RESEARCH ARTICLE

Social Factors that Affect the Hand Hygiene of Elementary and Highschool Students in İstanbul – Turkey [1]

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Summary

Persons are the primary performers for all food security systems and public health procedures, but humans do not have a standard configuration. The personal variables like age, gender, economic positions, psychological conditions, educations given by the family, life style and environment are the factors that determine main personal differences of humans. This situation can cause implementation differences for standard procedures as food security performances and educations related with food hygiene. Especially individual hygiene procedures must be tought to individulas when they are in childhood and early adult period very effectively. In this study we aim to determine how the social factors (economic position, mother/father occupation, number of siblings/household, etc.) effect hand hygiene according to the chosen microbiological parameters statistically who are registered in elementary and highschool programs of different schools in Istanbul. For this purpose 20 schools were visited for 3 months (visits were monthly). From each school 50 students (25 male and 25 female students) were sampled. The samples were anaylzed for the chosen microbiological parameters the correlations were determined among the microbiological parameters and the social variables of the students. According to the results we got, it was determined that the social variables were very effective on the students hygiene habits and microbiological load of the hands.

Keywords: Elementary school, Highschool, Lycee, Social factors, Hand

İstanbul'daki İlköğretim ve Lise Öğrencilerinin El Hijyenini Etkileyen Sosyal Faktörler

Özet

Tüm gıda güvenlik programları ve halk sağlığı prosedürlerinde birincil uygulayıcı insanlardır. Sosyal bir varlık olan insanın yapısındaki ana farklılıkların oluşmasında yaş, cinsiyet, sosyo-ekonomik pozisyonlar, psikolojik durumlar, aile içi eğitimler ve bakış açıları gibi bireye özgü değişkenler etkin bir rol oynamaktadır. Bu durum da, hem standart bir bilginin veya eğitimin verilmesindeki kişisel farklılıklara hem de standart bilgiyi ve eğitimin alınması takiben her bireyin alınan bilgileri hayata geçirmesinde kişisel farklılıklara neden olmaktadır. Özellikle çocukluk ve genç erişkinlik dönemini yaşayan bireylere hijyen prosedürleri çok bilinçli bir biçimde öğretilmeli, uygulattırılmalı ve söz konusu prosedürler çocuklarda ve genç erişkinlerde alışkanlık haline getirilmelidir. Bu araştırmada İstanbul bölgesindeki ilköğretim ve lise öğrencilerinin sosyal faktörlerinin (ekonomik pozisyon, annelerinin/ babalarının işi, kardeş/hane halkı sayısı vb) el hijyenlerini nasıl etkilediği tespit edilmiş ve analiz edilen mikrobiyolojik parametreler ile öğrencilerin sosyal faktörleri arasındaki korelasyon ilişkileri belirlenmiştir. Bu amaçla İstanbul bölgesinde toplam 20 adet okul 3 ay boyunca, aylık frekanslarda ziyaret edilmiştir. Her bir okuldan 50 adet örnekleme yapılmıştır (25 erkek, 25 kız öğrenci olmak üzere). Elde edilen sonuçlar sosyal faktörlerin öğrencilerin hijyen alışkanlıkları üzerinde çok önemli etkilere sahip olduğunu göstermiştir.

Anahtar sözcükler: İlköğretim okulları, Lise, Sosyal faktörler, El

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INTRODUCTION

The incidence of foodborne illnesses is increasing worldwide [1]. In the United States of America, 76 million food poisoning cases are reported every year and 50.000 cases of those cases are reported to be fatal [2]. According to the laws related to the new hygiene regulations of European Community (EU), it is a compulsory process for all kinds of food plants to apply food security systems at the all steps of the production and selling practices since 2005 [3,4].

Mass consumption points as schools, hotels, hospitals, business centers have important roles on contamination ways and food related surfaces, equipments, staff and even final consumers are evaluated as critical control points for food safety chain [5,6]. Inadequate hygiene conditions and/or microbiologically loaded hands can be the weakest ring of the food safety chains and these factors can risk public health seriously. Systematic hygiene applications and continuous hygiene education programs decrease the incidence of contamination of food pathogens originated from the critical control points explained above [6].

In developed countries, one of the most important preventive factors for the public health is to provide healthy and qualified foods for balanced and correct diets to the consumers while eliminating the possible pathogens and producing all kinds of foods under sufficient hygienic conditions. Continuously increasing population of world, pollution of the natural sources, industry, lack of education

the results were interpreted in the aspect of formed statistical models. Thus, the significant/non-significant differences of individual variables determined that were effective on contamination.

MATERIAL and METHODS

School Visit Programs

To determine how the individual variables of the students effect the microbiological hand loads of the students, total of 20 schools were visited during one school term. Details of the school visit program are shown in *Table 1*.

Student Samplings

Hand swab samples of 50 students (25 male, 25 female) for each school were collected. Entire palm including fingers for each student was sampled by using double swab technique. All the hand swab samples were transported to the laboratory and analyzed in the same day of sampling for the chosen microbiological parameters. Same students were sampled in each school at every visit during the visiting period of the study. The rate of different student sampling because of the reasons such as changing schools, absence of the students because of illnesses and/or from individual excuses was less than 1% of total sampling process. *Table 2* shows the analyzed microbiological parameters and the individual variables of the students.

Table 1. *Details of the school visit programs*
Tablo 1. *Okul ziyaret program detayları*

School Type	Number of Schools Visited	Economic Status	Number Students Analyzed (Hand Swabs)	Visiting Frequency	Visiting Period
Elementary	5	In low income regions	50 (25 male/25 female)	Monthly	September - January
Elementary	5	In high income regions	50 (25 male/25 female)	Monthly	September - January
High school	5	In low income regions	50 (25 male/25 female)	Monthly	September - January
High school	5	In high income regions	50 (25 male/25 female)	Monthly	September - January

due to economic reasons, complicates to provide hygienic and safe food products and enlarges nutrition problems and cause to increase the cases suffering from foodborne illnesses and toxications all over the world. Based on these reasons, it is very important to expose the contamination ways of the foodborne pathogens, and the risk factors especially in mass consumption points by using statistically and microbiologically based risk models and risk maps [3].

In this study it was purposed to expose how individual variables (age, gender, income of the family, etc.) of the students who were included to primary, secondary and high school education programs of different schools located in Istanbul effect the microbiological loads of their hands according to the chosen microbiological parameters and

Table 2. *Analyzed microbiological parameters and the individual variables of the students*
Tablo 2. *Analiz edilen mikrobiyolojik parametreler ve öğrencilerin kaydedilen bireysel değişkenleri*

Microbiological Parameters Analyzed	Individual Variables of the Students Recorded
Total Mesophilic Aerobic Bacteria Count	Age
Total Coliform Group Bacteria Count	Gender
Escherichia coli	Number of Siblings
Staphylococcus aureus	Number of Household
Salmonella spp.	Occupation of the parents
Bacillus cereus	Hand washing frequency (number of hand washings/day)

Microbiological Analysis

All the microbiological analysis were performed according to the standards of FDA/BAM (Food and Drug Administration/Bacteriological Analytical Manual) (U.S. FDA) and double swab technique was used. All the swab samples were transported to the laboratories of Istanbul University, School of Veterinary Medicine, Department of Food Hygiene and Technology and the analysis were performed in the same day of the sample transportation for each visit program. During transportation period, tubes included Stuart Transport Medium (Oxoid, CM 0111) was used for each swab. Different swabs were used for each microbiological parameter would be analyzed.

Total Mesophilic Aerobic Bacteria Count: Swabs were streaked onto PCA (Plate Count Agar) contained Petri dishes. Petri dishes were inoculated at 37ºC for 48 h and typical colonies were counted at the end of the incubation period [7].

Coliform Group Bacteria Count: Swabs were streaked onto VRBA (Violet Red Bile Agar) contained Petri dishes. After inoculation an additional VRBA layer was poured to each dish. Petri dishes were inoculated at 37ºC for 24 h and typical colonies were counted at the end of the incubation period [7].

Escherishia coli Count: Swabs were streaked onto TBX (Tryptone Bile X-glucuronide) agar contained Petri dishes. Petri dishes were inoculated at 44ºC for 24 h and typical colonies were counted at the end of the incubation period. Approximately 98% of *E. coli* serotypes include β - D glucuronidase enzyme. The enzyme is found extremely rare in other pathogens and breakdowns MUG (4 - Methylumbilliferyl-β-D glucuronid) substrate and the brokendown products form fluorescent radiation under U.V. light. Therefore, an additional chromogenic medium including MUG (*E. coli* Broth with MUG) was used for verifying [7].

Staphylococcus aureus Count: Swabs were streaked onto BPA (Baird - Parker Agar) contained Petri dishes. Petri dishes were inoculated at 37ºC for 24 h. At the end of the incubation period, black colonies with white zones were passeged to DNAse Agar and incubated at 37ºC for 24 h. Coagulase test was applied to the suspected colonies and coagulase positive colonies were evaluated as *S. Aureus* [7].

Salmonella spp. Count: Swabs firstly were pre - enriched in BPW (Buffered Peptone Water). After an incubation period at 37ºC for 24 h, isolates then enriched in Rappaport Vassiliadis Soy Broth which is a selective medium for Salmonella spp. Again enriched isolates were incubated at 37ºC for 24 h, then enriched cultures were streaked onto Brilliant Green Phenol Red Lactose Sucrose Agar, which is a solid specific media. Besides, XLD (Xylose Lysine Deoxycholate Agar) agar was also used for verification. Both XLD and Brilliant Green Phenol Red Lactose Sucrose Agar included Petri dishes were inoculated for 24 h at 37ºC and chemical tests were used to identify the suspected colonies. At this stage TSIA (Triple Sugar Iron Agar), urea broth and SIM (Semi Indol Motility) agar were used and identification procedure was completed [7].

Bacillus cereus Count: Swabs were streaked onto *B. cereus* Selective Agar included Petri dishes. Petri dishes were incubated at 37ºC for 24 h. At the end of the incubation period typical colonies were counted [7].

Statistical Analysis

To expose the corelations between individual variables of the students and chosen microbiological parameters, MANOVA, t test, Friedman test, Mann Whitney U test, Pearson corelation analysis, Kendall's Tau relationship analysis, Chi square relationship analysis and logistic regression analysis were used [8-15].

RESULTS

In this study, 20 schools (10 elementary schools and 10 high schools) were visited during one term (September - January) and from each school, the microbiological loads of 50 students' hands (25 male students, 25 female students) were analyzed for the chosen microbiological parameters. Besides, to establish microbiological pollution models and to determine correlations between microbiological pollution and individual parameters 6 questions were asked to students which thought to be effective to microbiological pollution and total contamination. *Table 3* shows the questionnaire of the students.

According to the results we got, some individual variables of the students were directly effective on their hands' microbiological loads. Both Significant and non-significant variables were evaluated as possible risk factors for total contamination at schools and the students' health. "Father Occupation" and "Age" variables were not effective to any microbiological parameter analyzed. However, non-significant variables showed us insufficient general and hand hygiene habits that were acquired in the period of early childhood could not easily be changed during lifetime and it was evaluated as a serious immeasurable risk factor for the food and public health in the situation of employment of the children in food related occupations in the future years of their lifetime. *Table 4* shows binary correlations between the individual variables of the students according to the analyzed microbiological parameters.

DISCUSSION

In this study, it was aimed to determine how the individual parameters and living habits (age, gender, economical status, etc.) of the students were interacted with the microbiological load of the students' hand and

Table 3. *Student questionnaire and the detailed data bases of the related questions*					
Tablo 3. *Öğrencilere yapılan anket ve ilgili sorulara ait veri dağılımları*					
Individual Variables of the Students Investigated (n=1000)	**Sub-diffraction Topics and Values of the Related Individual Variables (Numbers and Percentage)**				
Age	8 Years Old	9 Years Old	15 Years Old	16 Years Old	19 Years Old
	192 (19.2%)	238 (23.8%)	321 (32.1%)	246 (24.6%)	3 (0.3%)
Number of Siblings	None	1 Sibling	2 Siblings	3 Siblings	3+ Siblings
	330 (33%)	342 (34.2%)	181 (18.1%)	105 (10.5%)	42 (4.2%)
Number of Households	3 people	4 people	5 people	6 people	6+ people
	299 (29.9%)	345 (34.5%)	220 (22%)	87 (8.7%)	49 (4.9%)
Occupation of Mothers	Housewives	Self - employed	Private Sector Employees	Governmental Employees	Academics
	372 (37.2%)	132 (13.2%)	178 (17.8%)	286 (28.6%)	32 (3.2%)
Occupation of Fathers	Unemployed	Self - employed	Private Sector Employees	Governmental Employees	Academics
	61 (6.1%)	381 (38.1%)	382 (38.2%)	80 (8%)	96 (9.6%)
Hand washing Frequency (numbers/day)	None	1 Time	1 to 5 Times	5 to 10 Times	10+ Times
	5 (0.5%)	12 (1.2%)	720 (72%)	130 (13%)	133 (13.3%)

the role of explained parameters and habits on total contamination ways at schools of Istanbul by using statistical models. Multiple and binary correlations of the parameters were exposed and the effect of the parameters on contamination pathways on schools were investigated on the basis of selected groups. Thus, differences between schools and parameters were included into the statistical pollution models.

Corelations of the chosen microbiological parameters due to economic status of the schools were analyzed and statistical differences were in favor of the schools located in the regions which had higher economical income levels relatively (the students of the schools located in the regions which had higher income level relatively were "cleaner" then the students of the schools located in the regions which had lower income level due to chosen microbiological parameters). It is thought that more effective hand hygiene education are both given and applied to the students in schools by their teachers and/or families. Besides, usage of more effective and high quality soaps/disinfectants may be one of the reasons of our results. Period and frequeny of handwashing is also very important for eliminating the pathogens. We observed that the students of the schools located in higher income level regions were spending approximately double time period for each handwashing process than the students of the schools located in lower econimic income level regions (data not shown). Medical literature indicates that it is very important to use effective chemicals (the chemicals which are non toxic, do not leave any residues and provide optimal antiseptic conditions) for minimizing cross contamination and eliminating the pathogens from hands [16]. Applications of effective hygiene education programs by educational institutions and families from the begining of the childhood to the students are

very important as well as the usage of correct chemicals for handwashing for both protecting food and public health [17]. Microorganisms in the hands due to duration period are seperated into 2 groups as permanent and temporary microorganisms [18]. Soil and water originated permanent microorganisms as *S. aureus. B. Cereus* and coliforms may induce fatal food intoxications and the infections [19]. Permanent pathogens generally use cross and animal/soil-food-human digestive system contamination ways and grow in the fat tissue of the hands and the agents are continiously spread by the hosts unless an effective and continious handwashing processes are applied [18]. Because of the reasons discussed above, especially hand washing habits in children are very important for both food and public health.

According to our results, ages of the students were not an effective individual parameter on microbiological pollution of hands. These findings cause to think us habits acquired in the childhood period do not change. Gaining hand and general hygiene habits for persons, especially for children and elementary school students is very important for permanent and continious hygiene applications. In the case of acquiring inadequate hygiene habits it may be very hard to change in the future years for a person, while a child or elementary school student can apply correct hygiene processes during his lifetime and can minimize the risk factors in case of gaining correct habits of hand and general hygiene. Another point that must not be forgotten is; an elementary school student with inadequate hygiene habits can be a serious risk factor if he/she works at any food related position when he/she is adult for the total plant in spite of the explained risk factors have not been evaluated in our study. It can be very difficult changing the habits acquired, no matter how the food hygiene training

Table 4. Binary correlations between individual variables and the chosen analyzed microbiological parameters
Tablo 4. Analiz edilen mikrobiyolojik parametreler ile öğrencilerin bireysel değişkenleri arasındaki ikili korelasyonlar

Variables	Microbiological Parameters	P Value	Significance
School Type	Total Mesophilic Aerobic Count	46.525	**.000**
	Total Coliform Group Bacteria Count	35.078	**.000**
	E. coli	21.626	.004
	S. aureus	11.941	**.000**
	B. cereus	9.591	**.000**
Age	Total Mesophilic Aerobic Count	9.186	.687
	Total Coliform Group Bacteria Count	12.760	.687
	E. coli	5.795	.821
	S. aureus	5.440	.387
	B. cereus	10.745	.112
Number of Siblings	Total Mesophilic Aerobic Count	22.649	**.000**
	Total Coliform Group Bacteria Count	13.727	**.017**
	E. coli	13.438	.016
	S. aureus	10.920	**.001**
	B. cereus	3.025	.111
Number of Household	Total Mesophilic Aerobic Count	23.057	**.002**
	Total Coliform Group Bacteria Count	16.085	**.001**
	E. coli	24.662	.000
	S. aureus	31.424	**.024**
	B. cereus	26.255	.598
Mother Occupation	Total Mesophilic Aerobic Count	12.753	**.005**
	Total Coliform Group Bacteria Count	10.573	**.013**
	E. coli	4.735	**.012**
	S. aureus	12.199	**.001**
	B. cereus	7.146	.061
Father Occupation	Total Mesophilic Aerobic Count	6.446	.336
	Total Coliform Group Bacteria Count	1.778	.620
	E. coli	0.990	.636
	S. aureus	3.336	.940
	B. cereus	0.199	.696
Hand Washing Frequency	Total Mesophilic Aerobic Count	132.742	**.000**
	Total Coliform Group Bacteria Count	208.928	**.000**
	E. coli	117.334	**.000**
	S. aureus	107.748	**.000**

Salmonella spp. parameter was excluded from statistical model because of have not benn isolated from any of hand swabs sampled from students, Bold characters refer significant results between the related parameters at "Significance" column

enterprises/applications are effective applied by the plants and/or institutions [20]. This situation cause to think us it is so important to gain early students the veryfirst general and hand hygiene habits for public health and food security chains.

Household and number of siblings parameters were effective on plate count, coliform group bacteria, E. coli and S. aureus values according to our findings. Dumen and Sezgin [20], investigated total of 100 franchise bakeries of same brand located in different geographic regions in Turkey during one year and they indicated that household parameter were effective to the microbiological hand loads of the staff for coliform group bacteria count. Because the number of siblings directly effects the number of household variable, both variables in our study were effective on the same microbiological parameters. The variables were also effective on total contamination ways of the schools due to our findings. As the number of siblings, and therefore the number of household increases, we think that microbiological risk factors may increase due to lack of quality

Table 5. *Examination of the school groups (the schools located in the regions that had higher economic income level relatively and the schools located in the regions that had lower economic income level relatively) according to the economic status of the regions that they were located in*

Tablo 5. *Ekonomik gelir düzeyine göre (ekonomik gelir seviyesi görece düşük bölgelerde bulunan okullar ile ekonomik seviyesi görece yüksek bölgelerde bulunan okullar olmak üzere) okulların analiz edilen mikrobiyolojik parametrelere göre grup bazındaki farklılıkları*

Microbiological Parameter	Mean	Standart Deviation	95% Confidence Interval of Lower	95% Confidence Interval of Upper	t	df	Sig. (2-tailed)
Total Mesophilic Aerobic Count	.2000	.17817	-.1650	.56521	1.122	28	**.027**
Total Coliform Group Bact. Count	.5333	.15936	.20674	.85978	3.347	28	**.002**
Escherichia coli	.4667	.13333	.18070	.73979	3.500	28	**.002**
Staphylococcus aureus	.5333	.15936	.20674	.85978	3.347	28	**.002**
Bacillus cereus	.4000	.14907	.08961	.70536	2.683	28	**.012**

time spent with children and/or economical reasons, and this situations cause to gain the children insufficient hygiene habits. Not applying the general and hand hygiene rules in the family can directly effect total cross - contamination pathways and food security in houses. This case may possibly risk the general hygiene of the plants such as workplaces, schools that the individuals (students, teachers, staff) spent their time during the day and also the foods that are consumed in the places declared above. According to a decleration published by UNICEF in 1998, it was indicated that household variable is the main risk factor for the food consumed in the houses and it was also declared that even the foods produced under hygienic conditions, they can become serious risk factors in a house/place that general and hand hygiene procedures are not applied. The same decleration also points out that the most common reason of the diarrheas originated from different aetiologic reasons is the inadequate hygienic conditions in houses of the undeveloped/developing countries [2,14]. In spite of it was not investigated in our study, according to us, an important point that must not be forgotten is, insufficient hygienic conditions would be very serious risk factors for the cases who have immature/depressed immune systems such as neonates, HIV/cancer patients and the cases suffering from metabolic diseases.

Occupation of the mothers of the students analyzed in our study was another variable that effects the micro-biological pollution of the hands. This variable was effective on plate count, coliform group bacteria, *E. coli* and *S. aureus* parameters according to the results we got. The significant differences of "cleanliness" was in favor of the mothers who were housewives and the mothers who worked at health sector. We think that housewife mothers can take care of personel hygiene of their children more effectively because they can spend more time in the house than the working mothers. It is also thought that the mothers who work at health sector can embrace the general and hand hygiene applications to their children because of professional consciousness about general and hand hygiene rules. Medeiros et al.[21], indicate that mothers are last ring of food security chians against the contamination of the pathogens to children. Rao et al.[22], state that the most

important factor for awareness of hygiene habits for the children who are under 5 years old are the mothers according to a study that they made in India in the year of 2007. Also the same researchers pointed out that the hygiene habits settled to the children at the same age range do not change during the lifetime. In our study too, it was determined that the age variable was not effective on the microbiological pollution of the students' hands according to the chosen parameters. This situation cause to think us maternal factors are very important for achild about awareness of hygiene habits and the recovery of basic hygiene applications are due to the very first education given to the children by the mothers. This situation can be very important for the public health and food security in case of employement of the children who are not acquired correct hygiene applications from their mothers in the future years of their lifetime. We also think that it is very hard to estimate and measure the qualitative, quantitative and economic effects of the individuals that did not acquired correct hygiene applications from their mothers in period of early childhood to the public health and this situation is evaluated as a very important hidden risk factor for both public health and food security. According to us, the results we got point out that correct hygiene habits of children acquired from their mothers can be an important factor for decreasing the risk incidences in food sector. Another important point that must be indicated is the permanence of the hygiene educations given by the professionals under the organization of governmental institutions by using the communication tools as televisions and radios. Besides, we think that it is very important to establish plot education centers related to the subjects for education of the public about hygiene applications especially in the regions which have lower economic income relatively. Father occupation variable was not effective on the micro-biological pollution of students' hands for the chosen micro-biological parameters according to our results. This output supports the importance of the maternal factors on the hygiene habits of children. Fathers may not have sufficient effect for their children to acquire correct habits of hygiene because of economical (long hours of working) and traditional (less interests to the children relatively to the mothers) reasons.

Handwashing frequency variable was effective on all the microbiological parameters. For all the microbiological parameters, all the students determined as "clean" stated thet they wash their hands at least 5 times a day. In spite of hand washing frequency variable was first degree decisive the microbiological hand loads of the students, it must not forgotten that the variable's effect may vary according to the some secondary related variables as the time of handwashing process, usage of effective chemicals and hygiene conditions of common areas. Japanese Ministry of Health declared that 37% of total food intoxication cases in Japan were inadequate handwashing processes oriented in the yaer 1998 [3,23]. Scott [24], inticates that this rate increase up to 80% in Europe. Unfortunately there is not an exact rate decleration in our country but we assume that inadequate hand washing processes is a very important factor in the total food intoxication cases. Handwashing applications are indicated as a very important preventive process for eliminating the pathogens which use faeces-hand-mouth/food contamination pathway by the medical literatures [25-28]. Because of the reasons discussed above correct handwashing applications decrease the incidence of cross contaminations and help to protect total hygiene of the plants.

Economic income level was another variables that was investigated in our study. According to the results we got, the students of the schools which were located in the regions that had higher economic income level relatively were "cleaner" than the schools which were located in the regions that had lower economic income level relatively. All the chosen microbiological parameters showed a significant differences ($P<0.005$) according to the economic income variable. According to Dharod et al.[29], in United States America the hand mincrobiological loads of the individuals who earn less than 1.000 USD/month were significantly higher than the individuals who earn more than 1.000 USD/month. Our results, too, were parallel to Dharod et al.[29] and we observed that there is an inverse rate between the hand microbiological pollution of the students and economic income. Medical literature indicates that hand washing frequencies of the families that have very nominal economic income levels (300 USD and lower) are much more lower than it should be [29,30]. According to the results we got, it was determined that the handwashing frequencies of the students in the schools that were located in the regions which had lower economic income relatively were lower than the studens in the schools that were located in the regions which had relatively higher economic income. Moreover, we observed that there were not soaps in the toilets of the schools included lower economic income group. We also observed that in all the schools included to the high income level had hand - washing instructions in their toilets while one school included to the low economic income group had the instruction. It is thought that usage of ineffective disinfectants and/or absence of disinfectants can seriously increase the existance of pathogens in the hands so the risk factors for the schools.

Schools included to the both low economic and high economic income levels were also compared among themselves seperately and the significant differences was only determined for the *S. aureus* parameter at the students of high economic income level schools. There were no significant differences for the other microbiological parameters analyzed for the schools included to both low and high economic income levels. This situation cause us to guess that *S. aureus* is an indicator microorganism for the students of the high economic income level schools. *S. aureus* is the only permanent foodborne pathogen of the hand microflora [31]. The agent can penetrate to the fat tissue of the hands and can be eliminated only by using effective disinfectants with high frequencies in long times [29]. *S. aureus* can easily grow in almost all kinds of media however, generally, it can be found especially in the flora of nose, mouth and hands, and this situation facilitates of the cross contamination of the agent. According to the results we got, last hand loads of all investigated microbiological parameters except *S. aureus* were parallel for the students included into the similar economic income level group schools, however, the beginning flora of the hands of the students of different school groups were different. As a result, we can say that economical status is a very important and effective variable for the microbiological hand loads and cross contaminations of the foodborne pathogens.

Foodborne infections and toxications are widely seen all over the world and risk the public health seriously [32]. However production, transportation and selling of all kinds of foods under hygienic conditions by application food security systems is very important, consumer related variables can be significant for food security and public health as our investigated in our study. However different individual variables of children and adults seem to be unrelated with contamination and public health, it was determined that the explained variables were very decisive hidden risk factors on both public health and contamination pathways of foodborne pathogens. According to our thoughts it would be very useful to handle hygiene applications by considering individual variables of people for minimizing food related risk factors.

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