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# Familial aggregation of traffic risky behaviours among pedestrians: a cross-sectional study in northwestern Iran

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## ABSTRACT

**Objective** This study aims to assess the familial aggregation of traffic risky behaviours among pedestrians and describe the sociodemographic profile of pedestrians in northwestern Iran.

**Methods** A cross-sectional study was conducted among 933 pedestrians in 2023. Participants were selected using stratified random sampling. Traffic risky behaviour was measured using a validated instrument among heads of households and their first relatives. The generalised estimating equations were computed to estimate the adjusted OR and 95% CI for familial aggregation of traffic risky behaviours.

**Results** Of the total sample, 52.2% and 27.7% of the participants were male and aged 41–50, respectively. The majority of respondents were categorised in middle socioeconomic class (36.9%). The OR for familial aggregation of traffic risky behaviours was 1.42 (95% CI 1.07 to 1.89), indicating that the presence of traffic risky behaviours in at least one family member increased the likelihood of similar behaviour in other members. Fathers showing violation behaviours were associated by 1.98-fold increase in violation behaviours among their offspring. Similarly, the existence of violation behaviour in one sibling increased the odds of violation behaviour among other siblings (OR 1.99, 95% CI 1.18 to 3.73).

**Conclusions** This study revealed the familial aggregation of traffic risky behaviours of pedestrians, with father-offspring and sibling aggregations emerging as prominent components of familial aggregation. The findings suggested that family-based prevention programmes may yield greater effectiveness than individual-based approaches. As such, implementing targeted interventions focusing on family might have a substantial impact on reducing pedestrian traffic risky behaviours.

## INTRODUCTION

Road traffic injuries represent a critical global public health issue, exacting a substantial toll on human lives. Annually, a staggering 1.35 million individuals succumb to road traffic crash.<sup>1–4</sup> In Iran, road traffic injuries exhibit an alarming annual incidence rate of approximately 32 per thousand individuals, ranking as the first and second cause of years of life lost and mortality, respectively.<sup>5</sup> Notably, Iran contributes to approximately 2.5% of global road traffic crash.<sup>6–9</sup>

The WHO underscores that nearly half of all road traffic deaths occur among vulnerable road users,

## WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Road traffic injuries represent a critical global public health issue and as a substantial toll on human lives. Despite numerous studies addressing the prevalence and causes of traffic risky behaviours among pedestrians, a gap exists in the literature regarding the assessment of familial aggregation of such behaviours.

## WHAT THIS STUDY ADDS

⇒ The presence of familial aggregation in traffic risky behaviours of pedestrians holds significant implications for public health interventions. According to the present study results, the aggregation observed among fathers-offspring as well as siblings emerges as significant components of their familial pattern.

## HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Results from this study will help in the implementation of preventive interventions regardless of the underlying causes of familial aggregation. Intervention programmes aimed at preventing or modifying high-risk behaviours within the community are likely to be more effective when conducted on a family basis rather than on individual basis. Furthermore, there is potential to establish a screening system within referral hospitals to traffic crashes. Under this system, if the injured individual is a pedestrian displaying risky behaviour, their family members could undergo screening for risky behaviours as well.

with pedestrians constituting 22% of this cohort. Furthermore, pedestrians accounted for 85% of mortality and 90% of disabilities due to road traffic crashes in developing countries.<sup>10–11</sup> Road traffic mortality in Iranian pedestrians is 1.56 times higher than in other countries of the region.<sup>12–13</sup> Pedestrian safety remains a critical public health concern in urban environments, with millions of lives affected by pedestrian-related crashes annually. These incidents lead to loss of life and impose a substantial burden on healthcare systems and economics worldwide.<sup>14–15</sup> While numerous factors contribute to pedestrian crashes including infrastructure design and drivers' behaviour, an emerging area of research suggests that familial aggregation may play

a significant role in the perpetuation of traffic risky pedestrian behaviours.

As for theoretical justification, familial aggregation is broadly characterised by some core features, including the clustering of traffic risky behaviours (TRB) within families, and raises crucial questions about genetic predisposition, environmental conditions and the interplay between them.<sup>16</sup> The shared environmental condition may also align with behavioural learning components, indicating that behaviour is largely influenced by interactions with other surrounding factors. On the other hand, familial aggregation may also be attributed to the aggregation of certain genes or disorders within the family.<sup>17 18</sup>

Familial aggregation studies are the first step in genetic epidemiology and are deemed a fundamental prerequisite for more specialised assessment in genetic epidemiology. Moreover, these studies undertake the task of scrutinising the underlying causes of the diseases through the lenses of phenotype. In the human sciences, phenotype is a physical, biochemical or behavioural characteristic associated with a disease or event that is known to be capable of direct observation or measurement in the laboratory.<sup>19</sup> In the familial aggregation studies, the initial step involves the selection of an individual from each family, referred as the proband. Proband can exhibit either a positive or negative phenotype under investigation. Subsequently, the proband family members are evaluated for the presence of the specific phenotype of interest. The presence of the phenotype suggests a potential role of genetic or hereditary, specific environmental condition or their interplay in the manifestation. Furthermore, this phenotype becomes a prime candidate for more in-depth investigation within the field of genetic epidemiology.<sup>20–23</sup>

To the best of the investigators' knowledge, while numerous studies have explored the prevalence of the TRBs among pedestrians and their underlying causes, a notable gap in the literature exists concerning the assessment of familial aggregation in the context of these TRBs. The presence of familial aggregation in pedestrian's TRBs regardless of their cause (environmental or genetic) holds significant implications for public health programmes. Therefore, this study aimed to examine the extent of familial aggregation of TRBs among first-degree relatives of pedestrians as well as to describe the sociodemographic profile of pedestrians in northwestern Iran.

## METHOD

### Study design and population

The present cross-sectional study was conducted in Tabriz, the capital city of East Azerbaijan Province in northwestern Iran, from 23 August to 20 March 2023. The study encompassed a total of 993 pedestrians as its subjects. Source population was clients of the Family Medicine Clinic of the Asad Abadi Hospital. Asad Abadi Hospital is a public university hospital with various outpatient clinics located in west Tabriz. The Family Medicine Clinic provides wide ranges of outpatient services, including preventive care, diagnosis, counselling and educational services for the general population.

Head of household was designated as proband serving as the focal point for identifying and enrolling relatives who would participate in this research. Initially, probands were selected from a list of clients attending the clinic. Subsequently, if these selected probands consented to take part in the study, their first-degree relatives including their spouses and children were selected as participants in this study if they met the eligibility criteria.

### Sampling and sample size

The samples for this study were chosen using the stratified random sampling method. The rural and urban areas of Tabriz were designated as strata. Subsequently, samples were selected based on the proportion of the population size of each stratum.

The calculation of the sample size of this study was performed by the data of initial pilot test involving 300 participants and an assessment of the likelihood of TRBs among pedestrians. Then prevalence ( $p$ ) corresponding to a larger sample size was used in the calculation to ensure robust estimates. Finally, the sample size was computed 933 subjects given the  $p = 0.18$ , a 95% confidence interval, a margin of error ( $d$ ) set at 0.15 and accounting for an anticipated non response rate of 20%. Accordingly, we used the following formula for calculation of sample size:

$$n = \frac{p(q) * z^2}{d^2}$$

### Eligibility criteria

Inclusion criteria encompassed individuals who were a minimum of 14 years old, have resided in Tabriz for at least 1 year, did not possess any walking disability and expressed an interest in participating in the study. Conversely, individuals with walking limitation and mental disabilities and participants who completed less than 50% of the questionnaire were excluded from the study.

### Measurements

Data collection relied on two standardised questionnaires. Pedestrians' traffic behaviours were assessed using the Pedestrian Behavior Questionnaire (PBQ), a self-reported tool gauging pedestrian's behaviour over the past year. The content validity coefficient for clarity, relevance and overall average were 0.88, 0.86 and 0.87, respectively. The questionnaire exhibited a Cronbach's alpha reliability coefficient of 0.84. Comprising 29 items, the PBQ explored five domains of pedestrian behaviours: adherence to traffic rules (7 items), violation (10 items), positive behaviours (7 items), distraction (4 items) and aggressive behaviours (2 items). Respondents rated items on a 5-point Likert scale, where 5 indicated 'never' and 1 indicated 'always'. A higher cumulative score on this scale denoted safer pedestrian behaviours.<sup>24</sup>

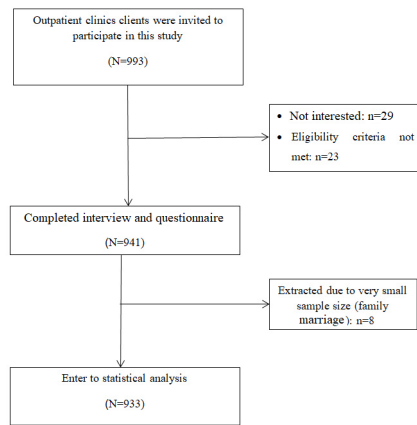
Moreover, we employed an abbreviated version of the SES Questionnaire (SESIran) to evaluate the socioeconomic status (SES).<sup>25</sup> The SESIran is a self-reported tool comprising six items, which include participants' occupation, education level, housing cost, automobile expenses and health-related expenditure. Responses for the first three items were recorded on a 7-point Likert scale, while items 4 and 5 were assessed using 6-point Likert scales, respectively.

In this study, father as the head of household was defined 'proband'. The role of other household members was determined according to the proband's role. The proband was then coded as reference category to calculate the familial aggregation measures.

### Data management and statistical analyses

We managed, organised and analysed the data using STATA software package V.17. To ensure objectivity and minimise bias, the individual responsible for data entry and subsequent data analysts were kept blinded to proband's status.

For categorical variables, we calculated both the frequency and percentage. We employed the mean clustering method. This technique allowed us to classify individuals and their relatives into distinct groups, namely the 'risky behavior group' and 'without risky behavior group'.<sup>26</sup>



**Figure 1** Participant selection to assess the familial aggregation of traffic risky behaviours among 933 pedestrians in northwestern Iran in 2023.

In this study, we employed bivariate and multiple logistic regression to examine the association between sociodemographic characteristics and TRBs. To account for clustering within various family relationships, we used the generalised estimating equations (GEE) algorithm with an exchangeable correlation structure. We applied 95% CIs to assess the precision of our estimates.

We explored clusters among different family relationships, including parents-offspring, fathers-offspring, mothers-offspring, between siblings and spouses. To ensure robust and unbiased results, we adjusted for variables had the potential to modify or confound family relationship within the bivariate analysis.<sup>27 28</sup> These covariates included age, family size and SES. We considered a p value <0.05 to indicate statistical significance in all our analyses.

### Patient and public involvement

Patients and the public were involved in the data gathering stage.

### Ethics approval

The study was carried out in accordance with the ethical standards of the 1964 Helsinki Declaration. All methods were carried out in accordance with relevant guidelines and regulations.

### RESULTS

Figure 1 illustrates the composition of our participant pool consisting of 933 individuals, with 258 identified as probands.

Table 1 provides an overview of sociodemographic characteristics of participants categorised by the presence or absence of TRBs as determined by the total behaviour score. The overall prevalence of TRB was found to be 33.11% with specific rates of 36.04% among fathers, 35% among mothers and 30.34% among their offspring. It is evident that the proportion of family

**Table 1** Baseline characteristics and traffic risky behaviours among 933 pedestrians in Northwestern Iran, 2023

Variable		Traffic risky behaviours in probands and relatives			P value
		Yes n (%)	No n (%)	Total n=933	
Family members	Father (proband)	93 (36.05)	165 (63.95)	258 (100)	0.32
	Mother	84 (35)	156 (65)	240 (100)	
	Children	132 (30.34)	303 (69.66)	435 (100)	
Age group	<20	42 (30.43)	96 (69.57)	138 (100)	0.23
	21–30	57 (29.84)	134 (70.16)	191 (100)	
	31–40	39 (31.97)	83 (68.03)	122 (100)	
	41–50	95 (36.68)	164 (63.32)	259 (100)	
	51–60	48 (33.33)	96 (66.67)	144 (100)	
	>60	28 (35.44)	51 (64.56)	79 (100)	
Gender	Male	166 (34.09)	321 (65.91)	487 (100)	0.51
	Female	143 (32.06)	303 (67.94)	446 (100)	
Marital status	Single	94 (29.65)	223 (35.74)	317 (100)	0.37
	Married	200 (34.96)	372 (65.04)	572 (100)	
	Divorced	9 (29.03)	22 (70.97)	31 (100)	
	Widowed	6 (46.15)	7 (53.84)	13 (100)	
Education	Illiterate/primary	33 (31.73)	71 (68.27)	104 (100)	0.94
	Secondary	38 (31.4)	83 (68.60)	121 (100)	
	Undergraduate	164 (33.61)	324 (66.39)	488 (100)	
	Postgraduate	74 (33.64)	146 (66.36)	220 (100)	
Socioeconomic status	Very low	50 (23.15)	166 (76.85)	216 (100)	0.001
	Low	61 (28.77)	151 (71.23)	212 (100)	
	Medium	131 (37.97)	214 (62.03)	345 (100)	
	High	56 (41.48)	79 (58.52)	135 (100)	
	Very high	11 (44)	14 (56)	25 (100)	
Family size (members)	3	113 (31.83)	242 (68.17)	355 (100)	0.50
	4	152 (35.43)	277 (64.57)	429 (100)	
	5	35 (30.43)	80 (69.57)	115 (100)	
	6	9 (26.47)	25 (73.53)	34 (100)	

**Table 2** The association between traffic risky behaviours and sociodemographic characteristics among 933 pedestrians in northwestern Iran, 2023

Variable	Total		Adherence to traffic rules		Violation		Positive behaviour		Distraction		Aggressive behaviour	
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	
Age	0.99 (0.98 to 1.89)	<b>1.06 (1.005 to 1.89)</b>	<b>0.98 (0.78 to 0.99)</b>	1.08 (0.99 to 1.97)	1 (0.99 to 1.98)	<b>0.95 (0.82 to 0.99)</b>						
Gender	Male	Reference	Reference	Reference	Reference	Reference						
	Female	0.91 (0.69 to 1.89)	1.21 (0.63 to 2.08)	0.8 (0.48 to 1.53)	1.09 (0.8 to 1.54)	0.9 (0.69 to 1.46)	0.73 (0.47 to 1.51)					
Family size	3	Reference	Reference	Reference	Reference	Reference						
	4	0.85 (0.63 to 1.41)	0.64 (0.28 to 1.48)	0.57 (0.32 to 1.02)	0.54 (0.2 to 1.44)	1.25 (0.61 to 2.57)	2.07 (0.8 to 5.38)					
	5	1.06 (0.67 to 1.68)	<b>0.42 (0.18 to 0.95)</b>	1.05 (0.41 to 2.71)	0.53 (0.2 to 1.41)	1.26 (0.62 to 2.56)	1.96 (0.76 to 5.02)					
	6	1.29 (0.58 to 2.86)	<b>0.4 (0.16 to 0.97)</b>	1.87 (0.24 to 1.48)	0.43 (0.45 to 1.21)	1.45 (0.66 to 3.1)	<b>4.84 (1.35 to 17.68)</b>					
SES	Very high	Reference	Reference	Reference	Reference	Reference						
	High	1.1 (0.46 to 2.62)	1.04 (0.43 to 2.53)	0.94 (0.46 to 1.9)	<b>0.38 (0.22 to 0.66)</b>	<b>1.58 (1.09 to 2.28)</b>	1.46 (0.32 to 6.59)					
	Medium	1.28 (0.56 to 2.91)	1.08 (0.45 to 2.58)	1.58 (0.79 to 3.17)	0.45 (0.16 to 1.23)	<b>1.68 (1.07 to 2.65)</b>	<b>2.23 (1.21 to 4.1)</b>					
	Low	1.94 (0.83 to 4.52)	1.04 (0.43 to 2.53)	1.93 (0.92 to 4.04)	<b>0.39 (0.24 to 0.62)</b>	<b>1.63 (1.09 to 2.44)</b>	0.72 (0.4 to 1.25)					
	Very low	<b>2.60 (1.11 to 6.10)</b>	0.77 (0.32 to 1.88)	2.57 (0.14 to 3.45)	0.4 (0.24 to 0.66)	<b>2.55 (1.03 to 6.28)</b>	<b>2.96 (1.18 to 7.4)</b>					

Highlighted numbers indicate statistically significance.

CI, confidence interval ; OR, odds ratio; SES, socioeconomic status .

members, age group, gender, marital status, education levels and family size were remarkably similar in both TRB and without TRB groups and there were not statistically significant differences between the two groups. However, a notable contrast emerged in terms of SES levels, where a statistically significant difference was detected between the two groups ( $p=0.001$ ).

Table 2 shows that one-unit increase in age significantly reduces the likelihood of violations and aggressive behaviours by an average of 2% and 5%, respectively (OR 0.98, 95% CI 0.78 to 0.99) (OR 0.95, 95% CI 0.82 to 0.99). Although females had lower risky behaviour in all parts of pedestrian behaviours compared with males, these differences did not reach statistical significance. Furthermore, the likelihood of total TRBs in participants with very low SES was 2.6 times more than in participants with very high SES (OR 2.60, 95% CI 1.11 to 6.10).

Table 3 presents the findings of GEE analysis offering adjusted OR with corresponding 95% CI to evaluate familial aggregation of TRBs among pedestrians. Familial aggregation of TRBs, as assessed by the total score, revealed an OR of 1.42 (95% CI 1.07 to 1.89). This finding signifies that the presence of pedestrian TRBs in at least one family member significantly increased the likelihood of TRBs occurring

within the broader family context. As shown in table 3, no significant association was found between spouses' risky behaviour or between siblings. However, a significant association was identified between fathers and their offspring (OR 1.4, 95% CI 1.06 to 2.01) as well as between mothers and their offspring (OR 1.3, 95% CI 1.1 to 1.86).

Our analysis unveiled significant patterns of familial aggregation in violation behaviour among certain familial relationships. Fathers who exhibited violation behaviours were found to substantially increase likelihood of similar violations among their offspring approximately 1.98 times (OR 1.98, 95% CI 1.12 to 2.78). Moreover, the presence of violation in one of the siblings had a significant impact, elevating the likelihood of violation among other siblings by approximately 1.99 times (OR 1.99, 95% CI 1.18 to 3.73).

Our analysis also explored the familial aggregation of aggressive behaviours. Probands who displayed aggressive behaviour were found to significantly increase the likelihood of aggressive behaviour among their relatives by about 1.5 times (OR 1.44, 95% CI 1.17 to 2.01). Moreover, offspring whose fathers exhibited aggressive pedestrian behaviours had 2.23 times higher odds of aggressive-displaying behaviour compared with offspring whose fathers were not

**Table 3** Result of GEE analysis to estimate adjusted OR with 95% CI for familial aggregation of traffic risky behaviours among 933 pedestrians in northwestern Iran, 2023

Variable	Risky behaviour dimensions					
	Total*	Adherence to traffic rules†	Violation‡	Positive behaviour*	Distraction*	Aggressive behaviour§
	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)	OR (95% CI)
Spouses	1.07 (0.8 to 1.4)	1.2 (0.85 to 2.71)	1.02 (0.54 to 1.9)	1.17 (0.85 to 2.3)	1.1 (0.84 to 1.46)	1.06 (0.84 to 2.36)
Parents and offspring	<b>1.42 (1.07 to 1.89)</b>	<b>1.26 (1.09 to 2.46)</b>	1.30 (0.96 to 1.74)	1.03 (0.89 to 2.1)	<b>1.89 (1.25 to 3.4)</b>	<b>1.44 (1.17 to 2.01)</b>
Mothers and offspring	<b>1.33 (1.1 to 1.86)</b>	<b>1.84 (1.34 to 2.98)</b>	1.61 (0.9 to 2.85)	1.06 (0.79 to 3.54)	0.99 (0.74 to 1.34)	1.03 (0.7 to 1.52)
Fathers and offspring	<b>1.4 (1.06 to 2.01)</b>	<b>1.54 (1.14 to 2.5)</b>	<b>1.98 (1.12 to 2.78)</b>	1.16 (0.86 to 2.15)	<b>2.58 (1.89 to 4.2)</b>	<b>2.23 (1.52 to 3.25)</b>
Siblings	1.22 (0.80 to 1.86)	<b>1.35 (1.15 to 3.15)</b>	<b>1.99 (1.18 to 3.73)</b>	1.23 (0.79 to 2.3)	1.30 (0.87 to 1.93)	<b>2.06 (1.38 to 3.08)</b>

highlighted numbers indicate statistically significance.

\*Adjusted for socioeconomic status.

†Adjusted for age and family size.

‡Adjusted for age, family size and socioeconomic status.

§Adjusted for age, family size and socioeconomic status.

CI, confidence interval ; GEE, generalised estimating equations; OR, odds ratio .



aggressive pedestrians. Similarly, aggressive behaviours in one sibling increased the likelihood of aggressive behaviour in their sisters or brothers by nearly 2.06 times (OR 2.06, 95% CI 1.38 to 3.08). In this study, the response rate was approximately 95%.

## DISCUSSION

Family studies serve as a fundamental approach to investigate the familial distribution of disorders and traits.<sup>29</sup> In the present study, we found significant familial aggregation among parents and their offspring, fathers and their offspring and mothers and their offspring in terms of the total score of TRBs. This indicates that the likelihood of TRBs among offspring is significantly higher if their parents exhibit TRBs compared with offspring of parents without TRBs. However, no significant associations were observed among spouses or siblings in terms of total risky behaviours. To gain deeper insight into the familial aggregation of TRBs among pedestrians, various dimensions of pedestrian behaviour were investigated.

The results showed that aggressive and violation behaviours among pedestrians are more prevalent in offspring whose fathers exhibit these behaviours. Furthermore, if one child exhibited aggressive behaviour, the likelihood of this behaviour occurring in other offspring increased. These findings suggest that the influence of family members extends beyond the parent-offspring relationship; indeed, offspring strongly influence one another in terms of aggressive pedestrian behaviours. This may be due to the pivotal role of fathers typically holds within the Iranian family, where children often perceive their father as family leader and moral exemplars. The aggregates of these behaviours among siblings also suggest that peer dynamics play a role in shaping and expressing TRBs among pedestrians.

Theoretical explanations for familial aggregation in risky pedestrian behaviours may involve shared environments, genetic factors or a combination of both. The shared environmental component aligns with behavioural learning theory, which posits that all behaviour is influenced by interactions with the external environment.

Although pedestrian-specific aggressive behaviour has not been extensively studied, investigations into the genetic susceptibility of general aggression have focused on candidate genes, particularly those related to dopaminergic and serotonergic neurotransmission.<sup>30 31</sup> Previous reviews of adoption and twin studies and studies on aggression have estimated heritability of up to 0.50, with a minor influence of the shared environmental factors.<sup>32</sup>

In accordance with our result, an overview demonstrated the presence of a cluster of aggression within families.<sup>33–35</sup> Sampson and Lauritsen and Sampson *et al* have highlighted the clustering of aggressive behaviours within families, and noted that developmental modification in these behaviours may be more similar among family members than between families.<sup>35 36</sup>

Furthermore, our study revealed that distraction related to pedestrian in fathers increased the likelihood of the TRBs among their offspring. This underscores the significance of the father's role in shaping offspring behaviour, which may be influenced by genetic factors, the environment and their interplay. This familial aggregation may also be attributed to the aggregation of genetic conditions or disorders within the family. While familial aggregation of distraction among pedestrians has not been previously explored, our findings align with previous research documenting familial

aggregation of distraction in other disorders such as adult attention deficit hyperactivity disorder, its genetic factor and its familial aggregation.<sup>37</sup>

## Limitations

The present study is subject to several limitations. First, it relies on self-evaluation through questionnaires, which can introduce biases due to variations in participants' interpretations of questions. To mitigate this limitation, we employed trained data collector who provided initial explanations of the questionnaire's content to enhance participant comprehension.

Second, the study was constrained by small proportion of family marriage within the sample; consequently, we were unable to assess potential differences in familial aggregation of TRBs among pedestrians between family marriages and non-family marriages. Future investigations with larger sample sizes are recommended to explore gender-specific pattern of familial aggregation among offspring and to conduct twin, adoption and migration studies than can offer further insight into underlying causes of familial aggregation in pedestrian TRBs. These approaches would allow for a more comprehensive understanding of the factors contributing to familial aggregation pattern in risky pedestrian behaviours. Another limitation is that the results of this study may not be generalisable to countries with different cultures due to the influence of environment and culture on behaviour.

## CONCLUSION

According to the present study results, there is a clear evidence of the aggregation of TRBs among pedestrians within families. Specifically, the aggregation observed among fathers-offspring as well as siblings emerges as significant components of their familial pattern. In essence, the family unit plays a pivotal role in either shaping or fostering the pedestrian-related risky behaviour within its members.

Regarding the substantial burden of road traffic crash and the high contribution of behaviour in their occurrence, these results hold great importance for the implementation of preventive interventions regardless of the underlying causes of familial aggregation. Intervention programmes aimed at preventing or modifying high-risk behaviours within the community are likely to be more effective when conducted on a family basis rather than on individual basis. Furthermore, there is potential to establish a screening system within referral hospitals to traffic crashes under this system if the injured individual is a pedestrian displaying TRBs, so that their family members could undergo screening for TRBs, too. This proactive approach could help identify and address TRBs within the family unit contributing to improved road safety and reduction in traffic crashes.

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**Contributors** SD and EDE developed the original idea, developed the protocol, interpreted and analyzed data, collected data, and drafted all the manuscript sections. LK, AZ and AGH contributed to the protocol development, data collection, technical comments, and interpretation. All authors read and approved the final version of the manuscript. SD is the overall content guarantor.

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**Competing interests** None declared.

**Patient and public involvement** Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

**Patient consent for publication** Not applicable.

**Ethics approval** This study involves human participants and was approved by the ethics committee at TUMS (Ref No IR.TBZMED.REC. 1400.614). Participants gave informed consent to participate in the study before taking part.

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**Data availability statement** Data are available upon reasonable request.

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#### REFERENCES

- 1 Organization WH. Global status report on alcohol and health 2018: world health organization. 2019.
- 2 Vakili M, Mirzaei M, Pirdehghan A, et al. The burden of road traffic injuries in Yazd province-Iran. *Bulletin of Emergency & Trauma* 2016;4:216.
- 3 Hosseinpour M, Mohammadian-Hafshejani A, Aghdam ME, et al. Trend and seasonal patterns of injuries and mortality due to Motorcyclists traffic accidents; a hospital-based study. *Bulletin of Emergency & Trauma* 2017;5:47.
- 4 Khatibi SR, Dinpanah H, Maajani K, et al. Mahdavi Njioi, research V: the burden of road traffic injuries in the northeast of Iran: the result of a population-based Registry. *J Inj Violence Res* 2020;12:63–72.
- 5 Gorgin L, Khorasani D, Ahmadi N. Demographic characteristics of pedestrians died from traffic accidents in Kurdistan province during 2004-2009. *Iranian Journal of Forensic Medicine* 2011;17:183–8.
- 6 Naghavi M, Abolhassani F, Pourmalek F, et al. The burden of disease and injury in Iran 2003. *Popul Health Metr* 2009;7:9:1–21:.
- 7 Hatamabadi H, Vafae R, Hadadi M, et al. Epidemiologic study of road traffic injuries by road user type characteristics and road environment in Iran: a community-based approach. *Traffic Inj Prev* 2012;13:61–4.
- 8 Karbakhsh M, Zandi NS, Rouzrokh M, et al. Injury epidemiology in Kermanshah: the National trauma project in Islamic Republic of Iran. *East Mediterr Health J* 2009;15:57–64.
- 9 Motamedi MHK, Dadgar E, Ebrahimi A. Curbing road traffic accidents—the major cause of facial fractures. *Int J Emerg Ment Health* 2014;16:326–7.
- 10 Nantulya VM, Reich MR. The neglected epidemic: road traffic injuries in developing countries. *BMJ* 2002;324:1139–41.
- 11 Jancey J, Cooper L, Howat P, et al. Pedestrian and motorized mobility Scooter safety of older people. *Traffic Inj Prev* 2013;14:647–53.
- 12 Beck LF, Dellinger AM, O'Neil ME. Motor vehicle crash injury rates by mode of travel, United States: using exposure-based methods to quantify differences. *Am J Epidemiol* 2007;166:212–8.
- 13 Organization WH. Pedestrian Safety: A Road Safety Manual for Decision-Makers and Practitioners: World Health Organization. 2023.
- 14 Ackermann M, Ragland DR. Pedestrian and bicycle crashes on arterial roads in California. *Transp Res Rec* 2017;2662:68–76.
- 15 Sminkey L. Sminkey L: world report on child injury prevention. *Inj Prev* 2008;14:69.
- 16 Dastgiri S, Esmaili Ejjopm D. Familial aggregation studies for finding risk factors of diseases: A systematic review. *J Prevent Med* 2022;9:308–19.
- 17 Mowrer OH. Learning theory and behavior. Hoboken; 1960. Available: <https://content.apa.org/books/10802-000>
- 18 Sharifi M, Samandari N, Heydari M. Parental biological behavior patterns are influencing the children's biological rhythms. *Khanevadeh Pajoohi* 2005;1:11–5.
- 19 Choudhury N, Benasich AA. A family aggregation study. *J Speech Lang Hear Res* 2003;46:261–72.
- 20 Baglietto L, Jenkins MA, Severi G, et al. Measures of familial aggregation depend on definition of family history: meta-analysis for colorectal cancer. *J Clin Epidemiol* 2006;59:114–24.
- 21 Zimmerman R, Pal DK, Tin A, et al. Methods for assessing familial aggregation: family history measures and confounding in the standard cohort, reconstructed cohort and case-control designs. *Hum Hered* 2009;68:201–8.
- 22 Faraone SV, Larsson H. Larsson H: Genetics of attention deficit hyperactivity disorder. *Mol Psychiatry* 2019;24:562–75.
- 23 Nordquist N, Orelund L. Serotonin, genetic variability, behaviour, and psychiatric disorders—a review. *Ups J Med Sci* 2010;115:2–10.
- 24 Bazargan HS, Haghghi M, Heydari ST, et al. Developing and validating a measurement tool to self-report pedestrian safety-related behavior: the pedestrian behavior questionnaire (PBQ). *Bulletin of Emergency & Trauma* 2020;8:229.
- 25 Sadeghi-Bazargani H, Aboubakri O, Ashgari-Jafarabadi M, et al. Psychometric properties of the short and ultra-short versions of socioeconomic status assessment tool for health studies in Iran (SES-Iran). *Journal of Clinical Research & Governance* 2015;4.
- 26 Lund B, Ma J. Metrics: A review of cluster analysis techniques and their uses in library and information science research: K-means and K-Medoids clustering. 2021;22:161–73.
- 27 Laird NM, Cuenco KT. Cuenco KT: regression methods for assessing familial aggregation of disease. *Stat Med* 2003;22:1447–55.
- 28 Onu JU, Olatayo TI, Okorie AC, et al. Ohaeri JU: family, twin and adoption studies of severe mental disorders in sub-Saharan Africa: a Scoping review. *Soc Psychiatry Psychiatr Epidemiol* 2023;58:685–92.
- 29 Lobo DSS, Kennedy JL. The Genetics of gambling and behavioral Addictions. *CNS Spectr* 2006;11:931–9.
- 30 Waltes R, Chiocchetti AG, Freitag CM. Freitag Cmjajomgpbng: the Neurobiological basis of human aggression: a review on genetic and epigenetic mechanisms. *Am J Med Genet B Neuropsychiatr Genet* 2016;171:650–75.
- 31 DiLalla L. Behavior Genetics of aggression in children. *Review and Future Directions* 2002;22:593–622.
- 32 Bezdjian S, Tuvblad C, Raine A, et al. The genetic and environmental Covariation among psychopathic personality traits, and reactive and Proactive aggression in childhood. *Child Dev* 2011;82:1267–81.
- 33 Veroude K, Zhang-James Y, Fernández-Castillo N, et al. Faraone Svajomgpbng: Genetics of aggressive behavior: an overview. 2016;171:3–43.
- 34 Van der Laan CM. It runs in the family: A genetically informative study of individual differences in aggression. Doctoral Dissertation, Vrije Universiteit Amsterdam; 2022. Available: <https://Nscr.nl/App>
- 35 Sampson RJ, Lauritsen JL. Violent Victimization and offending: Individual-, Situational-, and community-level risk factors. *Understanding and Preventing Violence* 1994;3.
- 36 Sampson RJ, Laub JH, Wimer C. Does marriage reduce crime? A Counterfactual approach to Within-Individual causal effects. *Criminology* 2006;44:465–508.
- 37 Franke B, Faraone SV, Asherson P, et al. The Genetics of attention deficit/hyperactivity disorder in adults, a review. *Mol Psychiatry* 2012;17:960–87.