qualitative data. The results were evaluated in a significance level of $p < 0.05$ and confidence interval of 95%.

3. Results

The study group comprised 106 cases who were admitted to our clinic with early and/or late loss of pregnancy and the control group comprised 81 cases without fetal loss. The mean age of the

106 cases in the study group and 81 cases without any pregnancy complications was 28 ± 4.9 and 29.7 ± 7.4 respectively. As expected, the number of pregnancies were determined to be significantly higher and the number of live births significantly lower in the study group. (Table 1)

Table 1. The comparison of the study and control groups in terms of age, gravida and live births

	Study Group	Control Group	P value
Age	28 ± 4.9	29.7 ± 7.4	0.06
Gravida	3.5 ± 1.8	1.48 ± 1.28	<0.0001
Live Births	0.46 ± 0.71	1.46 ± 1.28	<0.0001

In the study group, early loss of pregnancy was seen in 85 cases and one or more loss of pregnancies during the second or third trimesters were seen in 31 cases. The mean gestational week of the late pregnancy losses were determined to be 28.1 ± 4.8 in this group.

The rates of MTHFR, Factor V Leiden and Prothrombin multiple gene mutations as well as Protein C, Protein S and Antithrombin III activities were compared between the study and control groups. There was no significant difference between the two groups in terms of MTHFR heterozygous gene mutation, but in terms of MTHFR homozygous form, a significant difference was found. The rate of homozygous mutation was 11.3% (12 cases) in the study group and 3.7% (3 cases) in the control group ($P=0.049$). The rate of Factor V Leiden heterozygous gene mutation in the study group was determined to be significantly higher than the control group (12% vs. 1.3%, $p=0.01$). Homozygous mutation was not observed in neither of the groups. The number of heterozygous prothrombin gene mutations in the study and control groups was 10 (9.4%) and 3 (3.7%) respectively. The difference was not significant ($P=0.2$). We determined the number of cases with a protein C activity of <65% to be significantly higher in the study group ($P=0.0003$). The number of cases with a protein S activity of <65% were also significantly higher in the study group, but there was no significant difference between the groups in terms of Antithrombin III activity ($p:0.000074, p: 1.0$). The study and control groups were examined in terms of multiple gene mutations. Multiple gene mutations were detected in 12 cases (11.3%) in the study group and 4 cases (4.9%) in the control group. The difference was not statistically significant ($p=0.19$) (Table 2)

Table 2. The comparison of the study and control groups in terms of MTHFR, Factor V Leiden and Prothrombin and Multiple Gene Mutations as well as Protein C, Protein S and Antithrombin III activities

		Study group (n:106) %	Control Group (n:81) %	P value
MTHFR	Heterozygous	49 (46.2%)	33 (40.7%)	0.5
	Homozygous	12 (11.3%)	3 (3.7 %)	0.049
FactorV Leiden	Heterozygous	10 (9.4%)	1 (1.3 %)	0.01

Prothrombin	Heterozygous	10 (9.4%)	3 (3.7 %)	0.2
	Homozygous	1 (0.94 %)	0 (0%)	0.88
Protein C activities	<%65	14(13.2%)	1 (1.3 0%)	0.00
Protein S activities	<%65	35(33.01%)	7 (8.6%)	0.000074
Antithrombin III activities	<%75	7(6.6%)	5(6.1%)	1.0
MTHFR+Factor V Leiden	Heterozygous/ Heterozygous	5 (0.47)	1(1.2%)	0.23
MTHFR+ Protrombin	Heterozygous/ Heterozygous	7(6.6%)	3(2,83%)	0.51

The rate of MTHFR homozygous mutation rate was determined as OR 3.3 (0.9-12.18), i.e, the possibility of detecting homozygous mutations in the study group was determined to be 3.3 more than that in the control group. The rate of heterozygous Factor V Leiden mutations was 8.3 times more (OR 8.3, 1.04- 66). Homozygous mutations were not seen in either of the groups. In the patient group, the detection rate of Protein C levels <%65 was 5.2 times more, and the Protein S activity was 12.17 times higher than the control group. (OR 5.2 2.7-12.49, OR:12.17 1.5-94.64) Table 3.

Table 3. Prevalence of thrombophilia

Type of thrombophiliaa	Study group (n:106) no. (%)	Control group (n:81) no. (%)	Odds ratio	95% confidence interval	P value
MTHFR (Homozygous)	12 (11.3%)	3 (3.7 %)	3.3	0.9-12.18	0.049
FactorV Leiden (Heterozygous)	10 (9.4%)	1 (1.3 %)	8.3	1.04-66	0.01
Protein C activities	14(13.2%)	1 (1.3 0%)	5.2	2.7-12.49	<0.001
Protein S activities	35(33.01%)	7 (8.6%)	12.17	1.5-94.64	<0.001

Mean Protein C, Protein S and antithrombin III activities were evaluated in Table 4. In cases with fetal loss, the Protein C and S activities were significantly lower ($P < 0.0001$) and no significant difference was found in terms of Antithrombin III activity ($p = 0.47$). TABLO:4

Table 4. The comparison of the Study and Control groups in terms of MEAN Protein C, Protein S and antithrombin III activities

	Study	Control	P değeri
Protein C activity (%)	74.2±0.29	95.7±17.5	<0.0001
Protein S activity (%)	86.9±0.23	94.8±19.4	<0.0001
Antitrombin III activity (%)	96.9±0.15	98.3±20	0.47

4. Discussion

Pregnancy is an acquired condition during which the thrombogenic activity increases. The changes in the coagulation system due to pregnancy may strengthen the thrombogenic tendency due to hereditary thrombophilia, causing various clinical diseases [4]. Different clinical cases arise due to the pathologies emanating in the placental bed, causing recurring losses of pregnancy, early severe preeclampsia, IUGR, stillbirth and placental pathologies during pregnancy and related complications [5].

Thrombophilia may be hereditary or acquired. The most common cause of the acquired thrombophilia is antiphospholipid antibody syndrome (APA). Deficiency of Protein C, deficiency of Protein S, Antithrombin deficiency, Active protein C resistance (APCR), Prothrombin G20210 mutation, Hyperhomocysteinaemia- MTHFR (Methylenetetrahydrofolate reductase) mutation are among the hereditary thrombophilia

A point mutation in factor V was shown as the cause of APCR for the first time and this mutation is referred to as 'Factor V Leiden (FVL)'. FVL mutation is the most common cause of hereditary thrombophilia and responsible for 40% of the thrombosis [6]. FVL heterozygous mutation is seen between the rate of 5 and 10% while homozygous mutation is seen at a rate of 0.04% [7, 8]. It is known that homozygous mutations increase the risk of venous thrombosis by 80 times while this risk increased by seven times in heterozygous carriers [9].

There are conflicting results regarding thrombophilia in severe preeclampsia in the literature. While a significant correlation is found between thrombophilia and severe preeclampsia [10, 11, 12] other pregnancy complications in some studies [13, 14, 15] there is not any correlation in some others [16].

In Dizon-Townson DS et. al's study done on 158 severely preeclamptic and 403 healthy pregnant women, the rates of Factor V Leiden mutation in the preeclamptic and control groups were determined to be 8.9% and 4.2% respectively, a significant difference [10]. In the metaanalysis of Linj et. al comprising 31 studies and 7522 patients, the detection rate of Factor V Leiden mutation on all preeclamptic and severely preeclamptic women were 1.81 and 2.24 times higher respectively, which led to the conclusion that Factor V Leiden mutation caused an increased risk of preeclampsia [11]. In the meta-analysis where Rodger et al. evaluated ten prospective studies, there was a significant correlation between FVL mutation and pregnancy losses, but there was not a statistically significant correlation between FVL and prothrombin gene mutations and preeclampsia [13]. Likewise, in the

prospective study by Said et al., although a correlation was found between FVL mutation and ablation placenta and stillbirth, no correlation was found with preeclampsia [14]. In a study where Deveer et al. compared 50 patients developing severe preeclampsia and 50 healthy control group, they found FVL mutation carrying at a similar rate and stated that there was not any correlation between thrombophilia and severe preeclampsia [15]. In a study where Kjelberg et al. compared 491 pregnant cases having FVL mutation with 1055 healthy pregnant cases, there was not any correlation between adverse pregnancy outcome and FVL mutation [16].

Among the hereditary thrombophilic factors, we researched the relationship between Protein C activity, protein S activity, antithrombin III, factor V Leiden mutation, prothrombin gene mutation and MTHFR gene mutation's and bad obstetric history in our study.

According to the results we obtained regarding Factor V Leiden gene mutation, there was no homozygous gene mutations in either groups, but the rates of heterozygous Factor V Leiden gene mutation in the study and control groups were 12% and 1.3% respectively. The rate of heterozygous gene mutation detection in cases with fetal loss was 8.3 times more (OR 8.3, 1.04- 66). Based on this statistically significant ratio, we determined that Factor V Leiden gene mutation played an important role in the aetiology of recurring losses of pregnancy and late-onset pregnancy complications.

In our study, the rate of heterozygous prothrombin gene mutation in the study and control groups were determined to be 9.4% (n=10) and 3.7% (n=3). The difference was not statistically significant (p=0.2). The homozygous form of the prothrombin gene mutation was detected in 1 case only in the study group (0.94%) and 0 cases in the control group (0%) (p=0.88). Reznikoff et al. determined the rate of prothrombin G 20210A mutation to be significantly higher in the study group in their study done on 260 cases with recurring losses of pregnancy under the 10th gestational week and 240 control cases (2,7 (% 95 CI 1-7)) [17].

MTHFR gene mutation is more frequently detected in the population as compared to the other gene mutations. In Foka. Et al's study, the detection rate of MTHFR C677T homozygous mutation in the study and control groups were 8% and 15% respectively, therefore they reported that MTHFR mutation could not be a factor in recurring losses of pregnancy [18]. In a similar study done by Pauer et. al, they determined the rate of MTHFR homozygous gene mutation to be 14% and 12% in the study and control groups, not finding a statistically significant difference between the two [19]. In our study, the rate of heterozygous MTHFR gene mutation was determined to be 46.2% and 40.7% in the study and control groups respectively, revealing a statistically insignificant difference (p=0.5). The rates of homozygous MTHFR gene mutations in the study and control groups were 11.3% and 3.7% respectively and a significant difference was found (p=0.049, OR=3.3). It was seen that the possibility of detecting a homozygous MTHFR mutation was 3.3 times more in the study group than in the control group.

As a result of the analyses on MTHFR gene mutation, it was deduced that the heterozygous form was not clinically significant in terms of pregnancy complications, but the heterozygous form could take on an important role in their development.

Protein S activity decreases by 40-60% as compared to normal in the first trimester of pregnancy and remains low during the rest [20]. Despite this normal decrease during pregnancy, in our study, the mean Protein S activity of the study group was determined to be much lower than that of the control group. In Kupferminc's study in Israel, published in 2000, the study group was comprised of the severely preeclamptic only and the blood for the detection of Protein S activity was drawn after the

second postpartum month, Protein S deficiency was determined to be significantly higher in the study group as compared to the control group [21].

In our study the mean Protein S and Protein C activities of the control group were 95.7 ± 17.5 and 94.8 ± 19.4 respectively. The same parameters for the study group were 74.2 ± 0.29 and 86.9 ± 0.23 respectively. The distinct difference in between was statistically significant for both parameters ($p < 0.0001$, $p < 0.0001$). The two groups were compared in terms of Protein S and C activities $< 65\%$ and There was a statistically significant difference in values under 65% (p values for both parameters are $P = 0.0003$ and $P = 0.000074$ respectively). In cases with fetal loss, the detection rate of Protein C levels $< 65\%$ was 5.2 times more (OR 5.2 2.7-12.49), and the Protein S activity was 12.17 times higher than the control group.

There are conflicting explanations regarding antithrombin III levels in severe preeclampsia. Osmanoglu et. al reported that antithrombin III deficiency might be used in the prediction of the prognosis and clinical monitorization in preeclampsia [22].

In the study of Ramalakshmi et al., the mean antithrombin III value was determined to be significantly lower in the group with gestational hypertension [$0.76 (0.233)$ IU/ml; $0.97 (0.234)$ IU/ml] and low levels of antithrombin III were found to be related to bad pregnancy outcomes [23].

The results of our study are not coherent with the literature. The mean antithrombin III values in the study and control groups are 96.9 ± 0.15 and 98.3 ± 20 respectively, without a significant difference ($p = 0.47$). In the comparison between the study and control groups with a cut off value for Antithrombin III activity of 75% a significant difference was not detected (p values are $p = 1.0$).

Scanning women with positive thrombosis conditions in their personal or family histories for FV Leiden and Prothrombin gene mutations is important in the prevention of pregnancy complications. Although thrombophilia has an important role in the etiology of early losses of pregnancy (especially in recurring cases), we do not have enough data to add thrombophilia to the initial evaluation tests for early pregnancy loss. In cases with recurring loss of pregnancy, late pregnancy complications (IUMF, preeclampsia and complications) and positive history of thrombosis, evaluation of the thrombophilic base will prove beneficial in terms of both diagnosis and treatment.

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SERVICE QUALITY IN HEALTHCARE SERVICES: AN APPLICATION IN PRIVATE DENTAL CLINIC

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Abstract: *At present, succeeding and competing of the health institutions substantially based on the quality service provided. It is seen that the studies on measuring the quality of health services gradually increase in recent years. This research was conducted in a private dental clinic in İstanbul between the dates of 15th June 2014-15th August 2014 for the purpose of measuring the quality of the health services that they perceived or expected. Our study is composed of totally 200 patients who applied to the clinic during the investigation period and accepted to attend to the study as well. The questionnaire form has two parts. The questions about the socio-demographic features are in the first part, questions of SERVQUAL Service Quality Scale are in the second part. The data obtained from the research are subjected to reliability analysis, and all the sub-dimensions of the scale is found as high-level reliable. Attendees' point averages of Tangibles, Reliability, Responsiveness, Assurance, Empathy and General Service Quality SERVQUAL are found as high when the Expected and Perceived Quality levels of them are considered. It is determined when being reviewed the SERVQUAL point averages after getting the clinic service that they left with the perception more than expected.*

Key words: *Healthcare Services, Quality of Service, SERVQUAL Scale*

1. Introduction

Becoming the sense of quality more significant in our country day by day has pretty much affected the health sector as well. Similarly, the health care services that are privatized from the government monopoly have turned into a great competition environment for both the patients who have ever increasing pickiness and the patient relatives. Expectations of the patients from the health facilities gradually multiplying and studies have done to meet these growing expectations. Health facilities continuously need to be in a struggle for improving the quality of their services. The purpose of the institution during this process should always be gaining profit by considering the employee satisfaction as well as providing benefit to the society. In other words, the relationship of the effective employee, quality service, and satisfied customer needs to emerge.

Since the service is not presented as a product, evaluating the service is just be possible by measuring the perceptions of the people get the service. Determination of the perceptions of the customers about the service comes into prominence to evaluate the services given in health facilities. This study was performed to measure the quality of the service expected/perceived in health care services.

1.1. Service and Service Quality Concepts

It is possible to see different definitions of the service when the related literature is reviewed. Service is the abstract products that are produced for the purpose of meeting the requests and expectations of the customers [1]. In the other definition, services are the abstract efforts that are identifiable and sufficient to meet the demands of the consumers as the chief goal or the factor of an activity [2]. With reference to the statement of Devebakan and Aksaraylı [3], ‘Service is performing a work for anybody else’. After all, the services are a whole of abstract activities that generate benefit and satisfaction, cannot be standardized, are intangible and put on the market by a certain price to satisfy the needs of individuals or communities [4].

Service can be analyzed under two main titles as ‘material service and person service’. Service’s easiest side to measure and compare is the material. It is not possible to render a good personal service in case of there is no good service. However, even if the quality of the material service is pretty high, the impression of the service on the customers is neutral when the personal service is not quality. On the other hand, the title that gives a good impression on the customers and enhances the quality is the good personal service. Accordingly, the service can be defined as the whole of abstract activities that create benefit and satisfaction, do not necessitate the property of any asset and also the activities put on the market by a certain price to satisfy the needs of people or communities [5].

Even though there are quite a change features differentiate the service concept from good/product concept, the services have four key features have specific characteristics. These are; being abstract, being non stockable, being heterogeneous, consumed in the minute that it is produced [6]. Much as the health facilities produce the goods, the health facilities are the enterprises produce healthcare services in general terms. When considered from this point of view, the quality assessment of healthcare services has importance because of both the difficulty of measuring the service quality and the characteristics of the healthcare services.

The service quality has started to be defined by the explanations started with Adam Smith and continued with Alfred Marshall at the end of the eighteenth century while tangible product-driven studies dominated during the historical development of the quality. The service quality concept that has become significant recently is defined as the ‘strategical value’ for the enterprises [1].

Parasuraman et al. [7] discuss the service quality based on the expectation and perceptions of the customers and defined it as the comparison of the customer expectations and the perceptions. During the service evaluation process, the customers do not only consider the service but also evaluate the presentation phase. This is because one of the main problems in service marketing is to make the service different from the service of the competitors; however, it is pretty hard to actualize it. This differentiation can be provided by adding innovation to the service [6].

According to Odabaşı [8], the broadest definition of the service quality is to render perfect intensified service to meet all the expectations of the customers. Thus, the service quality is also mentioned as meeting and even exceeding the expectations of customers.

The attention shown to the service quality provides an organization to make itself different from the competitors and take lasting advantages in competition. High service quality is the irreplaceable part of the long-term decisions of both the organizations render service and organizations make production. It is accepted in some of the production industries that the service quality is more important than the product quality. Outstanding service quality is not the return of working, it is a key for higher profit margins. Service forms the basis for the next sale [9].

1.2. Quality of Healthcare Services and Quality Assessment

Quality in healthcare services has discussed in different dimensions. With reference to a description, quality is to perform the certain activities to heal or at least to stop a regression as a function of a disease or a state occurs in the physical condition of an individual. With a briefer definition, quality is to perform the correct medicinal implementations so as to give the best result. National Institutes of Health (NIH) defined the quality in healthcare services as the consistency degree of the health care services with the professional knowledge of the modern day and the increase the possibility to reach the desired health outputs from the healthcare services rendered to the individual and the society [10].

There are major differences between the sense of quality in production&service sectors and the sense of quality in health. The production is stopped, the precautions are taken to rectify the mistake and the defective units are put aside if there is a fault in the production process of the industry. The customer profile of the modern day has changed and they demand the quality service. In the service sector, it apologizes to the customer and maybe the customer is loosed; but the measures are taken to not to repeat the same mistake. ‘Sorry!’ is a word that can never be used in health. Even the ‘mistake’ word is not pronounced in this sector [11]. The crucial difference between the healthcare services and the production services is this.

Quality in the health sector has different meanings for different customers in the health sector. All the customer’s sense of quality different from each other need to be considered to create a quality health system. Improvement activities should be performed to do this [12]. These activities hinge upon to the increase in healthcare services, well-determination of the demand and needs of patient and customers, reinforcement the technical services by utilizing the available sources, analyzation the data used in decision mechanism and selection the proper solutions. Enhancing the customer satisfaction and bringing down the costs should be grounded on when the quality works are performed. Moreover, facing the problems head-on is an uphill task requires to work together.

This difficulty happens based on managing, measuring and defining the quality, and also the multidimensional structure of the quality. Customers use healthcare services’ definitions and measurements when evaluating the organizations render healthcare services [13]. In this regard, Donabedian defined the quality of health care services as ‘the service should maximize the general well-being of the patient after calculating the gains and loses ‘[14].

All the factors in healthcare services constitute the service are obliged to get in a wholistic harmony. In sanitation, existing a powerful management model and organization and being known of the person who performs the work, the pace where the work is performed, the tools and methods which are used to perform the work are significant to reach and apply the quality [15]. Because the quality of health is an inevitable fact in terms of the modern enterprises by reason of the increasing competition and communication, educational level, humanitarian approaches.

There are basically two types of approaches in quality evaluation in healthcare services. The technical quality is evaluated in the first approach. Quality in technical meaning is the appropriateness of the services to the scientific norm and standards. Scientific norms are the common views about the inputs used by healthcare professionals during the service rendering process, production process and the results. The essential one of the approaches used in evaluating the technical quality of the service is 'Structure-Process-Outcomes' approach that was developed by Donabedian. Structure means the general features (building, equipment, human resources, organizational structure, etc.) of the health organizations render services. The process factor is for the production and focusing on the activities performed during the production and presentation of the service. Outcome means the effect of the services given on the health status of the patients and the society [14]. Another approach used in evaluating of healthcare service quality is being evaluated the services by the patients themselves [1]. According to Parasuraman, Zeithaml and Berry who developed a conceptional service quality model by bringing a broad perspective to the service quality fact, the perceived service quality is a result of the direction of customers' perceptions occurred during the service presentation towards the service performance [7]. 'Expected service quality' means the desires or demands of the customers from the service they take [16]. SERVQUAL model is the commonly used method to measure the quality that is expected and perceived by the patients in healthcare services [17]. The base of the SERVQUAL model is based on actualizing the expected service of the customer by the business executives by perceiving and also comparing the service provided with 'perceived service' by the customers [1].

2. Material and Methods

The purpose of this research was to determine the level of perceived-expected service quality in healthcare services. This survey was conducted in a Private Dental Clinic in Yenibosna District of İstanbul Province between June 15, 2014 - August 15, 2014. The survey would be applied on 310 patients applied to the clinic within those days, but totally 200 patients who gave verbal approval generated the sample of the research because of the reasons such as being undesirous to fill out a questionnaire and spare time.

In this research, the questionnaire was used as the data collection tool. The questionnaire was filled in by the clinic's auxiliary staff by the face to face meeting method. There are three parts to the survey. The first part includes the socio-demographic questions on the patients; the second part has the questions on the expectations of the patients from the dental clinics; the third part measured the perceptions about the dental clinic they got the service. The surveys were applied in two stages. The patients filled in the first and second part before the treatment, the third part was filled in after the treatment. SERVQUAL Service Quality Scale developed by Parasuraman, Zeithaml, and Berry [7] was used to measure the perceived/expected service quality. This scale was adapted to the hospital services by Babakus and Mangold [18] and translated into Turkish by Devebakan [19].

SPSS 18.0 packaged software analyzed the data obtained. Average, percentage, Student t-test, and One Way ANOVA tests were used to analyze the data. The data obtained from the research were put to reliability analysis, all the sub-dimensions of the scale were found as a high degree of reliable (Table 1). The findings were evaluated in 95% confidence interval and in 5% significance level.

Table 1. Cronbach's Alpha Reliability Coefficients

Sub-Dimensions	Expected	Perceived
Tangibles	0,873	0,895
Reliability	0,914	0,931
Responsiveness	0,894	0,828
Assurance	0,868	0,896
Empathy	0,863	0,872
Total	0,904	0,911

3. Results

200 patients who applied to a private dental clinic in Yenibosna District of İstanbul Province attended to this research. Table 2 shows the findings relating to the sub-dimensions of expected/perceived service quality with the socio-demographic features of the participants. It is seen when looking at the age groups of the attendees that the general run of them is in 36-45 (28%) age group, 21,5% of them is in 26-35 age group and 20% of them is in 18-25 age group. The greater part of the attendees consists of females (52%). About the marital status, 67,5% of them are married. About the educational background, 32% of them is the primary school graduate, 31% of them is the bachelors. The high-school graduates follow them with 28,5%. It is found when the professions are analyzed that 30,5% of the participants are freelancers, 26% of the is the workmen. The general run (82,5%) of the participants has health insurance. The highest ratio of the monthly income levels is between 1001-2000 TL (Turkish Lira) as 42,5%. 41,5% of the attendees chose that clinic at the recommendation. 27,5% of them chose that clinic because of the familiar medical personnel, 12,5 of them chose that clinic because of the relative personnel.

In the expected service level, statistically significant differences ($p < 0.05$) were found between educational background and reliability, readiness, empathy and general service quality; occupational groups and reliability, readiness, health insurance with the physical properties; income level and the reliability; reliability and the reason to choose that clinic, readiness and empathy dimensions. About the perceived service level, statistically significant differences ($p < 0.05$) were found between educational background and physical features, reliability, readiness, trust and general service quality; occupational groups and reliability, readiness, empathy and general service quality; health insurance and trust; income level and the physical properties, reliability, readiness, trust and general service quality; the reason to choose that clinic and the reliability dimensions. No statistically significant difference ($p > 0,05$) was found between age, gender and marital status with the expected/perceived service quality dimensions (Table 2).

Table 2. Socio-Demographic Charasteristics of Participant’s and Expected/Perceived Service Quality Findings

Variables	n (%)	Expected						Perceived					
		Tangibles	Reliability	Responsive-ness	Assurance	Empathy	Total	Tangibles	Reliability	Responsive-ness	Assurance	Empathy	Total
Age													
18-25	40 (20)	4,45±0,45	4,43±0,46	4,42±0,49	4,58±0,45	4,31±0,51	4,44±0,41	4,59±0,36	4,63±0,38	4,61±0,46	4,77±0,36	4,53±0,54	4,63±0,34
26-35	43 (21,50)	4,48±0,66	4,31±0,54	4,45±0,52	4,55±0,63	4,21±0,62	4,40±0,51	4,6±0,56	4,57±0,48	4,56±0,51	4,7±0,41	4,48±0,68	4,58±0,45
36-45	56 (28,00)	4,58±0,4	4,42±0,49	4,49±0,45	4,62±0,41	4,34±0,53	4,49±0,41	4,66±0,4	4,62±0,38	4,66±0,42	4,77±0,31	4,52±0,52	4,65±0,34
46-54	34 (17,00)	4,41±0,44	4,38±0,47	4,46±0,43	4,55±0,42	4,38±0,55	4,43±0,39	4,7±0,42	4,68±0,39	4,64±0,44	4,68±0,4	4,45±0,56	4,63±0,38
>55	27 (13,50)	4,41±0,42	4,22±0,48	4,17±0,50	4,39±0,47	4,10±0,48	4,26±0,41	4,67±0,35	4,43±0,46	4,50±0,45	4,64±0,41	4,40±0,52	4,53±0,37
p**		0,404	0,370	0,078	0,436	0,253	0,253	0,809	0,203	0,573	0,467	0,895	0,713
Gender													
Female	104 (52,00)	4,49±0,44	4,37±0,47	4,42±0,46	4,60±0,41	4,27±0,52	4,43±0,41	4,66±0,35	4,63±0,39	4,63±0,44	4,72±0,37	4,48±0,53	4,62±0,36
Male	96 (48,00)	4,47±0,53	4,36±0,51	4,42±0,51	4,50±0,55	4,29±0,58	4,41±0,47	4,62±0,50	4,55±0,45	4,58±0,47	4,73±0,37	4,49±0,60	4,59±0,39
p*		0,839	0,991	0,954	0,151	0,749	0,762	0,474	0,174	0,494	0,883	0,838	0,586
Marital Status													
Married	135 (67,50)	4,52±0,45	4,44±0,46	4,52±0,38	4,61±0,47	4,45±0,51	4,51±0,4	4,72±0,34	4,71±0,35	4,66±0,43	4,72±0,39	4,45±0,53	4,65±0,34
Single	65 (32,50)	4,38±0,56	4,27±0,52	4,34±0,56	4,44±0,57	4,2±0,55	4,32±0,48	4,54±0,49	4,47±0,45	4,48±0,5	4,59±0,43	4,43±0,5	4,5±0,41
p*		0,120	0,240	0,06	0,092	0,308	0,063	0,052	0,599	0,138	0,320	0,748	0,210
Educational Status													
Illiterate	17 (8,50)	4,31±0,38	4,13±0,40	4,10±0,42	4,35±0,42	3,96±0,49	4,17±0,35	4,63±0,40	4,55±0,42	4,41±0,48	4,59±0,45	4,34±0,52	4,50±0,39
Primary	64 (32,00)	4,38±0,59	4,24±0,53	4,29±0,51	4,38±0,59	4,18±0,51	4,29±0,48	4,50±0,54	4,45±0,46	4,45±0,51	4,58±0,44	4,39±0,52	4,47±0,43
High	57 (28,50)	4,57±0,45	4,43±0,47	4,52±0,46	4,62±0,44	4,39±0,51	4,51±0,40	4,65±0,37	4,59±0,38	4,63±0,44	4,72±0,35	4,53±0,48	4,62±0,32
University	62 (31,00)	4,56±0,40	4,50±0,46	4,54±0,44	4,72±0,33	4,37±0,59	4,54±0,37	4,78±0,30	4,77±0,34	4,80±0,30	4,91±0,17	4,59±0,67	4,77±0,28
p**		0,084	0,003	0,0001	0,0001	0,007	0,0001	0,004	0,0001	0,0001	0,0001	0,150	0,0001

p*: Student’s T-Test, p**: One Way-Anova Test

Table 2. (Cont) Socio-Demographic Characteristics of Participant's and Expected/Perceived Service Quality Findings

Variables	n (%)	Expected						Perceived					
		Tangibles	Reliability	Responsive-ness	Assurance	Empathy	Total	Tangibles	Reliability	Responsive-ness	Assurance	Empathy	Total
Occupation													
Worker	52 (26,00)	4,58±0,4	4,41±0,43	4,45±0,41	4,61±0,37	4,29±0,46	4,47±0,35	4,66±0,39	4,63±0,39	4,68±0,4	4,83±0,25	4,55±0,54	4,67±0,31
Officer	29 (14,50)	4,57±0,4	4,46±0,52	4,51±0,46	4,72±0,36	4,31±0,67	4,51±0,41	4,83±0,3	4,77±0,35	4,75±0,36	4,9±0,18	4,56±0,8	4,76±0,31
Retired	25 (12,50)	4,39±0,53	4,33±0,56	4,28±0,51	4,47±0,57	4,28±0,58	4,35±0,51	4,56±0,43	4,57±0,48	4,61±0,44	4,67±0,41	4,56±0,48	4,59±0,37
Self-employment	61 (30,50)	4,33±0,47	4,28±0,44	4,17±0,45	4,41±0,43	4,12±0,4	4,26±0,38	4,54±0,41	4,54±0,44	4,5±0,51	4,63±0,41	4,59±0,47	4,56±0,4
Housewife	33 (16,50)	4,58±0,4	4,42±0,49	4,49±0,45	4,62±0,41	4,34±0,53	4,49±0,41	4,66±0,4	4,62±0,38	4,66±0,42	4,77±0,31	4,52±0,52	4,65±0,34
p**		0,697	0,001	0,011	0,168	0,347	0,064	0,212	0,007	0,005	0,205	0,0001	0,005
Health Insurance													
Yes	165 (82,50)	4,52±0,42	4,38±0,49	4,45±0,47	4,58±0,43	4,3±0,56	4,45±0,41	4,67±0,39	4,6±0,41	4,63±0,45	4,75±0,35	4,48±0,57	4,63±0,36
No	35 (17,50)	4,31±0,7	4,28±0,5	4,28±0,52	4,43±0,69	4,19±0,49	4,3±0,5	4,51±0,58	4,56±0,45	4,5±0,49	4,6±0,45	4,51±0,53	4,54±0,44
p*		0,019	0,240	0,060	0,092	0,308	0,063	0,052	0,599	0,138	0,032	0,748	0,210
Income Level (monthly)													
500-1000 TL	29 (14,50)	4,52±0,45	4,44±0,46	4,52±0,38	4,61±0,47	4,45±0,51	4,51±0,4	4,72±0,34	4,71±0,35	4,66±0,43	4,72±0,39	4,45±0,53	4,65±0,34
1001-2000 TL	85 (42,50)	4,38±0,56	4,27±0,52	4,34±0,56	4,44±0,57	4,2±0,55	4,32±0,48	4,54±0,49	4,47±0,45	4,48±0,5	4,59±0,43	4,43±0,5	4,5±0,41
2001-4000 TL	56 (28,00)	4,58±0,4	4,41±0,43	4,45±0,41	4,61±0,37	4,29±0,46	4,47±0,35	4,66±0,39	4,63±0,39	4,68±0,4	4,83±0,25	4,55±0,54	4,67±0,31
>4000 TL	30 (15,00)	4,57±0,4	4,46±0,52	4,51±0,46	4,72±0,36	4,31±0,67	4,51±0,41	4,83±0,3	4,77±0,35	4,75±0,36	4,9±0,18	4,56±0,8	4,76±0,31
p**		0,066	0,156	0,178	0,022	0,197	0,058	0,01	0,002	0,01	0,0001	0,559	0,003
Reasons for Preference													
Advice	83 (41,50)	4,54±0,55	4,43±0,52	4,48±0,52	4,6±0,55	4,35±0,56	4,48±0,47	4,68±0,49	4,67±0,4	4,65±0,47	4,74±0,4	4,53±0,58	4,65±0,41
Acquaintance	55 (27,50)	4,5±0,4	4,38±0,44	4,44±0,43	4,53±0,41	4,34±0,48	4,44±0,36	4,63±0,37	4,6±0,36	4,65±0,4	4,75±0,34	4,4±0,5	4,61±0,3
Availability	9 (4,50)	4,39±0,53	4,33±0,56	4,28±0,51	4,47±0,57	4,28±0,58	4,35±0,51	4,56±0,43	4,57±0,48	4,61±0,44	4,67±0,41	4,56±0,48	4,59±0,37
Emergency case	19 (9,50)	4,33±0,47	4,28±0,44	4,17±0,45	4,41±0,43	4,12±0,4	4,26±0,38	4,54±0,41	4,54±0,44	4,5±0,51	4,63±0,41	4,59±0,47	4,56±0,4
Closeness	25 (12,50)	4,33±0,39	4,06±0,43	4,26±0,46	4,48±0,42	3,87±0,56	4,2±0,35	4,62±0,38	4,29±0,48	4,32±0,45	4,6±0,35	4,34±0,74	4,43±0,37
Other	9 (4,50)	4,67±0,48	4,69±0,41	4,83±0,25	4,86±0,22	4,72±0,44	4,75±0,31	4,78±0,38	4,89±0,19	4,83±0,33	4,94±0,11	4,72±0,49	4,83±0,29
p**		0,212	0,007	0,005	0,205	0,0001	0,005	0,697	0,001	0,011	0,168	0,347	0,064

p*: Student's T-Test, p**: One Way-Anova Test

The perceived point averages in all the sub-dimensions and general service quality were found as statistically higher ($p < 0,05$) than expected point averages (Table 3).

Table 3. Averages and Comparisons Expected/Perceived Service Quality Levels

Sub-Dimensions	Expected	Perceived	t	p
Tangibles	4,48±0,49	4,64±0,43	5,44	0,001
Reliability	4,37±0,49	4,60±0,42	8,03	0,001
Responsiveness	4,42±0,49	4,60±0,46	5,62	0,001
Assurance	4,55±0,48	4,72±0,37	5,87	0,001
Empathy	4,28±0,55	4,49±0,57	4,88	0,001
Total	4,42±0,43	4,61±0,37	8,09	0,001

4. Discussion

About the expected and perceived service quality levels of the participants, SERVQUAL point averages of physical features, reliability, readiness, trust, empathy, and general service quality were found as high. It is determined when analyzing the SERVQUAL point averages perceived after getting clinical service that they left with perception more than the expectations. According to the observations of this research conducted in a private dental clinic, the expectations of the patients on the patient-centered clinical method's main components are high; the expectations of the patients were largely met. This situation may be explained by the high ratio of the patients applied at the recommendation (41,5%) and via familiar health personnel (27,5%)

It is determined in the research of Harput [20] about the patients stayed in a university hospital that the expected service quality is higher than the perceived service quality. Similarly, Adebayo et al.[21] conducted a study on the patients applied to a dental clinic of a hospital in Nigeria and John et al [22] performed a survey of patients in a public dental health institution. At the end of both the studies, the expectations of the patients were higher than the perceptions.

With reference to the study of Perron et al., about the perceptions of the doctors about the expectations of the patients migrated from different countries to a region of Switzerland, the doctors remain incapable to perceive the expectation of the patients and again the same doctors perceive non-existent patient expectations as present [23].

In a research of Hooper et al., that was conducted to review the consensus of the patient and doctor about whether the patient's expectations are satisfied, there is a consensus about the prescribing and referring. In spite of that, there is not a consensus on demanding tests, making suggestions, explaining the complaints and supporting [24].

Similar results have been obtained in other studies about the healthcare services. In contrast to the results of this research, the perception levels of the patients are lower than the expectations about the quality of healthcare services [3], [25]. This circumstance can be explained by the place where the work is done is a private dental clinic, recommendations and the patients who are the regular customers.

The services given to health organizations are intrinsically open to the mistakes and negative results. Each of the patients applied to those organizations may not back to health completely. Even the worse results may occur sometimes. The adverse outcomes are inevitable in some situations while they stem from the violations of rights. These violations in hospitals are rooted in different reasons. Insufficiency and mistakes of the health system are one of those reasons. Other significant reasons for the violations in health organizations are the problems arising from the patients and healthcare personnel. Patients' slushiness stemming from the physical condition, lack of knowledge on health field and rights, prejudice to the health system and personnel can be given as the examples for the violation of rights arising from the patients. The factors such as modern equipment, the attitude of the dentist and auxiliary staff, quality of treatment, pain control, waiting time, accessibleness of the dentist, the time spared for the treatment are the components affect the patient satisfaction. The patient satisfaction needs to be thought as same with the customer satisfaction in each of the sectors in today when the human rights have been understood better. The institution and organizations give health service should degrade the quality management policy that is used to review the patient satisfaction to the units and doctors. Even though measuring and evaluating the patient satisfaction is pretty difficult, increasing competition, educational background, and the communication are the inevitable situations of our century in terms of the health sector.

5. Conclusion and Suggestions

In the competitive environment of the modern day, the business target to survive and make good have centered upon the service concept. The factors such as increasing the share of the service sector in production, technological advancements, increase in welfare level, and the close relationship between the customer satisfaction and service quality play a crucial role in being popular of the service concept.

Being the service abstract, dynamic and unstackable, not to make quality evaluation before the presentation, being much of the human factor in the service, the difficulty of standardizing, supplying to the degree of demand and other structural characteristics complicate the customer satisfaction for the enterprises aim to reach the service quality to provide pleasure and focus on the service concept that has become more important day by day.

To ensure and develop the service quality in the health sector like all the sectors is an essential strategy for the business want to achieve the success and provide continuity in the competition environment.

It has remained faithful to the original scale of Parasuraman, Zeithaml, and Berry in terms of being the research subject in a private dental clinic. This study was applied to the patients in a private dental clinic and the sample of the research was composed of 200 people. Servqual scale was used to measure the expected and perceived quality level relating to the services of the private dental clinic and to analyze the relationship of the service quality with the demographic and social characteristics of the patients. Expected and perceived service quality points and also the service quality dimension points of the clinic were computed by

analyzing the data. It is determined when reviewing the SERVQUAL point averages of the patients after getting clinical service that they left by perception more than the expectation.

In the light of the results obtained, below suggestions can generally be made to private dental clinics to render efficient and quality health care services;

- It must be paid attention to rendering the services promised on time.
- The doctors should speak the language that the patients understand about the physical conditions, they should ask patients' opinion and encourage them to participate in the decisions.
- Clinics need to work for increasing the knowledge level of the patient relating to the treatment if they want to completely satisfy the patient.
- Patient satisfaction investigations ought to be made consistently and as standard. The reasons that decrease the satisfaction and cause to dissatisfaction should be determined at the end of the investigations, the required service improvements should be actualized. The quality policies and standards need to be created as well.
- The improvements on the presentation of health services ought to be standardized.
- The patients come to meet the doctors by some expectations. Also, they can the issue about whether these expectations are satisfied at the end of the meeting.
- Customer satisfaction investigations should be done with the customer expectation studies. It needs to determine the expectation level where the satisfaction result occurred and the quality level of the clinic should be specified based on this finding.
- It should be provided the personnel to get training so as to be respectful, polite and helpful to the patients.
- The desires of the patients need to be considered as long as complying with medical science and within the frame of the ethical rules. An approach to patient-centered ought to be adopted in the doctor-patient relationship.
- Constructing the profiles of customers of the clinic is the way of starting to increase the patient satisfaction in dental clinics.
- The problems of the health sector need to be scheduled and the satisfaction and complaints of the patients and the features of the health services should be analyzed well to reach 100% success.
- An efficient appointment system should be developed and the waiting times of the patients need to be shortened.
- The physical equipment of the dental clinic ought to be new and in conformity with the requirements of the century.

Same research and the similar studies may be repeated with more participants and the longer period to increase the generalizability of the findings. As the subject of a next study, the foremost service dimension that is accepted by the patients can be revealed by comparing these findings with the analyses of other clinics. Thus, it is possible to lead the way for clinics that will be opened for the first time and also the clinics which will enter into the process of renewal about the issues need to be considered.

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**PSYCHOSOCIAL AND BEHAVIORAL PREDICTORS FOR PREVENTION OF
OBESITY AMONG ADOLESCENTS: A TRANSTHEORETICAL MODEL
PERSPECTIVE**

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Abstract: *To predict demographic, psychosocial, and behavioral variables specific to each stage by determining the stages of change of dietary behaviors of adolescents within the framework of Transtheoretical Model (TTM) and thus to guide for interventions make adolescents ready for next stage of change. A descriptive, cross-sectional design was used in the study. The students aged between 10-12 and selected indicators. Separate multivariate logistic regression models were created to determine the readiness of adolescents to make changes in dietary behaviors. Of the adolescences, 89.5% were in the Preparation, Action and Maintenance stages. In the Contemplation stage, father education and mother Body Mass Index (BMI); In Preparation, mother BMI, dietary knowledge and dietary self-efficacy; In Action, adolescent BMI, dietary knowledge and stress management were able to predict the later stage of promoting behavior change. In the Maintenance stage the sex, adolescent BMI, dietary knowledge, dietary behavior, dietary self-efficacy, stress management and social support were able to predict the maintenance of promoting health. TTM was useful to evaluate and predict health behaviors of adolescents. Except for exercise behavior, all of the determinants predicted the later stage for promoting behaviors. Female adolescents were more likely to be ready to make changes.*

Keywords: *adolescents, obesity, nutrition, predictors, school nursing, transtheoretical model.*

1. INTRODUCTION

Over the last 30 years, the prevalence of obesity has increased two times among children and three times among adolescents in the world [1]. In developed countries, 1% of children become overweight every year [2]. In Turkey, 14.3% are overweight and 8.2% are obese among 6 and 18 year-old children and adolescents [3]. Obesity is a predictor of chronic diseases like diabetes, cardiovascular disorders, ischemic heart disease, and cancer for adolescents who will suffer from these diseases in their adulthood period [2-4]. Therefore,

early diagnosis and prevention of obesity take a high priority, which keeps the search for the most effective interventions which will enable adolescents to acquire the habits of healthy life.

Numerous factors may influence the dietary behaviors of adolescents. On the other hand, biochemical, genetic, socio-cultural, and psychological factors affect the prevalence of obesity [5-6]. CDC (2014) points out that poor dietary behaviors such as eating of low-quality foods containing significant amount of salt, sugar, and fat and consumption of soft and carbonated drinks, as well as insufficient levels of exercise and stress are among the most important causes of obesity at younger ages [2]. On the other hand, fruit and vegetables (FV) help to reduce the risks for many illnesses such as cardiovascular diseases, diabetes, obesity, and some types of cancers [5-7]. Adolescents with high dietary self-efficacy perception levels consume lower fat and less sugary foods, as well as foods that are good for health promotion [8-9].

It is recommended to consume five servings of vegetables and fruit a day to maintain a healthy diet and ideal weight [2]. Acquiring the habit of eating vegetables and fruits in early life is an important indicator of the consumption of vegetables and fruits in adulthood. Vegetables and fruits contain antioxidants, folate, fiber, potassium, which help protect against cardiovascular diseases. They are rich in fiber and water, help reduce appetite, lower calories. For these reasons, especially for obesity prevention and healthy nutrition, the group of vegetables and fruits should be handled separately and emphasized [5-7].

Insufficient exercise behaviors are the fourth most common of global deaths [2]. According to the WHO (2014)'s report, it is necessary for healthy development of adolescents to perform minimum 60 minutes of moderate- or high-intensity physical activities for five days a week [4]. It is also reported that such exercise contributes to physical, mental, and social development of adolescents. Previous studies revealed that TTM stage-based interviews conducted with adolescents increased their exercise behaviors and were effective on their weight control [1].

Psychosocial problems prevent the development of good dietary behaviors. The studies have revealed that obesity is higher among adolescents experiencing psychosocial and behavioral problems [10]. A stressful life may lead to impaired quality of life and nutrition among adolescents. In general, stress management skills and a social support system help them to adopt positive health behaviors more easily [11]. Moreover, the level of perceived social support is a powerful source to prevent and solve social and psychological problems and cope with stressful situations [12]. In this regard, nursing interventions concerning dietary knowledge and behaviors, dietary self-efficacy, exercise behaviors, stress management, social support, and background characteristics may provide benefits for school-age children to develop food habits.

The TTM offers a conceptual explanation about the processes experienced when individuals alter a problematic behavior or get a positive behavior. Its structure consists of three stages: "stages of change", "process of change", and "level of change" [13]. In this study, the stages of change of TTM were employed as a theoretical scope. The structure of the stages of change includes 5 stages: pre-contemplation, contemplation, preparation, action, and maintenance. These stages explain a process which takes place starting from the moment

when a problematic health behavior is discovered and continues with the change of this behavior up to the point where this behavior is exhibited positively [13]. The studies have reported that stage-based multiple interventions affect behavioral change that prevents and reduces obesity among adolescents [13-14-15-16].

This study was conducted primarily to predict demographic, psychosocial, and behavioral variables specific to each stage by determining the stages of change of dietary behaviors of adolescents within the framework of TTM and thus to guide for interventions make adolescents ready for next stage of change.

2. MATERIAL AND METHOD

2.1 Participants

The study was conducted with the descriptive and cross-sectional research design. This school-based study included 530 fifth-grade students (260 females and 270 males) aged between 10 and 12 years in five secondary schools located in Uşak, Turkey as well as their parents. The sample of the study consisted of the fifth-grade students ($n=2993$), who did not have any chronic disease and agreed to participate in the study, selected by using the stratified random method. The sample size was calculated with the power analysis ($\alpha: 0.05, 1-\beta = 0.80$). According to stratum weight, the sample included 380, 115, and 35 students from a state school, a religion-affiliated school and a private school, respectively. A random number table was used to select the students from the strata. The study was conducted between January and December 2014. The Transteoretic Model suggests that the behavior change process consists of five distinct and sequential stages [13]. It provides a framework for evaluating the beliefs (self-efficacy) of individuals when they are ready for change (change stages), how they perceive the positive and negative effects of change of behavior (decision making), and their behavior. One of the basic components of the transtheoretical model is the change phases, which represent the time dimension of the model and consist of five steps. The change phases that make up the core structure of the TTM consist of a single question with five options. The amount of time consumed by those who consume 5 servings of fruit and vegetable per day (one month or six months), and those who do not consume the intent and time to start in this regard.

The students filled the measurement tools independently and could ask questions. The height and weight measurements of the students were performed. A Family Information Questionnaire was sent in a closed envelope to the parents.

2.2. Questionnaire Forms

2.3. Family Information Questionnaire

This questionnaire was prepared by the researchers upon the literature review. It included the adolescents' age, gender and BMI values and parents' educational status, income status, and BMI values. In terms of age and gender, the children were categorized as underweight (<5 p.), normal (5-85 p.), overweight (85-95 p.), and obesity or obese (>95 p.) based on BMI (kg/m^2) reference values published by Bundak et al. (2006) for Turkish children [15]. BMI values of the parents were calculated based on weight and height values reported by them. Their educational status was specified as (1) low (≤ 5 years), (2) moderate

(6–11 years), and (3) high (≥ 12 years), and their income status was graded as (1) high, (2) middle, and (3) low.

2.4. Stages of Change for Fruit and Vegetable Intake

This questionnaire was prepared based on five stages of change included in the Transtheoretical Model. Its aim is to measure the fruit and vegetable intake behaviors of adolescents. These five stages are (1) Precontemplation, in which an individual may or may not be aware that a behavioral change is warranted and has no intention of changing own behaviors within the next 6 months; (2) Contemplation, in which an individual is aware that a change is warranted and is intending to change own behaviors within the next 6 months; (3) Preparation, in which an individual is planning to change own behaviors within the next 4 weeks; (4) Action, which begins the day an individual makes the behavioral change and lasts until he or she has maintained the change for 6 months; and (5) Maintenance, which begins after an individual has successfully maintained a behavioral change for 6 months.

2.5. Nutrition Knowledge Scale

This scale was developed to find out the dietary knowledge level of adolescents [17]. It is a three-point Likert-type scale with twenty items. A total score between 1 and 60 points is obtained in the scale. The Turkish validity and reliability study of the scale was conducted by Ardiç and Erdogan (2016); The Cronbach's alpha coefficient of the scale was 0.84 [18]. Its Cronbach's alpha coefficient was determined as 0.70 in this study.

2.6. Diet Behavior Scale: This scale was developed to explore the usual food consumption of adolescents [19]. It includes 14 pictorial items using a forced-choice format indicating a higher fat or sodium food versus a lower fat or sodium food. The total score of the scale ranges from -14 to +14. The total score obtained from the scale is shown as a percentage indicating that 0% is unhealthy food consumption and 100% is healthy food consumption. The Turkish validity and reliability study of the scale was conducted by Haney and Erdoğan (2013). Its test-retest reliability was 0.74. Its Cronbach's alpha coefficient was 0.68 [8]. This coefficient was determined as 0.63 in the present study.

2.7. Children's Dietary Self-Efficacy Scale

This scale measures the self-confidence of adolescents, which helps them choose less fatty and salty foods [19]. It is a three-point Likert-type scale with 15 items. The total score is between -15 and +15. A higher score indicates a higher self-efficacy. The Turkish validity and reliability study of the scale was conducted by Haney and Erdoğan (2013) [8]. Its reliability coefficient was 0.79, the test-retest reliability was 0.68; it was found to be 0.77 in the present study.

2.8. Exercise Behavior Scale

This scale assesses the exercise behaviors of adolescents. It is one of seven subscales of the Adolescent Lifestyle Profile (ALP) Scale [20]. It is a four-point Likert-type scale with 6 items. The total score is between 6 and 24 points. The Turkish validity and reliability study of the scale was conducted by Ardiç and Esin (2015). Its test-retest reliability was 0.84 and its Cronbach's alpha coefficient was 0.80. Its Cronbach's alpha coefficient was determined as 0.76 in this study.

2.9. Stress Management Scale

This scale identifies the stress management behaviors of adolescents. It is one of seven subscales of the Adolescent Lifestyle Profile (ALP) Scale [20]. It is a four-point Likert-type scale with 5 items. The total score is between 7 and 20 points. The Turkish validity and reliability study of the scale was conducted by Ardiç and Esin (2015)[21]. Its test-retest reliability was 0.61 and its Cronbach's alpha coefficient was 0.61. Its Cronbach's alpha coefficient was determined as 0.59 in this study.

2.10. Child-Adolescent Social Support Scale

It assesses adolescents' perceptions on social support received from their "mothers", "fathers", "classmates", and "close friends" [22]. This Likert-type self-report scale measures the social support perception at "frequency" and "importance" levels. The scoring ranges from 12 to 72 for frequency and from 12 to 36 for importance. The total score is between 12 and 72 points. The Turkish validity and reliability study of the scale was conducted by Yardımcı & Başbakkal (2009). Its test-retest coefficients were 0.80 and 0.72 and its Cronbach's alpha coefficients were 0.96 and 0.95 for frequency and importance sections of the scale, respectively[12]. In the present study, its Cronbach's alpha coefficient was found to be 0.95 and 0.94 for frequency and importance sections, respectively.

2.11. Ethical Considerations

Before conducting the study, an ethical approval was obtained from the Ethics Committee of Usak University (No: 54749836-050-01-03/11). Uşak Provincial Directorate of National Education for the implementation of the school will be maintained and institutional permission from school administrations. Permission was received from the families to use the "Family Information Questionnaire" which they would fill out. Verbal consents of the children and written consents of their families were received. They were informed that their identities and answers would be kept confidential.

2.12. Statistical Analysis

The data were analyzed by using SPSS for Windows 17.0 (SPSS Inc., Chicago, IL, USA) and the level of significance was accepted as $p < 0.05$. Descriptive statistical methods were used to assess the data of the study (mean, median, number, and percentage). The ANOVA test was performed to reveal the relationships of (ordinal) stage of behavioral change with the independent variables. Moreover, Tukey's HSD test was used to analyze the differences among the sub-variables. The multinomial logistic regression (MLR) analysis was employed to determine demographic (adolescent's age, gender, BMI, income of family, education of parents, and BMI), behavioral (dietary knowledge, dietary behaviors, diet self-efficacy, exercise behaviors), and psychosocial (stress management, social support) data.

3. RESULTS

The average age of the adolescents was 10.85 ± 0.53 . Of the adolescents 50.9% were male and 30% were overweight and obese. The educational levels of the parents were found to be 57.2 % and 39.2% and their income status was found 67.5%. The rates of overweight and obese mothers and fathers were found to be 44.2% and 68.5%, respectively (Table 1).

Table 1. Main characteristics of adolescents and family (N: 530)

Category	Number	Percent
Adolescents		
Age (Mean±SD= 0.85±0.53)		
10	120	22.6
11	369	69.6
12	41	7.7
Gender		
Female	260	49.1
Male	270	50.9
BMI(Mean±SD= 18.84±3.55)		
Underweight	25	4.7
Normal	346	65.3
Overweight and obese	159	30.0
Family		
Education-Mother		
Primary	303	57.2
High	110	20.8
College	117	22.1
Education-Father		
Primary	208	39.2
High	163	30.8
College	159	30.0
BMI-Mother (Mean±SD= 26.10±4.33)		
Normal	244	46.0
Overweight and obese	286	54.0
BMI-Father (Mean±SD=27.05±3.62)		

Normal	167	31.5
Overweight and obese	363	68.5
Income		
Low	122	23.0
Moderate	358	67.5
High	50	9.4

It was found that 4.5% ($n=24$) of the adolescents were in the Precontemplation stage, 6% ($n=32$) were in the Contemplation stage, 23% ($n=122$) were in the Preparation stage, 22.5% ($n=119$) were in the Action and 44% ($n=233$) were in the Maintenance stage. The mean score of all independent variables increased significantly in the Maintenance stage than the other stages (<0.001). It was determined that the Dietary Self-efficacy in all the stages except for the Maintenance stage; the Dietary Knowledge in the Preparation stage; the Diet Behaviors in the stages of Precontemplation, Contemplation, and Preparation; and the Exercise Behaviors, Stress Coping Behaviors, and Social Support in the Preparation and Action stages compared to the Maintenance stage were significantly lower.

The researcher conducted a Multinomial Logistic Regression (MLR) analysis in order to determine the prediction of stages of behavioral change in terms of the independent variables (Table 2). In the MLR analysis, each of the five stages was accepted as a reference group and they were compared with the non-reference groups.

In this analysis, the father's education (OR 2.6) and the adolescents' gender (OR 1.7) were the two strongest variables in terms of differentiating the stages. While the father's education predicted the Contemplation stage, adolescents' gender predicted the Maintenance stage compared to the others. Specifically, the female adolescents probably maintained fruit and vegetable intake more compared to the male ones. Mother's BMI became highly predictive once in the Contemplation (OR: 1.2) and Preparation (OR: 1.2) stages; whereas, adolescent BMI could also be predictive three times in the Action (OR: 1.1 and OR 1.1) and Maintenance (OR:1.1) stages. Higher self-efficacy was predictive in the Preparation (OR: 1.1) and Maintenance (OR: 1.1) stages compared to all of the other stages. Although dietary knowledge was predictive in the Preparation (OR: 1.1), Action (OR: 1.0) and Maintenance (OR: 1.0) stages, diet behavior was the only variable in the Maintenance (OR: 1.0) stage among the remaining stages. While Stress Management (OR: 1.0) could predict the Action (OR: 1.0) and Maintenance stages; Social Support (OR: 1.0) could predict the the Maintenance (OR: 1.0) stage. Exercise Behaviors were not a predictive factor for adolescents in any stage (Table 2).

Table 2. Multinomial Logistic Regression (MLR) analysis in order to determine the prediction of stages of behavioral change in terms of the independent variables

Reference category: Precontemplation ($n:24$, 4.5%, $n^{\text{boys}}:12$)				
Contemplation	Preparation	Action	Maintenance	

(n:32, 6%, n ^{boys} :21)	(n:122, 23%, n ^{boys} :65)	(n:119,22,5%, n ^{boys} :68)	(n:233, 44%, n ^{boys} :104)
Father education (p:0.047; OR:2.561; 95%CI: 1,014–6,469)	Mother BMI (p:0.042; OR:1.219; 95%CI:1.005–1.309)	Adolescent BMI (p:0.047; OR:1.152; 95%CI:1.002–1.324)	Dietary Self- Efficacy (p:0.013; OR:1.100; 95%CI:1.0130–1.116)
Mother BMI (p:0.010; OR:1.219; 95%CI:1.048–1.419)	Dietary Self-Efficacy (p:0.020; OR:1.100; 95%CI:1.010–1.118)		
Reference category: Contemplation			
	Preparation	Action	Maintenance
	Diet Knowledge (p:0.013; OR:1.100; 95%CI:1.013–1.114)		
Reference category: Preparation			
		Action	Maintenance
		Adolescent BMI (p:0.012; OR:1.111; 95%CI:1.024–1.209)	Adolescent BMI: (p:0.034; OR:1.100; 95%CI:1.006–1,158)
		Stress Management (p:0.010; OR:1.047; 95%CI:1.011–1.084)	Stress Management (p:0.004; OR:1.047;95%CI:1.014–1.081)
		Diet Knowledge (p:0.008; OR:1.043; 95%CI:1.011–1.1076)	Diet Behaviors (p:0.011; OR:1.035; 95%CI:1.008–1.063)
			Diet Knowledge (p:0.003; OR:1.043; 95%CI:1.015–1.1072)
Reference category: Action			
			Maintenance
			Social Support (p:0.011; OR:1.038; 95%CI:1.009–1.068)
			Sex (p:0,042; OR:1.692;95%CI:1.019– 2.808)

MLR: Multinomial Logistic Regression; OR: Odds Ratio; CI: Confidence Interval

4. DISCUSSION

The present study examined the efficacy of demographic, psychosocial, and behavioral variables for fruit and vegetable intake of adolescents to be predicted in the next stage under the guidance of the stages of change of TTM. The results supported the predictive power of some variables, which prevented obesity, on behavioral change and helped to understand this change better. The TTM also enabled to understand the differences in behavioral change to develop the stage-based interventions focused on the related predictors of each stage.

In this study, adolescents' nutritional behavior and nutrition self-efficacy perceptions differed according to gender and parental educational levels. Female adolescents and parents with higher educational levels had higher nutritional behavior and self-efficacy perceptions. These results supported the results of previous studies indicating that female adolescents chose healthier foods than male adolescents [8-9].

The adolescents in the Contemplation and Preparation stages were affected by their overweight or obese mothers; whereas, they were affected by their own weights in the Action and Maintenance stages. The relationship between adolescents' BMI and family eating habits has been well established in the literature. The studies have revealed that dietary habits of the parents influence the dietary habits of their children (23) and the most important factor in the increase of BMI among children is the BMI of their parents [8-24]. Another study by Rhee, De Lago, Arscott-Mills, Mehta, & Davis (2005) indicated that the children of parents who did not make any change in their lifestyles and home environment were not ready to participate in a weight control program[24].

The present study revealed that dietary knowledge, dietary behaviors, and the perception of dietary self-efficacy were the major predictors for progress to the Maintenance stage. The results supported the results reporting that there was a strong correlation among these three variables in school-age children and children with a high level of self-efficacy perception were adaptable and willing to change [14-25]. Furthermore, the previous studies indicated that the dietary self-efficacy of children with a higher level of dietary knowledge increased [26-27-28]. In this respect, the results emphasized that the perception of self-efficacy should be strengthened in all stages, particularly for progress to the Preparation and Maintenance stages, and also the dietary knowledge should be supported more with respect to Preparation, Action and Maintenance stages.

The results of the study also revealed that Stress Management behavior and Social Support predicted adolescents' healthy eating behaviors. It is stated in the literature that stress affects the maintenance of positive behavioral change [11-29]. Furthermore, the most important strategy for stress management is the perception of social support [13-22]. The results suggested that adolescents needed more social support to overcome stress through Preparation, Action, and Maintenance stages.

Despite the difference between stages of exercise behavioral change, these variables did not predict the other later stages of behavioral change. Previous studies showed that one of the most effective exercise strategies was social support [26] Furthermore, physical activities performed with parents were found to positively affect the obesity of adolescents. The results suggested that with motivation from others (e.g., group exercise) and activities especially performed with parents, it may be more likely to initiate and maintain physical activity at adequate levels [8-18].

In conclusion, the results have emphasized that it is important to investigate simultaneously multiple variables in order to determine the contributing factors which affect health promoting behaviors.

5. CONCLUSION

In this study, the stages of change of TTM provided useful information about the predictors of health-promoting behaviors for the next stage. This information was focused on the behaviors of the adolescents in the Preparation, Action and Maintenance stages who constituted a great majority of the sample. The results set a framework for stage-based multiple interventions for healthy food consumption and obesity prevention. Action-oriented

individuals should be paid attention and support because initiating actual behavior is an important step and the risk of relapse is high.

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EFFECT OF DEPOSITION TIME OF ZNO NANORODS BY HYDROTHERMAL METHOD ON PHOTOCATALYSIS ACTIVITY

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Abstract: *Zinc oxide Nanorods are grown by hydrothermal method on seed layer of ZnO for various deposition times at low temperature. The seed layers were deposited on soda lime glass by RF Sputtering with 100 nm of thickness. This study aimed to investigate the influence of deposition time of ZnO Nanorods on the photodegradation of Methylene Blue. It is well known that the experiment conditions control the growth of ZnO NRs. The crystalline structure of ZnO NRs was studied by means of X-ray diffraction and shows that the ZnO NRs obtained are primally well aligned and perpendicular to the substrate. Moreover, ZnO nanorods can be grown with a strong orientation along (101) and exhibit a wurtzite crystal structure in an XRD spectrum and possessed a high crystal quality. In addition the strong relative intensity of the (002) lines reveals a texture effect of the arrays consistent with c-axis oriented nanorods. The Photocatalysis activity has more efficiency when the deposition times decrease.*

Key words: *Zinc oxide, Hydrothermal method, Deposition time, Nanorods, RF Sputtering*

1. Introduction

Nanoscale materials have unique mechanical, electrical and thermal properties that make them very attractive in research and health related applications. Among these, one dimensional (1D) Zinc oxide (ZnO) nanorods (NRs) is a multilateral semiconductor which has been intensely studied as a promoting materiel for many industrial applications. Zinc oxide, a II-IV semiconductor, has a wide direct gap of 3.37 eV at room temperature and large exciton binding energy of 60 meV [1], has attracted considerable attention because of their application potential in a variety of fields, including chemical sensors, photo detectors, field-

effect transistors (TFTs), piezoelectric generators, solar cells [2-7] and photocatalysis activity [8],[9].

Various synthesis methods have been reported for 1D ZnO nanomaterials growth [10–14]. However, these methods always require a catalyst or severe conditions for nanowires (NW) growth.

In this study, we report that the vertical well-aligned ZnO NRs arrays were prepared on ZnO/soda lime glass templates by hydrothermal method, where ZnO seed layers were grown on glass via radiofrequency sputter (RF-sputter) deposition with thickness of 100 nm. The effects of deposition time on the growth of ZnO NRs have been investigated in detail. As a result, the well-controlled method on the morphology of ZnO nanorods arrays can be utilized in the improvement of the carrier collection for hybrid polymer photocatalyst devices based on ZnO.

2. Experimental

Before NRs synthesis by hydrothermal, ZnO seed layers with thicknesses of 100 nm were deposited onto soda lime glass substrates using radio frequency (RF) magnetron sputter-deposition technique. A glass substrate was placed on the top of an anode, which was placed 50 mm from the ZnO target of 3 in. diameter. During the growth, the working pressure of the chamber was 10 m Torr while the RF power was 40 W and the Ar gas flow was maintained at 5, 5 sccm. No substrate heating and bias were applied during the deposition.

The chemicals used in this work, zinc nitrate hexahydrate [$\text{Zn}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$, 98%] and sodium hydroxide [NaOH] were purchased from Aldrich and used as received. The growth solution was prepared by dissolving a calculated amount of zinc nitrate hexahydrate and sodium hydroxide in deionizer (DI) water. Successively, the addition of the hydroxide sodium is to adjust the pH of the growth solution. Then the glass substrates with ZnO seed layers were immersed in the growth solution in Teflon Lined Stainless Steel Autoclave and put them in oven at 120°C for 3 h, 5 h and 8 h. Finally, the ZnO NRs samples were removed from the solution after cooling, rinsed with distilled water and dried in air at 60°C.

The X-ray diffraction (XRD) was used to study the crystallographic properties. The optical properties of the obtained ZnO NRs were characterized by UV-Visible spectroscopy. The photocatalysis activity was investigated by the photodegradation of Methylene Blue with various time depositions of ZnO NRs.

3. Results and Discussion

Fig 1 shows XRD spectra of ZnO NRs prepared by hydrothermal at 120°C with different deposition time (Fig 1.a) deposited with 5 H and (Fig 1.b) with 8 H. As can be seen, the both samples are polycrystalline in nature with of the crystal growth along the plane (101) having a hexagonal wurtzite structure. Moreover the ZnO NRs with 8 H have more intensities than the previous one. It could be seen that the diffraction peaks were more intensive and narrower implying a good crystalline nature of the as-synthesized ZnO NRs, and all of the peaks can be well indexed to hexagonal phase ZnO reported in JCPDS card (NO.36-1451, a =

0.3249 nm, $c = 0.5206$ nm). Diffraction peaks related to the impurities were not observed in the XRD pattern, confirming the high purity of the synthesized NRs. These results are in a good agreement with Sini K. et al [9].

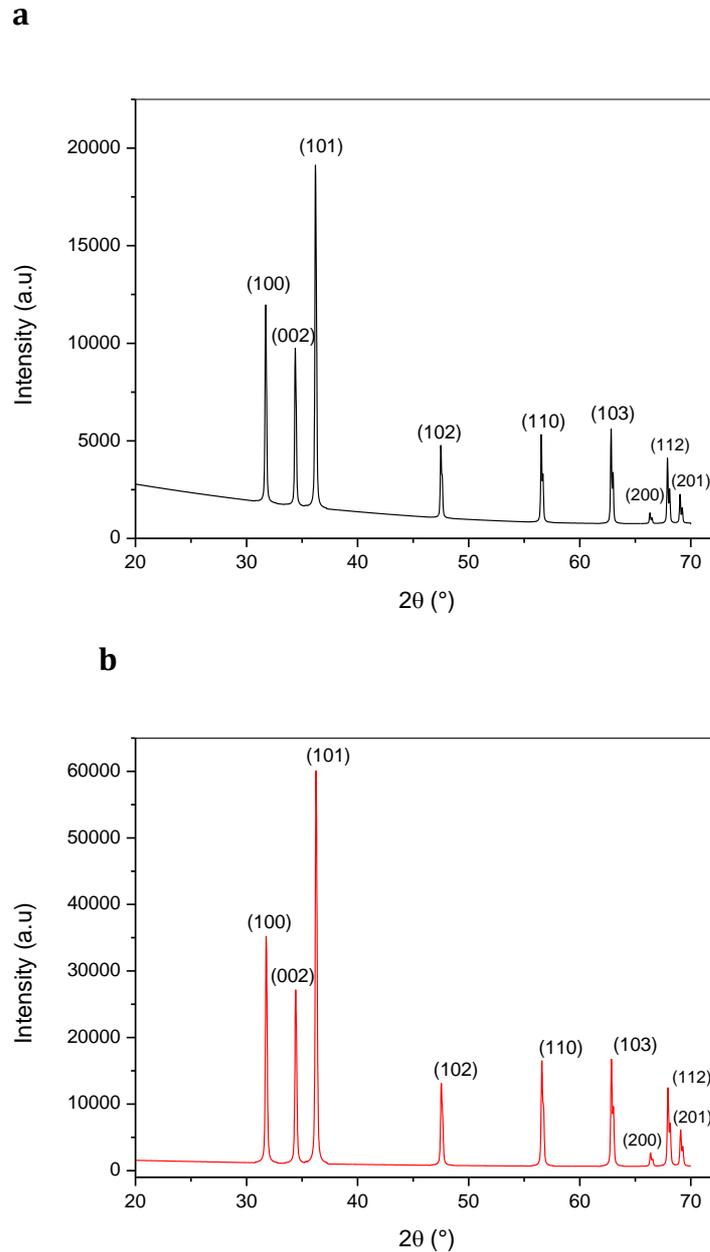


Fig. 1: XRD patterns for ZnO Nanorods with different deposition time: (a) 5 h and (b) 8 h

The samples prepared were used to research for treatment of water such as the photocatalysis activity. The photocatalysis activity was studied by Methylene Blue as a

pollutant with a concentration of 10^{-5} mol/l and the lamp used in this study is a lamp with a wavelength of 254 nm.

We have studied the variation of absorbance spectra of polluted solution after UV light exposure times. The wavelength region is ranged from 500 to 700 nm; this broad absorption band is a characteristic of the used Methylene Blue (MB) dye. The absorption peak intensity is used as signature of the dye degradation. From the variation of this absorption peak with exposure time, we concluded that the photo degradation is more significant when solution is in contact with ZnO Nanorods which deposited for film tested with 3 H as time deposition.

To have more insight on the photo degradation kinetics and the influence of deposition times of Zinc Oxide Nanorods, we have monitored the variation of the intensity of the absorption located at 664 nm.

Fig.2 exhibits the variation of the ratio C/C_0 . As shown, the photo degradation is more efficiency after 60 min when using 5 hours as a deposition time for ZnO Nanorods. The ratio is reduced with increasing exposure time; it reaches 0.35 after 240 minutes of irradiation for film with 3 h. However in the case of the other films the ratio is slightly increased up to 1.03 and 1.45 after 240 minutes for films deposited for 5 h and 8 h respectively.

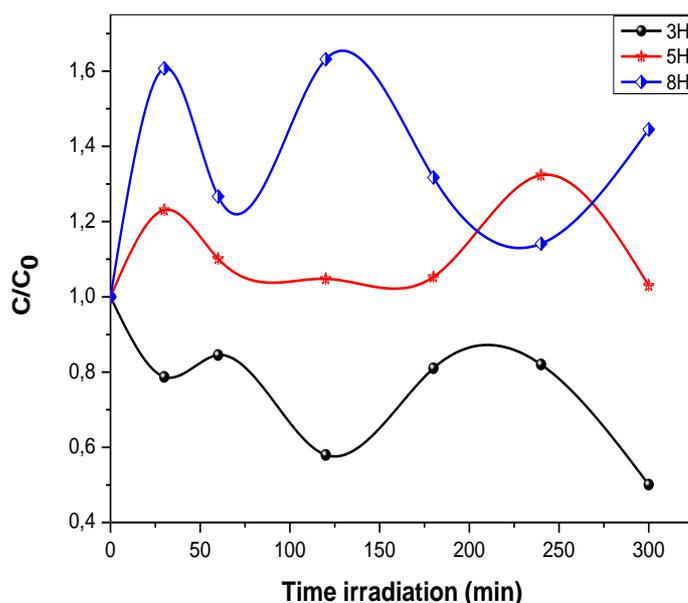


Fig.2: Photo degradation Kinetic of Methylene Blue by ZnO NRs with different deposition time

As can be seen in Fig.3, the photocatalytic decomposition of MB pollutant, in contact with the surface of ZnO Nanorods with different deposition times, follow a pseudo first-order kinetic law, it can be expressed as:

$$\ln\left(\frac{C_0}{C}\right) = kt$$

(1)

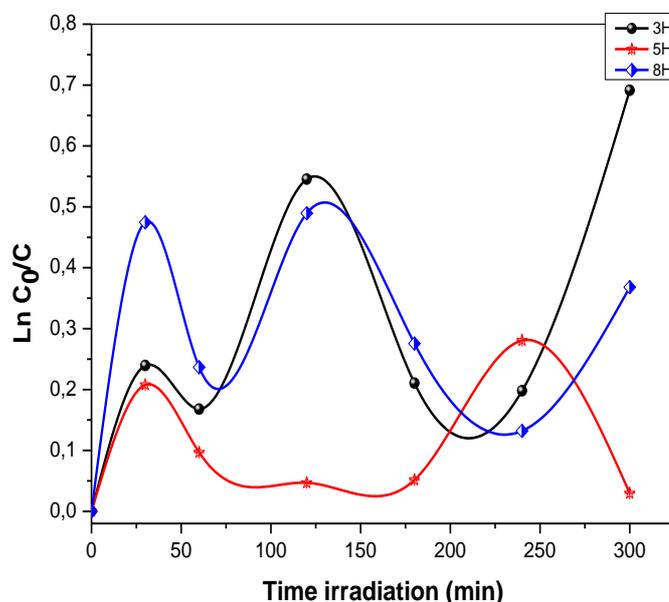


Fig. 3: Ln (C₀/C) of Methylene Blue by ZnO Nanorods with various deposition times used a lamp with 254 nm

In order to understanding better the results obtained, we calculated the conversion rate (τ) of the photodegradation of the BM by the set of samples. This ratio represents the ratio between the amount of transformed reagent and the initial quantity, using the following equation:

$$\tau = \frac{C_0 - C_t}{C_0} * 100 \quad (2)$$

Fig.4 shows the time evolution of the conversion of Methylene Blue for all the experiments, calculated using equation (2).

As can be seen 22% of MB is removed after 60 min of exposure time by ZnO NRs deposited for 3 H then after 240 min the conversion rate is reduce to 30%. While in the second case and after 60 min of irradiation time only less than 19% is removed when ZnO NRs deposited after 5h. Then the photodegradation is more important when the film is in contact with the solution under irradiation after 240 min the ratio is equal to 50%.

For the third samples ZnO NRs obtained after 8 h the ratio is reached 29% after 60 min but we observed the increase of this ratio until 45 % after 240 min of irradiation times.

According to this survey, the photodegradation of M.B is more significant when the samples which deposited after 5h are on contact with solution and the sample with 3h of deposition time has a larger constant of reaction K then the other samples.

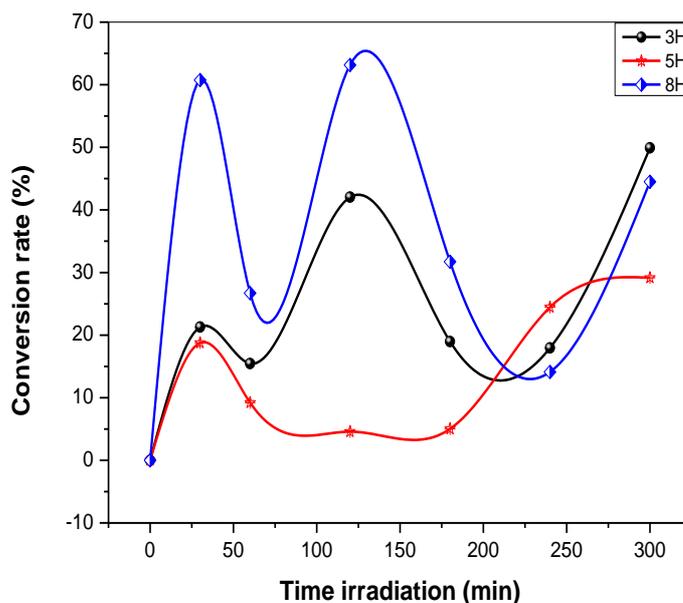


Fig. 4: Conversion rate of Methylene Blue by ZnO NRs with various deposition times

In Tab.1 we regrouped the values of the conversion rate and the constant of reaction K which are give us an idea about the photodegradation of the pollutant Methylene Blue by ZnO Nanorods obtained by hydrothermal at 120°C with several deposition times 3, 5 and 8 h.

ZnO Nanorods deposited with	Conversion rate τ (%)	Constant of reaction K (min^{-1})* 10^{-4}
3 H	30	13.6
5 H	50	1.12
8 H	45	2.16

Tab.1: the values of all parameters of the photocatalysis activity

4. Conclusion

In this present study we demonstrate that the growth of ZnO Nanorods can be performed by a simple and low cost method of growth from precursors in solution on ZnO seeds deposited by

RF sputtering on soda lime glass substrate. Such materials could be suitable for solar active devices such as dye-sensitized solar cells or photocatalytic devices for water decontamination. Although growth conditions influences the properties of the final material, the composition of seeding solution –in particular, the solvent- is the relevant parameter for controlling the structural and optical properties. The technique used in this work is a novel low temperature, and thus low cost method that could be extended to other metal oxide nanostructured materials.

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ANTIBACTERIAL ACTIVITY OF TiO₂ THIN FILMS AGAINST GRAM NEGATIVE OF BACTERIAL STRAINS

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Abstract: *Titanium dioxide (TiO₂) is one of the most important semiconductors. It has attracted growing attention in huge applications because of their unique properties. In this present survey we are interesting to investigate the resist growth of TiO₂ thin films with various dopants against gram negative of Escherichia coli bacteria. TiO₂ films were deposited on soda lime glass and tissue by two different methods (spray pyrolysis and sol-gel) in order to study their effect on antibacterial activity. We used two processes of bacteria and in both the results indicate that TiO₂ can resist the growth of E. coli. The zone of inhibition of this bacterium is found between 11 and 17 mm.*

Key words: *TiO₂, E. coli, antibacterial activity, dopants*

5. Introduction

Diseases caused by bacteria, viruses, fungi, and other parasites are major causes of deaths, disabilities, and social and economic disruption for millions of people. Infections acquired in hospital or in the course of medical treatment present a serious burden for patients and the health systems. Over 9.5 million people die each year due to infectious diseases in developing countries. There are many kinds of disease (e.g., listeriosis and strep throat) which can be caused by bacteria contamination of the environment. Escherichia coli (E. coli), gonococcus, salmonella, staphylococcus bacteria, streptococcus, and typhoid bacillus, are well known as common bacteria. For instance, enterohemorrhagic E. coli is very dangerous bacteria, which can cause serious diarrhea.

Therefore, the most urgent requirement for humans is to prevent these diseases by applying materials that are capable of killing or inactivating the causative bacteria. The development of new materials with high antibacterial properties has long been the goal of medical science.

Robust inorganic materials have received more recognition in the antibacterial market and photocatalytic products, because of their high heat resistance and long life expectancy. Especially, titanium dioxide (titania, TiO_2) has been recognized as the most familiar substance for widespread environmental applications [1], because of its biological and chemical inertness, strong oxidizing power, nontoxicity, and long-term stability. Nowadays, Titania nanomaterials with various morphologies have been used for wide applications such as an Instructions water treatment, air purification, hazardous waste remediation, environmental purification, and deactivation of bacteria [2].

The antibacterial activity of Titania strongly depends on its crystal structure, surface area, and surface morphology. Crystallized anatase nanoparticles (e.g., Degussa P-25) show excellent photocatalytic activity, which offers potentially a facile and cheap method to clean the environment from pollutant traces as well as from biological organisms such as bacteria and viruses. Mesoporous anatase with extremely high surface area can provide a higher amount of hydroxyl radical, which can increase the antibacterial activity compared to commercially available products [3].

6. Experimental

2.1. Preparation of films:

TiO_2 thin films on glass:

Doped and undoped TiO_2 were deposited by ultrasonic spray pyrolysis at 400 °C with 2.6 ml/l and 12 cycles (for 1 cycle: 20 s solution sprayed and 20 s paused). The solution of TiO_2 was prepared with 120 μl titanium isopropoxide dissolved in isopropanol then sprayed on soda lime glass.

TiO_2 films on tissue:

To deposit TiO_2 pure and doped by sol-gel method (dip-coating), we used 120 μl titanium isopropoxide dissolved in isopropanol and added acetic acid then took on various dopants such as: silver, Au Nanoparticles, Cobalt and Indium. The tissue was dipping in the solution for 15 s then dried for 10 min at 80 °C for 2 layers and 5 layers. The pieces of tissue cut at diameter of 1 mm.

2.2. Preparation of bacteria:

2.2.1 First method: (shaker)

We prepared liquid medium and agar medium for bacteria. For inoculums 1ml bacteria *E. coli* and 30 ml Nutrient Broth (NB) medium after 1 day or 24 hours, we took from this solution 100 μl and we sprayed in agar (plate). Then we put on film (agar) (100 μl on film) after this step, we put in the incubation then after 1 or 2 days we checked for which one has got inhibition zone .

2.2.2. Second method:

We took 1ml bacteria *E. coli* and added 9 ml N.B medium (Solution 1). After the first step, we took 100 μl from solution 1 and added 900 μl N.B medium (Solution 2). Then we took from solution 2:1 ml and put this quantity on our films. Finally, we put all samples with this method of preparation and we used the shaker for 2 hours at 37.5°C temperature. This was for incubation. After 2 hours, we took 100 μl from solution of samples. Then all plate

waited for 1 or 2 days in the incubation at 37.5°C. After we shake the samples and reference then we counted the colonies.

For medium: Agar Nutrient Broth liquid, we put 8g in 1 litre and for Nutrient agar for plate (colonies) the weight employed is 20 g in 1 litre. To prepare medium, we use autoclave at 121 bar for 20 minutes.

7. Results and Discussion

The antibacterial activity of glass slide coated doped and undoped TiO₂ was tested against the Gram negative bacterium E. coli. The viable bacteria were monitored by counting the number of colonies. As shown in Fig.1, all the samples: TiO₂ 3 % Co, TiO₂ 3 % In, TiO₂ 5 % In, TiO₂ 3 % Au NPs 2 layers, TiO₂ 5 % Au NPs 5 layers, TiO₂ 5 % Ag NPs 5 layers show the disappearance of colonies after 24 H of treatment. No bacterial growth was observed adjacent to the coating. As concluded the films can resist the growth of E. coli by the shaker Method.

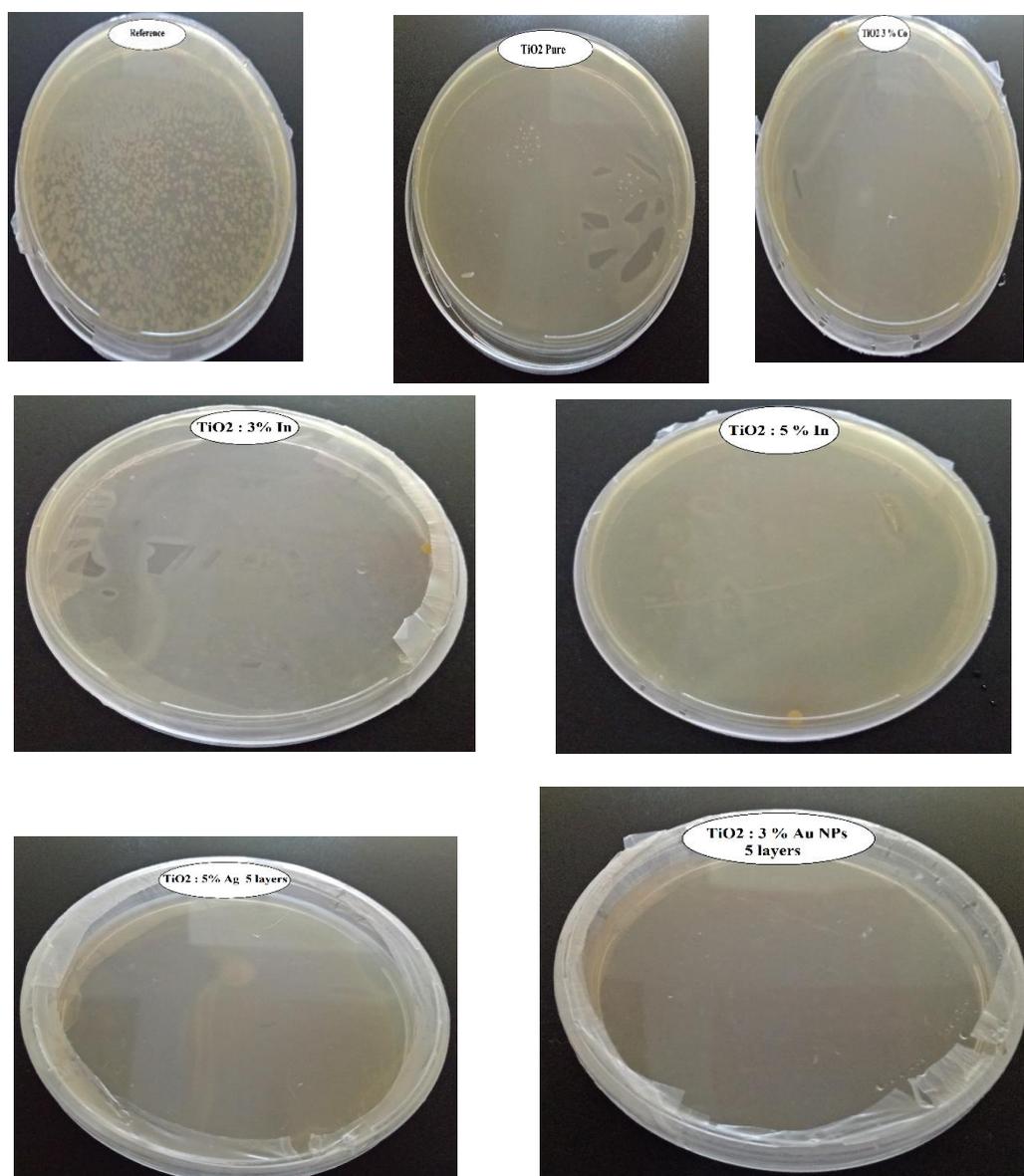


Fig.1: Doped and TiO₂ pure against gram negative bacterium E. coli

For the second method another set of bacterial tests was performed by applying the Kirby Bauer method, looking for zone of inhibition of the coated tissue. In these tests a tissue with and without TiO_2 coating partially covered the agar disk. Bacteria were then sprayed onto the surface of the coated disk. Bacterial growth was visualized after an overnight incubation in NB agar. No bacterial growth was observed adjacent to the coating, and for the higher percentage of TiO_2 coating the observed zone of inhibition was larger with 5 % Au NPs 5 layers. In comparison, many colonies were grown around the uncoated tissue as shown in Fig.2.

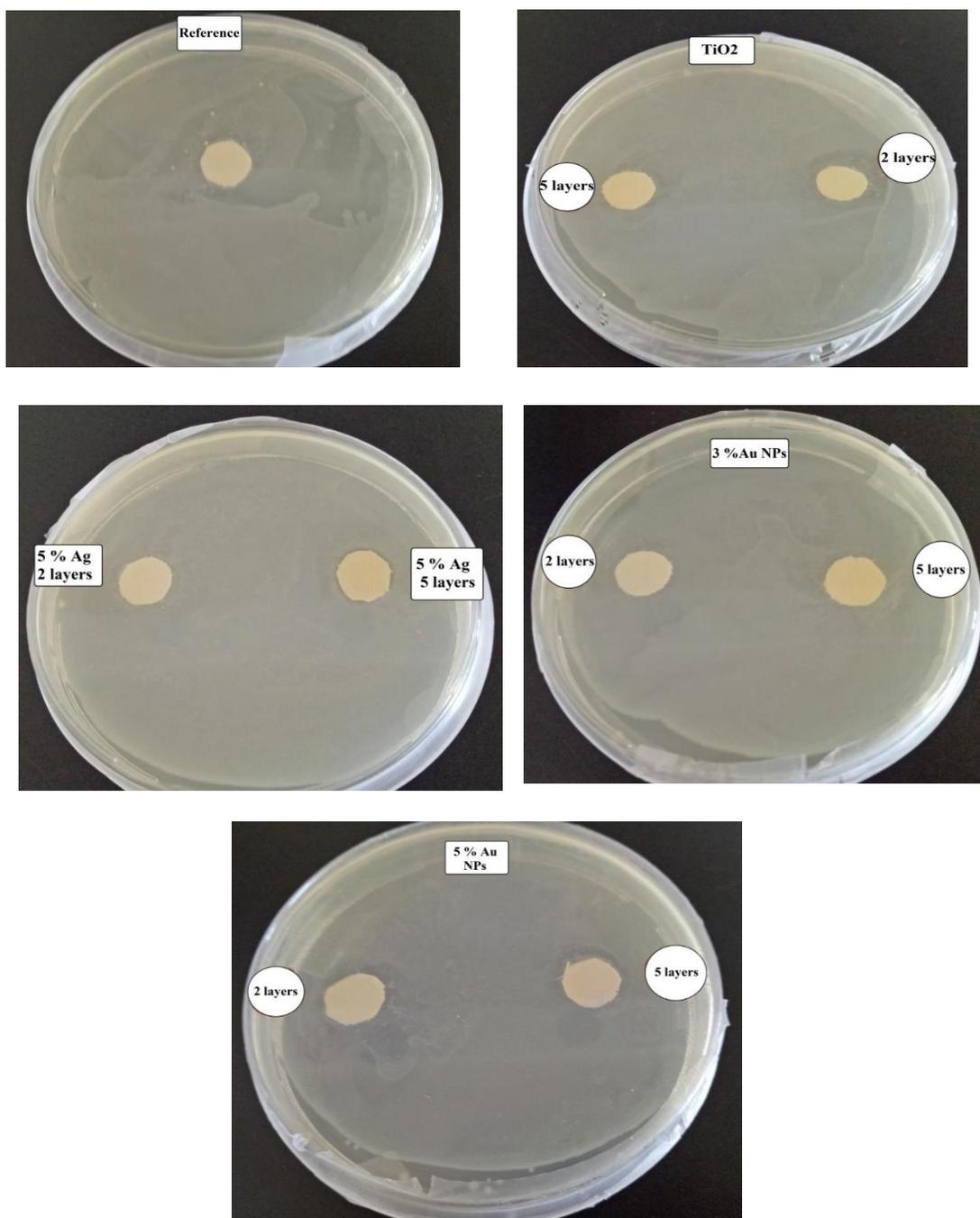


Fig.2: Doped and TiO_2 pure on tissue against gram negative bacterium *E. coli*

We have reported in Tab.1 the zone of inhibition for all samples prepared by sol-gel dip-coating on tissue. As observed the zone of inhibition is ranged between 11 and 18 mm. So the doped and undoped TiO₂ are harmful for this type of E. coli bacteria.

Tab.1 The zone of inhibition of TiO₂ pure and doped against E. coli bacterium

TiO ₂	Zone of inhibition (mm)
Reference	-
TiO ₂ pure 2 layers	17
TiO ₂ pure 5 layers	13
TiO ₂ 5% Ag 2 layers	11
TiO ₂ 5% Ag 5 layers	13
TiO ₂ 3 % Au NPs 2 layers	11
TiO ₂ 3 % Au NPs 5 layers	14
TiO ₂ 5 % Au NPs 2 layers	13
TiO ₂ 5 % Au NPs 5 layers	18

One of the factors influencing the antibacterial activity of the developed coating is the release of an active ingredient into the surrounding medium. The same observation was signed by G. Applerot et al. [4]. A detailed study of the mechanism of the activity of ZnO nanoparticles leads us to assume that the leaching of Zn ions governed by the K_{sp} of ZnO has a minor influence on the antibacterial activity. We have recently found [5] that the major components responsible for the bactericidal effect of ZnO nanoparticles were some species of oxyradicals in the solution, mainly hydroxyl radicals. These reactive-oxygen-species (ROS) were detected in electron spin resonance (ESR) studies. Moreover, the results of the antibacterial tests of the coated glass are in good agreement with the results obtained using pristine ZnO nanoparticles powders as an antibacterial agent [5]. Thus, it can be concluded that the major contributors of antibacterial activity of bacterium contains a large amount of carotenoid pigment, rendering it a higher resistance to oxidative stress [6].

8. Conclusion

The use of doped and undoped TiO₂ as a semiconductor for study the antibacterial activity was investigated. In this survey, two processes of bacteria were used with two deposition methods (Spray pyrolysis and dip-coating). The TiO₂ obtained were deposited with various dopants on glass slides and tissue with 1 mm as a diameter. The performance of glass slides coated with various percentages of TiO₂ as an antibacterial agent was investigated, and their excellent bactericidal effect was demonstrated by their zone of inhibition against gram negative bacterium E. coli.

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