Original Investigation / *Özgün Araştırma*

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# A Model-based Survey to Predict Head Lice Infestation (HLI)-related Preventive Behaviors Among the Iranian Primary School-aged Children

## İran İlkokul Çağındaki Çocuklarda Baş Biti Enfestasyonuna (BBE) İlişkin Önleyici Davranışları Tahmin Etmek İçin Modele Dayalı Bir Araştırma

Gona Bekry[1](İD), Parvin Sarbakhsh[2](İD), Hamid Allahverdipour[3](İD), Abdolreza Shaghaghi[3](İD)

[1] *Department of Health Education and Promotion, Tabriz University of Medical Sciences, Tabriz, Iran*
[2] *Department of Biostatistics and Epidemiology, Tabriz University of Medical Sciences, Tabriz, Iran*
[3] *Department of Health Education and Promotion, Tabriz University of Medical Sciences, Tabriz, Iran*

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**Abstract**

**Objective:** Ectoparasites are one of the important health-threatening pathogens worldwide, and head lice infestation (HLI) is a common disease among primary school-aged children. The intent of the current research was to envisage Iranian school-aged children's cognitions, risk perceptions and their behavioral attributes with regard to HLI and ultimately to outline an evidence-informed basis to support formulation of future strategic directions in alleviation of the ectoparasite's public health burden.

**Material and Methods:** This cross-sectional study was conducted on 350 randomly selected students aged 6-11 years who had been enrolled in two elementary schools with the highest prevalence rate of HLI in the city of Paveh, West of Iran. Study data collection tool was a researcher constructed instrument which had been adapted based on the extended Health Belief Model (HBM)'s constructs.

**Results:** The concluded model fit indices were all in the vicinity of acceptable range. The utilized structural equation modeling (SEM) on the study data revealed that perceived susceptibility of HLI had the strongest impact of the students' relevant health behavior. Other important predictors of the students' HLI-related health behavior were their perceived barriers and severity.

**Conclusion:** The conducted study aligns well with the efforts to recognize predictors of adapting HLI-related preventive behaviors among

**Öz**

**Giriş:** Ektoparazitler, dünya çapında sağlığı tehdit edici en önemli patojenlerden biri olmakla birlikte baş biti infestasyonu (BBİ) özellikle ilkokul çağındaki çocuklarda sıklıkla rastlanılan bir hastalıktır. Bu çalışmanın amacı, İranlı okul çağındaki çocukların BBİ ile alakalı bilişleri, risk algıları ve davranışsal özelliklerini araştırmak ve ektoparazitlerin halk sağlığı üzerindeki yükünü hafifletmek adına ileriki stratejik planlamaların olgunlaşmasını desteklemek için kanıta dayalı bilgiler sunmaktı.

**Gereç ve Yöntemler:** Bu enine kesit çalışma, İran'ın batısında bulunan Paveh şehrinde en yüksek BBİ prevalansına sahip iki ilkokula kayıtlı olan 6-11 yaş arasındaki rastgele seçilmiş 350 öğrenci üzerinde uygulandı. Çalışmanın veri toplama aracı, genişletilmiş Sağlık İnanç Modeli (SİM) temelinde uyarlanmış ve araştırmacı tarafından geliştirilmiş bir araçtı.

**Bulgular:** Ortaya çıkan modelin uygun indeksleri kabul edilebilir aralık civarındaydı. Çalışma verilerinde kullanılan yapısal eşitlik modellemesi (YEM), öğrencilerin ilgili sağlık davranışında en güçlü etkiye sahip olan yordayıcının "algılanan BBİ duyarlılığı" olduğunu ortaya çıkardı. Öğrencilerin BBİ-ilişkili sağlık davranışlarının diğer önemli yordayıcıları "algılanan engeller ve şiddet" idi.

**Sonuç:** Yürütülen bu çalışma, okul çağındaki çocuklarda BBİ-ilişkili önleyici davranışların uyarlanmasında yordayıcıların öngörülmesi çabası ile iyi uyuşmuş ve BBİ prevalansını azaltmak için uygulanacak ampirik

**Correspondence Address/Yazışma Adresi**
Sağlık Eğitimi ve Teşvik Bölümü,
Tebriz Üniversitesi Tıp Fakültesi,
Tebriz-İran
**E-mail:** ar.shaghaghi@gmail.com

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school-aged children and is a step forward to provide evidence for empirical health interventions to mitigate HLI prevalence.

**Keywords:** Pediculosis, head lice, health belief model, risk perceptions, primary school

sağlık müdahaleleri için kanıt sağlaması açısından ileriye doğru atılmış bir adımdır.

**Anahtar Kelimeler:** Pediküloz, baş biti, sağlık inanç modeli, risk algıları, ilkokul

## Introduction

Ectoparasites are one of the important health-threatening pathogens worldwide (1), and *Pediculus humanus capitis* that cause head lice infestation (HLI) is still one of the most common biological entity that invades the humankind, especially school-aged children even in the 21st century (2,3). HLI or pediculosis capitis is an endemic disease in many of both developing and developed countries (4), and it is approximated that about 6-12 million new cases of the infestation occur annually in children aged 3-11 years and especially among girls only in the United States (2,5). The infestation could also spread from the infested children to adults mostly in the age range of 24-36 such as parents, teachers and also caregivers who might be in close contact with the children (6). No socio-economic gradient exists when HLI is taken into account, and the parasite could coexist with any host from different socio-economic backgrounds (7). This disease leads to about 12-24 millions of lost days annually, and its direct and indirect economic burden may even extend far beyond tens of billions of US dollar (3,8).

The infestation is bothersome and generally leads to itching, restlessness, skin irritation, social stigmatization and secondary infection especially in young children (9). HLI has also been suggested to be able to cause conjunctivitis, cervical lymphadenopathy (10), allergic reactions and anemia in massive infestation among school children (11,12). *Pediculus humanus capitis* life cycle is dependent on the presence of a human host, and the parasite lays its eggs near the proximal portion of the head hair shaft which attach firmly to the hair by a glue-like secretes of the female louse (13). The nits usually hatches within one week, and parasite transmission occurs with close person-to-person contact or by sharing scarfs, beddings, headrests, towels, combs or hats since the eggs could attach themselves firmly to fibers in the cloth and may remain viable for up to one month (14). Pediculosis is a common disease among primary school-aged children in the Middle East (15) and due to several factors such as immigration of infested people from neighboring countries, sub-standard schools' buildings and overcrowding of classes in many of the deprived provinces in Iran, it is ranked as one of the country's main school health issues in recent years (16). The prevalence of HLI among the Iranian school-aged children has been reported to be at a range of 1-30% (16-20).

Due to importance of individuals' risk perceptions in healthy behaviors adaptation (21), the extended Health Belief Model (EHBM) (22,23) was used in this study as a theoretical framework to envisage the studied Iranian school-aged children's cognitions, risk perceptions and their behavioral attributes with regard to HLI and ultimately to outline an evidence-informed basis to support formulation of future strategic directions in alleviation of the ectoparasite's public health burden.

## Materials and Methods

### Participants

This cross-sectional study was conducted on a group of elementary school-aged girls who had been enrolled in two elementary schools with the highest prevalence rate of HLI in the city of Paveh, Kermanshah province, west of Iran from 1st September to 15th November 2017. The sample size was determined based on the assumption of the possible or expected HLI prevalence rate of 50%. Thus, 350 randomly selected students aged 6-11 years in grades 1-6 were approached to be recruited into the study. Parents of 343 students endorsed their children's participation in the study by reading, signing and returning a consent form. Inclusion criteria were being in the age range of 6-11, willingness to participate, comply with the study and share their thoughts with the researchers. Exclusion criteria were having alopecia due to any medical condition or any other hair or skin disease than HLI during the study period.

### Instruments and Procedure

Study data collection tool was a researcher constructed instrument (The Children's Perception Scale of Head Lice Infestation-CPS-HLI) (24) which had been developed and psychometrically tested for use among the study target group. The scale's items were retained based on an extensive literature search, and 47 items were selected and classified into underlying constructs of the Extended Health Belief Model (EHBM) (23) (i.e. six items to measure students' HLI related behaviors, five items to assess perceived susceptibility, three another items to ascertain perceived severity, six questions to determine perceived barriers, five questions to gauge about perceived benefits, five items relating to self-efficacy, four items to assess self-identity, four questions to find out any consideration of future consequences, four items to check for any concern of appearance, three questions to assess perceived importance and two items relevant to cues to action that might trigger an individual to perform the target behavior). An expert panel endorsed the qualitative content and validity of the prelimi-

nary draft, and its structural validity was assessed employing explanatory and confirmatory factor analyses. The values of Lawshe's Content Validity Index (CVI) (0.90) and Content Validity Ratio (CVR) (0.77), (25) the estimated subscales' Cronbach's alpha (0.59) (26) and Intra-Class Correlation (0.72) coefficients (27) yielded plausible internal consistency of the scale. The values of Root Mean Square Error of Approximation (<0.08, $\chi^2$< 0.05), Tucker-Lewis Index and Comparative Fit Index (>0.9) approved the applied statistical model's goodness of fit (28). The Principal Component Analysis that was performed using STATA version 14 (29) favored the 11-factor solution. All the betrothed factors had the recommended eigenvalues level greater than one (30,31), and the eleven-factor solution explained 44.46% of the total variance. Thence, the construct validity of the CPS-HLI was approved for use in studies on children's perception about head lice infestation risk factors.

The instrument's items response options included a three-point Likert type scale ranging from never, rarely to sometimes for behavioral subscale and from agree, neutral to disagree for other constructs with coding choice in the range of 0-2.

**Data Collection**

All official approvals and agreements were received from the local authorities in the district headquarters of the Ministries of Education (MoE) and Health and Medical Education (MOHME) before attending the study venues. Face-to-face self-completion method was utilized to collect data. The trained researcher in this field attended the girls' schools by scheduling and coordinating with the school principal at the time designated to attend the school, explaining the objectives of the study and obtaining informed consent from the students and their parents and then, began data collection.

The prepared informed consent sheet along with the study information leaflet had been attached to the (CPS-HLI) and the students were asked to hand over the package to their parents. Confidentiality of the information provided, their right to withdraw from the study without obligation in giving any reason and benefit of the study attendance were explained in simple words within the parents' specific information leaflets. The parents were also requested to help their first and second grade school children in filling of the CPS-HLI if they had consented to allow their children's participation in the study.

**Ethics Consideration**

This study received approval from the regional Medical Ethics Board of Trustees (MEBoT) affiliated to the Tabriz University of Medical Sciences (Approval number: IR.TBZMED.REC.1396.187). Anonymous completion of the CPS-HLI was perpetuated all through the data collection process and only the research's team members were given access to the filled questionnaires.

**Data Analysis**

Descriptive statistics were utilized to analyze the general socio-demographic and infestation-related data. A confirmatory factor analysis was conducted employing structural equation modeling (SEM) with the maximum likelihood method of parameter estimation to examine simultaneously the factor structure of the CPS-HLI and also associations or possible intermediation paths between the extended Health Belief Model's (EHBM) (23) constructs. Comparative Fit Index (CFI), Tucker-Lewis Index (TLI) and Root Mean Square Error of Approximation (RMSEA) were applied to evaluate the model fit and CFI≥ 0.9, TLI≥ 0.9 and RMSEA< 0.08 deemed to be in the acceptable range and the level of significance was considered at p< 0.1. SPSS software version 22 (32) and STATA software version 14 (29) were applied for data analysis.

This study was conducted according to the Helsinki declaration (33), and a written informed consent was obtained from all the participants after conveying ample information about the study aims, objectives and procedures to the parents or legal guardians of the participant school children. The consent-providers were also ensured about the anonymity and confidentiality of the study data in collection and storage stages.

## Results

Participation rate in the conducted study among the approached school children (350) was 98%, and parents of 343 students consented to allow their offspring's attendance in this research. Educational and socio-demographic attributes of the study participants and their parents are presented in Table 1. As indicated, overall 47.3% of the recruited parents had an academic degree (mothers= 15.5% and fathers 31.8%) but 7.6% of them (mothers= 4.1% and fathers= 3.5%) were illiterate. According to the data presented in the table, 31.7% of the students were living in families with more than four family members.

The estimated internal consistency measures of Cronbach's alpha for the subscales of the developed instrument based on the extended Health Belief Model (23) are presented in Table 2. Based on the provided data, values of the internal consistency coefficient for the behavior (0.36), perceived barriers (0.59), self-efficacy (0.51), consideration of future consequences (0.46) and self-identity (052) were below the recommended acceptable cut-off value (0.6) (25), but for other constructs, the estimated values revealed high reliability.

The concluded model fit indices were all in the vicinity of acceptable range ($\chi^2$/df< 5; p< 0.05; RMSEA< 0.08, CFI> 0.9 and TLI> 0.9) and the associations or possible intermediation paths between the extended Health Belief Model's constructs (23) were depicted in Figure 1. The utilized SEM on the study

**Table 1.** Iranian primary school-aged children's educational and socio-demographic attributes in the model-based survey to predict their Head Lice Infestation (HLI)-related preventive behaviors

| Variables | Number | Percent |
|---|---|---|
| Study grade of the students | | |
| Grade 1 | 67 | 19.5 |
| Grade 2 | 59 | 17.2 |
| Grade 3 | 64 | 18.7 |
| Grade 4 | 60 | 17.5 |
| Grade 5 | 41 | 12.0 |
| Grade 6 | 52 | 15.2 |
| Education level of the students' fathers | | |
| Illiterate | 12 | 3.5 |
| Primary | 35 | 10.2 |
| Secondary | 79 | 23 |
| High school | 108 | 31.5 |
| University | 109 | 31.8 |
| Education level of the students' mothers | | |
| Illiterate | 14 | 4.1 |
| Primary | 75 | 21.9 |
| Secondary | 89 | 25.9 |
| High school | 112 | 32.7 |
| University | 53 | 15.5 |
| Occupation of the students' fathers | | |
| Unemployed | 97 | 28.3 |
| Self-employed | 121 | 35.3 |
| Private-sector employed | 26 | 7.6 |
| Government-employed | 99 | 28.9 |
| Occupation of the students' mothers | | |
| Housewife | 320 | 93.3 |
| Private-sector employed | 6 | 1.7 |
| Government-employed | 17 | 5.0 |
| The students' family size | | |
| 3-member family | 57 | 16.6 |
| 4-member family | 177 | 51.6 |
| 5-member family | 83 | 24.2 |
| 6-member family | 19 | 5.5 |
| More than 6-member family | 7 | 2 |
| History of previous head lice infestation | | |
| Yes | 48 | 14 |
| No | 295 | 86 |

data ascertained that perceived susceptibility of HLI had the strongest impact of the students' relevant health behavior ($\beta$= 0.14, $p< 0.05$). Other important predictors of the students' HLI-related health behavior were their perceived barriers ($\beta$= -0.11, $p< 0.028$) for adapting relevant preventive behaviors and severity of HLI ($\beta$= 0.1, $p< 0.086$) (Table 3). Perceived importance of HLI indicated no association with the HLI-related health behavior construct.

**Table 2.** The internal consistency measure of Cronbach's alpha for the subscales of the instrument developed for the model-based survey to predict Head Lice Infestation (HLI)-related preventive behaviors among the Iranian primary school-aged children

| The extended Health Belief Model constructs | Estimated Cronbach's alpha for the subscales |
|---|---|
| Behavior | 0.36 |
| Perceived susceptibility | 0.64 |
| Perceived severity | 0.64 |
| Benefits | 0.70 |
| Perceived barriers | 0.59 |
| Self-efficacy | 0.51 |
| Cues to action | 0.64 |
| Consideration of future consequences | 0.46 |
| Concern for appearance | 0.78 |
| Perceived importance | 0.74 |
| Self-identity | 0.52 |

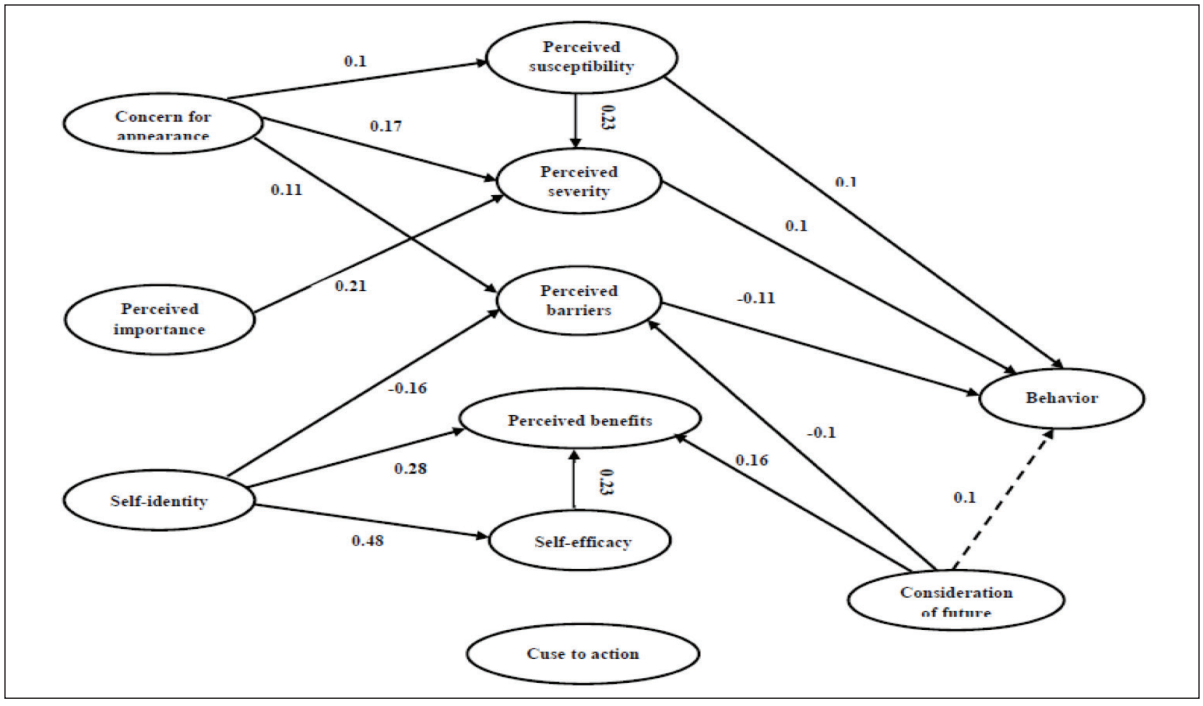


**Figure 1.** The associations or possible intermediation paths between the extended Health Belief Model's constructs.

## Discussion

This study was performed to recognize main predicting factors of HLI-related preventive behaviors among the Iranian primary school-aged children. Based on the findings, a higher level of perceived susceptibility and barriers, with a low level of perceived severity were major proxies for probability of adapting HLI-related preventive behaviors by the studied Iranian primary school-aged girl students. Presence of a strong association between the perceived susceptibility and severity and willingness of individuals to opt healthy behaviors have been suggested in previous studies (34,35). The combination of perceived severity and perceived susceptibility, which is referred literally to perceived threat, has been implied in the HBM to have direct effect on the likelihood of engagement in health-promoting behaviors (36). Having a higher level of perceived severity and susceptibility to a given health condition may lead to seek support from family members or certain others which could be especially imperative in young age school children (37). Subjective perceived barriers in front of a healthy behavior accommodation as mentioned in other health behavior theories was one of the identified predictors

**Table 3.** The observed intermediation paths between the extended Health Belief Model's constructs in the model-based study of the predictors of Head Lice Infestation (HLI)-related preventive behaviors among the Iranian primary school-aged children (n= 343)

| Predicting construct | | Outcome construct | Direct Effects | Indirect Effects | Total Effects |
|---|---|---|---|---|---|
| Perceived susceptibility | → | Perceived severity | β= 0.23 | β= 0.00 | β= 0.23 |
| Perceived susceptibility | → | Behavior | β= 0.14 | β= 0.00 | β= 0.14 |
| Concern for appearance | → | Perceived severity | β= 0.17 | β= 0.00 | β= 0.17 |
| Concern for appearance | → | Perceived barriers | β= 0.11 | β= 0.00 | β= 0.11 |
| Concern for appearance | → | Perceived susceptibility | β= 0.1 | β= 0.00 | β= 0.1 |
| Perceived importance | → | Perceived severity | β= 0.21 | β= 0.00 | β= 0.21 |
| Perceived barriers | → | Behavior | β= -0.11 | β= 0.00 | β= -0.11 |
| Perceived severity | → | Behavior | β= 0.1 | β= 0.00 | β= 0.1 |
| Consideration of future Consequences | → | Behavior | β= 0.00 | β= 0.11 | β= 0.11 |
| Consideration of future Consequences | → | Perceived benefits | β= 0.16 | β= 0.00 | β= 0.16 |
| Consideration of future Consequences | → | Perceived barriers | β= -0.1 | β= 0.00 | β= -0.1 |
| Self-efficacy | → | Perceived benefits | β= 0.23 | β= 0.00 | β= 0.23 |
| Self-identity | → | Perceived benefits | β= 0.17 | β= 0.11 | β= 0.28 |
| Self-identity | → | Perceived barriers | β= -0.16 | β= 0.00 | β= -0.16 |
| Self-identity | → | Self-efficacy | β= 0.48 | β= 0.00 | β= 0.48 |

of HLI-related preventive behavior in this study. The ascertained reverse association reported in other studies (38,39) needs to be noticed and intervened by health professionals (36). Consideration of future, concern for appearance, perceived importance, self-identity and self-efficacy were other examined constructs that indicated indirect association with the probability of HLI-related preventive behavior acquisition. Different people depending on their personal and living circumstances might have contrasting overviews about their future and the way a specific health-related dilemma could pose effect on their living circumstances (40). Consideration of the future is suggested for instance to predict healthy eating behaviors, and it has been revealed that those with higher concern about their future life are generally more interested about their health status (41). The perceived self-efficacy in procurement of a health-related behavior has also been recommended to predict probability of behavior acquisition in earlier studies (42,43). The construct was added to the model to reflect degree of individuals' self-confidence and perceived capabilities in adapting and maintaining a health behavior (44). Parents and other family members can help school-aged children in enhancing their self-efficacy by their supporting and education of daily life healthy routines such as combing or washing hairs in bathroom. The mediatory effect of self-efficacy on adapting HLI-related preventive behaviors by the studied students was through perceived benefit construct which was shown to impact on health beliefs (45).

The cue to action construct did not indicate any association with the HLI-related preventive behavior adaptation by the students nor with any other constructs of the extended HBM framework in this study. This might reflect unfamiliarity of the studied children with HLI and its symptoms and consequences or lacking of their proper health knowledge about the infestation. Cues to action could cover both external cues including mass media health messages, school-based health education contents and other socially-driven persuasive forces or internal cues for instance previous experience of an illness or a negative change in body or perception of an illness symptoms. Regarding the age-range of the participants in this study and reporting of a previous HLI by only 14.0% of the children, nonexistent association between this construct and other constructs could be justified which is consistent with the findings of other studies (46). However, perceived susceptibility and severity of the illness, perceived benefits and barriers to adapt the target health behavior were suggested to mediate intensity of cues to action construct in another study (47). Based on the study findings, self-identity construct presented a direct association with perceived barriers construct and via this variable, with the behavior construct which is in concordant with the findings of earlier research (48,49). Concern for appearance did not show a direct association with the adaptation of the target behavior but indirect acquaintance with the perceived susceptibility and severity of the illness. Based on the findings, the studied school children's concern for appear-

ance as a general attitude diminish the level of their perceived threat to HLI and therefore predict the probability of adapting the relevant preventive behaviors. Concern for appearance has been suggested in earlier studies to cause distress and even depression among children who might suffer from an appearance deteriorating illness (50,51).

Perceived importance of HLI also revealed a direct association with perceived severity or, in other words, with perceived threat in this research. The attribute of the construct has been reported in other studies (52) where a health related outcome behavior change is intended.

### Limitations

This study has some limitations worth to be pointed out for further research. First, the study sample was selected from two elementary schools in the city of Paveh, Kermanshah province, West of Iran and therefore, it was not nationally representative. The behavior subscale did not indicate adequate internal reliability in the psychometric analysis of the developed scale for data collection in this study and as a result, interpretation of the findings relevant to this subscale must be performed by caution. The observed attenuated internal consistency coefficient for some of the subscales might reflect the impact posed by the number of items in these subscales rather than their actual low reliability, which needs to be further speculated in future studies (53).

The existent stigma with HLI among the approached families and their children might also had effect on their responses and resulted to response-bias. In addition, the participants were limited to the 6-11-year-old age group, and hence the results cannot be generalized to children of other age-groups. Therefore, inclusion of a wider age range of children should be considered in future research. There is also the probability of confounding bias due to almost identical socio-economic status of the participants that necessitate inclusion of respondents from a diverse socio-economic background in future studies. Overall, the conducted study aligns well with the efforts to recognize predictors of adapting the HLI-related preventive behaviors among school-aged children and is a step forward to provide evidence for empirical health interventions to mitigate the HLI prevalence.

## Conclusion

Future studies should investigate the utility of the study findings for triaging available resources in provision of evidence-informed healthcare to families and testing the impacts of health interventions on HLI epidemiology.

**Ethics Committe Approval:** This study was approved by Tabriz University Medical Sciences Ethics Committee (Decision no: IR.TBZMED.REC.1396.187, Date: 1.06.2017).

**Informed Consent:** Patient consent was obtained.

**Peer-review:** Externally peer-reviewed.

**Author Contributions:** Concept- All of authors; Design- All of authors; Supervision- AS; Resource- AS, HA, GB; Data Collection and/or Processing- GB, AS; Analysis and/or Interpretation- All of authors; Literature Search - AS, GB; Writing- All of authors; Critical Review- All of authors.

**Conflict of Interest:** All the authors declare that they have no conflict of interest related to the design, conduct, or reporting of the research findings as presented in this manuscript.

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