


Examining self-reported aberrant behavior among Lebanese drivers using the Driver Behavior Questionnaire (DBQ)

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Abstract

Background The Driver Behavior Questionnaire (DBQ) is one of the most used tools for measuring self-reported aberrant driving behavior. Several versions of the DBQ exist varying in terms of the item number and factor structure.

Objectives This study aimed to investigate the psychometric properties and the factorial structure of the DBQ for assessing aberrant behavior among Lebanese drivers and to examine the relationship between DBQ subscales and socio-demographic characteristics and traffic-related variables.

Methods A cross-sectional study was conducted among Lebanese drivers aged over 18 years from all Lebanese governorates. Data were collected using a convenient sampling technique and an anonymous Arabic self-administered questionnaire that included socio-demographic characteristics and the Arabic Lebanese version of the DBQ (DBQ-L). Statistical analyses were performed using SPSS version 24 and Amos software. Exploratory factor analysis (N = 568) and confirmatory factor analysis (N = 534) were used to test the factorial structure of the DBQ-L. Linear regression analyses were performed to examine the association between DBQ-L, sociodemographic, and relevant traffic variables.

Results A total of 1102 drivers aged between 18 and 82 years participated in the study with an average age of 34.64 (SD = 12.33). Of the total, 68.4% of participants were male with an average driving experience of 13.46 years (SD = 10.76). The DBQ-L total scale revealed high internal consistency (Cronbach's $\alpha = 0.892$). Exploratory and confirmatory factor analysis supported the original four-factor structure reflecting aggressive violations, ordinary violations, errors, and lapses dimensions. Aggressive violations had the highest mean among all the DBQ subscales. Men were found to have a higher tendency to commit aggressive and ordinary violations than females. Furthermore, the ordinary violation score was positively associated with younger age and increased mileage. All DBQ subscales decreased with the highest educational level. Being a professional driver increased the likelihood of drivers reporting violations, errors, and lapses, and increased mileage amplified the tendency of displaying aggressive violations and lapses when driving. However, errors decreased for young drivers and increased with age and larger driver experience.

Conclusion The cross-cultural adapted version of the DBQ was found to be a reliable and valid tool for assessing aberrant behaviors among Lebanese drivers. This study revealed distinct behavior patterns, with men frequently displaying

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aggressive violations, and younger, high-mileage drivers more prone to ordinary violations and lapses. Higher education correlated with safer driving, while professional drivers reported more violations, errors, and lapses. These findings highlight the importance of tailored road safety interventions based on driver demographics. Further studies are needed to examine the ability of DBQ to predict road accidents.

Keywords Driver Behavior Questionnaire · Lebanese drivers · Psychometric properties

Abbreviations

DBQ	Driver Behavior Questionnaire
DBQ-L	Lebanese version of the Driver Behavior Questionnaire
EMR	Eastern Mediterranean Region
RTI	Road traffic injuries
C.I	Confidence interval
RTCs	Road traffic crashes
P	P-value
M	Mean
SD	Standard deviation
SPSS	Statistical Package for Social Sciences
CFA	Confirmatory factor analysis
EFA	Exploratory factor analysis
KMO	Kaiser–Meyer–Olkin
CVI	Content Validity Index
CVR	Content validity ratio
RMSEA	Root means square error of approximation
SRMR	Standardized root mean square residual.
GFI	Goodness-of-Fit Index
CFI	Comparative Fit Index
NFI	Normed Fit Index
α	Cronbach's alpha
r	Coefficient de correlation r
d	Cohen'd
IPNET	Lebanese Higher Institute of Technical & Professional

1 Background

Road traffic crashes (RTCs) are recognized as a leading cause of death and disability worldwide. The annual death toll due to RTCs has reached 1.35 million globally, with millions more suffering life-altering injuries and long-lasting effects [1]. Have demonstrated that human factors play a critical role in road traffic accidents [2, 3], particularly, the driver's behavior [4]. Consequently, there has been a growing interest in recent years in investigating the fundamental human factors that affect driving behavior in road transport research [5–7].

1.1 The Driver Behavior Questionnaire (DBQ)

One of the most widely used tools for measuring aberrant driving behaviors is the Driver Behavior Questionnaire (DBQ). It has been tested in various cultural contexts and nationalities, including samples of British, Dutch [8], Irish and Finnish [9], Italian [10, 11], Australian [12], Turkish [13, 14], French [15], Qatari and United Arab Emirates drivers [16]. The original version, developed by Reason et al. [17], evaluated driver behavior under a theoretical framework and reflected the metacognitive skills of drivers. Therefore, the DBQ could be a potential milestone in developing a model for understanding driver behavior [18]. It is important to note that the DBQ is based on the primary differentiation between errors and violations, which are presumed to originate from different psychological roots and appeal to different modes of remediation [17]. Errors are defined as a failure of a planned sequence of mental or physical activities in the selection of an action to achieve the intended goal [17]. However, their consequences could be potentially dangerous. Violations are defined as deliberate risky

behavior, not necessarily reprehensible, but may have detrimental consequences. According to Reason et al., errors reveal a cognitive dysfunction in information processing, whereas violations are derived from psychosocial and motivational origins [17]. Therefore, errors pertain to driving skills, while violations refer to driving style. It is important to note that a driver may commit violations without errors or may commit errors without violations.

Based on the original version of the DBQ, several versions of the instrument have been developed, such as the 104-item version by Aberg and Rimmö in 1998 [19], the 28-item version [20], and the 9-item version edited by Martinussen et al. [21]. In addition to the differences in the number of items, the factorial structures of the DBQ vary among different driving cultures and nations. However, this variety of DBQ versions used in the literature to assess risky driving behavior complicates the ability to compare findings across different studies. Although the most cited factorial structure of the DBQ endorses the original formulation of Reason et al. [17], which displays three factors, other complex factorial structures have also been suggested, e.g., by Rowe et al. [22]. A substantial regional difference between countries was observed in RTCs. Similarly, driver behavior and driving style might vary between countries due to many potential interpersonal conflict areas specific to each country's traffic environment [23].

1.2 Context and significance

Lebanon, a small Eastern Mediterranean nation, has a tumultuous history marked by political turmoil, civil wars, conflicts, instability, and a lack of safety standards. These factors have contributed to a growing problem: road traffic injuries (RTIs), which have been largely overlooked in Lebanon's injury literature, with injury prevention not receiving a high priority [24]. Many countries in the EMR lack simple measures to reduce road traffic injuries. According to the Lebanese Ministry of the Interior and Municipalities, 487 fatalities and 6101 injuries resulting from RTCs were recorded in 2019, mainly due to human factors [25]. However, a road safety tipping point cannot be reached if the human-made epidemic of road traffic injuries (RTI) continues to be neglected, underexplored, and marginalized. Since information related to driver behavior in Lebanon is scarce, exploring the driver behavior that could trigger RTCs could be interesting in pointing out gaps that should be addressed in future interventions. It might be a gateway to new studies to assess other human factors that may be associated with crash involvement as well. To the best of our knowledge, driver behavior has not been previously explored among Lebanese drivers using a psychometrically reliable and valid tool. Certainly, a self-reported evaluation of driving behavior cannot be addressed without the DBQ since it remains the most popular and used tool in traffic psychology that gained wide acceptance in various countries worldwide [26]. Given the absence of previous publication on psychometric evaluation of this instrument in Lebanon, it is therefore important to adapt the DBQ scale robustly for use among Lebanese drivers before embarking to explore their behavior. The investigation of driver behavior using a validated scale could assist stakeholders in target interventions to improve road safety.

1.3 Aims of the present research

The present research has two objectives. The first one is to adapt and validate the Driver Behavior Questionnaire (DBQ) to the socio-cultural characteristics of Lebanese drivers and evaluate its psychometric properties in assessing their aberrant behavior. The second objective is to examine the relationship between the Lebanese version of the DBQ (DBQ-L), sociodemographic characteristics, and relevant traffic variables.

2 Methodology

The validation of the Arabic version of DBQ consisted of two stages. The first stage involved the translation and cross-cultural adaptation of the DBQ into Arabic, while the second stage focused on testing the psychometric properties of the Arabic version of the DBQ among Lebanese drivers.

2.1 Adaptation of DBQ

2.1.1 Translation and back-translation

The original 50-item version of the DBQ was translated into Arabic through a process of forward–backward translation, including translation synthesis [27] (Fig. 1). Two independent bilingual translators, both proficient in English and whose mother tongue was Arabic, translated the English version of the DBQ to Arabic. One of the translators was a

road safety specialist who was aware of the DBQ concept, while the second translator was selected independently from the language department at the Lebanese university and was unaware of the concept. Any discrepancies found between the two translators were considered and discussed, and the two translated versions were synthesized into one. Subsequently, the Arabic translated version was back-translated into English by two independent translators whose native language was English and who were also fluent in Arabic. Notably, these translators did not have a behavioral science or road safety background and did not have access to the original version of the DBQ.

A committee of experts, which included a road safety specialist, a linguistic professional, a psychologist, and the principal investigator, was formed to verify the clarity and suitability of the items in terms of wording and specific features of the Lebanese context. Any inquiries raised in committee meetings were communicated to the forward and back translators. The two versions were reviewed and compared by the experts at the end of this procedure to discuss any discrepancies or inconsistencies in the previous stage of translation. Any changes made to the translated version were resolved by consensus. The committee reached consensus on removing five items and incorporating their contents into other items to avoid redundancy. The removed items were as follows: (1) become impatient with a slow driver in the outer lane and overtake on the inside, (2) On turning left, nearly hit a cyclist who has come up on your inside, (3) Fail to notice someone stepping out from behind a bus or parked vehicle until it is nearly too late, (4) overtake a slow-moving vehicle on the inside lane or hard shoulder of a motorway, and (5) fail to notice pedestrians crossing when turning into a side street from the main road. The rest of the modifications suggested by the review committee are presented in Annex, Table S1.

The translators were responsible for making these changes and updating the translated version once the variations were communicated to them. The pre-final version of the translated DBQ-L was piloted on a small sample of 35 drivers to evaluate the comprehensibility of the questionnaire and provide final input on its language. After completing the questionnaire, each participant was asked to elaborate on their thoughts about each questionnaire item and what their corresponding response meant. Based on their feedback, minor revisions were made, including changing confusing words and potentially misleading items, particularly those related to technical terms not commonly used by Lebanese

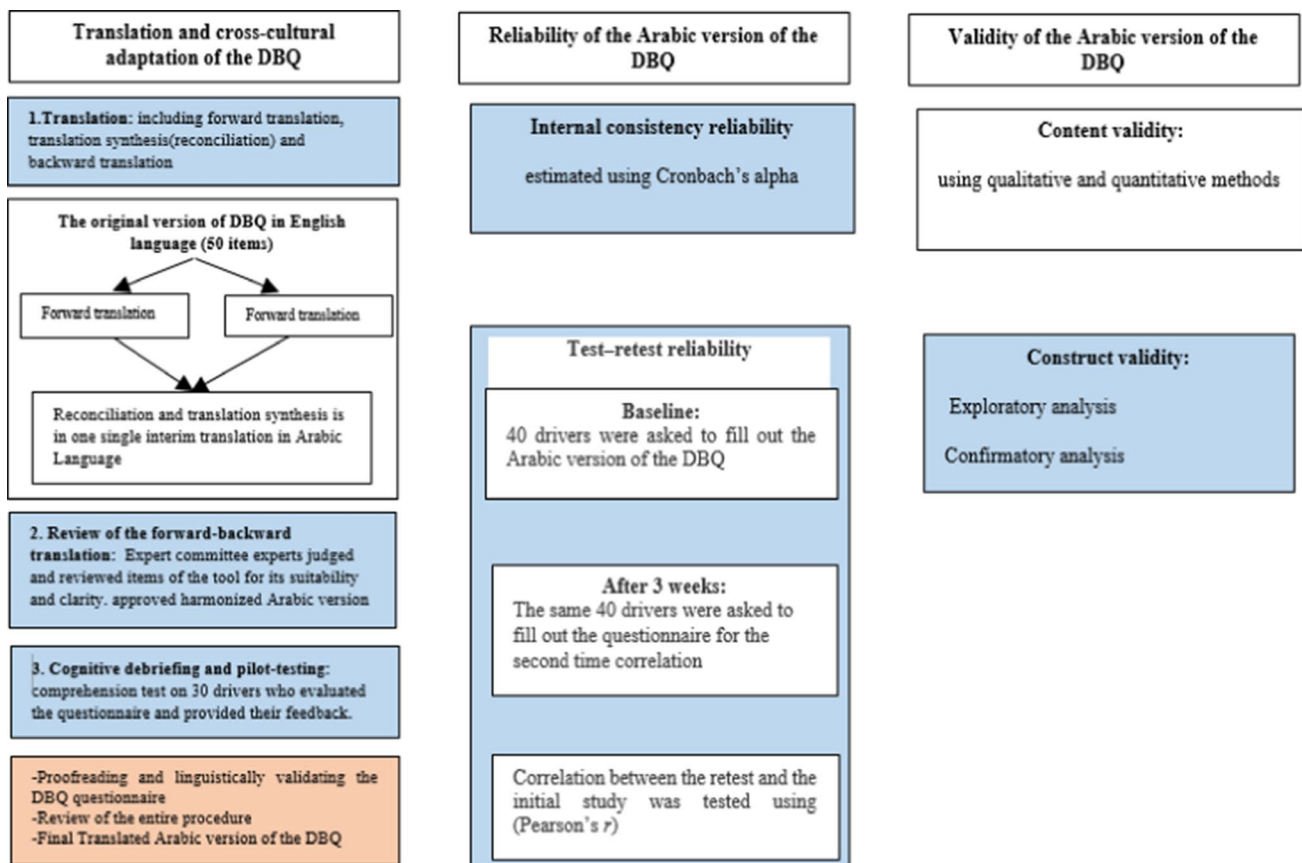


Fig. 1 Processes for cross-cultural adaptation and validation of the Arabic version of DBQ among Lebanese drivers

drivers. These were changed to slang language while conserving their meanings and ensuring that they could still be used in the relevant scale. Finally, the Arabic version of DBQ was produced and was ready for psychometric testing.

2.2 Psychometric testing

2.2.1 Participants and sampling

As part of a large project exploring driver behavior in Lebanon, a cross-sectional study was carried out using a convenience sampling technique among Lebanese drivers aged 18 years and above from all Lebanese provinces over the period from October to December 2019. To ensure the representativeness of the sample in terms of age, gender, and location, and to align the sample distribution with the population for those variables, a weighting procedure was used following an iterative proportional fitting. This procedure involved setting predetermined target figures across gender and age for each Lebanese governorate (Bekaa, Baalbeck-Hermel, Mount-Lebanon, Beirut, North, Akkar, South, and Nabatyeh).

All Lebanese drivers who were 18 years or older, had a driver's license, drove regularly in Lebanon, were literate in Arabic, and agreed to participate were eligible to be part of this study. This study excluded drivers who were not currently practicing driving activities, illiterate drivers who could not understand the questions, non-Lebanese drivers, and drivers who refused to participate in the study. Drivers who rarely drive, i.e., less than once per month, were also excluded. The research protocol was properly evaluated and approved by IPNET. All methods were performed following the relevant guidelines and regulations. The study design assured adequate protection of study participants, and neither included clinical data about patients nor was configured as a clinical trial. None of the survey's questions requested information that could harm the respondent in any way.

2.2.2 Minimal sample size calculation

According to Comrey and Lee, sample size guidance indicated that five to ten observations for each scale item were found necessary for establishing sufficient evidence of scale validity and reliability [28]. The original version of the DBQ scale consists of 50 items. Therefore, we needed 500 participants for the exploratory factor analysis. To increase the validity of the study, we used two different samples: one for the exploratory factor analysis (EFA) and one for the confirmatory factor analysis (CFA). Considering potential losses due to withdrawal, follow-up, or protocol violation, we aimed to recruit more than 500 participants for each analysis (exploratory and confirmatory).

2.3 Reliability

2.3.1 Internal consistency reliability

The reliability of the DBQ was evaluated using internal consistency, which assesses the degree to which each test item measures the same construct. Internal consistency reliability was estimated using Cronbach's alpha, and a value of $\alpha \geq 0.70$ was considered satisfactory according to the Rule of Thumb.

2.3.2 Test–retest reliability

Test–retest reliability measures the degree to which the measurement results in one sitting are consistent and stable over time (usually over two time points, T1 and T2) through the correlation between scores from one administration of the DBQ to another. For test–retest reliability, a small sample size is required, and a minimum of 22 drivers is considered sufficient, as such a test is commonly conducted during the initial pilot study. In this study, 40 drivers were asked to fill out the questionnaire a second time, after almost 3 weeks, which is a relatively short period, to mitigate against conclusions being due to memory bias. Test–retest reliability was evaluated using Pearson correlation (Pearson's r), and a value ≥ 0.70 was considered satisfactory for ruling on the correlation between the retest and the initial study. However, to ascertain the magnitude of agreement between the time points rather than the relationship, we calculated the difference between each data point and the mean (mean difference) alongside the standard deviation. This allowed us to determine how agreeable the measures are based on how close the data points deviate from the line of equality. We expected that 95% of differences would be less than two standard deviations away from the mean.

2.4 Validity

2.4.1 Content validity

Content validity is defined as “the extent to which elements of an assessment tool are relevant and fairly representative to the entire domain the tool seeks to measure [29]. The content validity of the DBQ was determined using the viewpoints of the panel of experts including content experts as well as lay experts. Content experts are professionals who have research experience or work in the field and lay experts who are the potential research subjects (drivers). Of note, using subjects of the target group as expert ensures that the population for whom the instrument is being developed is represented.

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$$CVR = \frac{Ne - \frac{N}{2}}{\frac{N}{2}}$$

“Ne” referred to the number of experts who rated an item as “relevant.” And N referred to the total number of experts [31].

The content validity ratio (CVR) ranges from 1 to –1 and a higher score indicates greater agreement among the panel members on the necessity of an item in an instrument. The acceptable range for the CVR depends on the number of experts on the panel, which in this study was based on the judgments of 8 panelists. According to the criterion values provided by Lawshe, a CVR of 0.49 or higher for each item indicates an acceptable level of significance, and thus the item was retained. The Content Validity Index (CVI) is the mean score of the retained items having a CVR of 0.49 or higher.

2.4.2 Floor and ceiling effects

To assess the sensitivity of the DBQ, we calculated the floor and ceiling effects. Terwee et al. [32] recommended a sample size of 50 participants to evaluate the floor and ceiling effects adequately. We considered floor and ceiling effects of more than 15% to be significant. We defined floor and ceiling effects as the percentage of respondents who scored the lowest or highest status, respectively, on the Arabic-DBQ.

2.4.3 Construct and factorial validity

For construct and factorial validity, we conducted two tests, the Kaiser–Meyer–Olkin (KMO) and Bartlett tests, to evaluate the suitability of the data for factor analysis. We divided our data into two random samples to increase the validity, one for the exploratory factor analysis (EFA) and the other for the confirmatory factor analysis (CFA). We used a sample of 580 drivers to perform a factor analysis using the principal axis factoring (PAF) method with varimax rotation on the retained items from the DBQ via SPSS to identify the DBQ-L dimensions. Based on Eigenvalues > 1 and the scree plot, we determined the number of factors. A minimum factor loading of 0.40 per item was required

for inclusion in the factor. We performed a parallel analysis (PA) to determine the number of components or factors to retain from factor analysis. To assess the internal consistency of the DBQ, we calculated Cronbach's alpha reliability coefficients [33, 34].

2.4.4 Confirmatory Factor Analyses (CFA) and psychometric analyses

The 45-item version of the DBQ-L was subjected to confirmatory analysis using SPSS Amos to examine the goodness of fit of the model to Lebanese drivers and to confirm its factorial structure. Confirmatory factor analyses (CFA) were used to compare the item organization of two models: (a) the exploratory factor model, and (b) the Lebanese adapted model. To identify the best fitting model, the following goodness-of-fit statistics [35] were calculated using IBM AMOS 24.0. The structural models were considered a good fit to the data when the Chi-squared value (χ^2)/degree of freedom (df) χ^2/df was less than 5 [36], the normative fit index (NFI) was greater than 0.9, the goodness of fit (GFI) was greater than 0.9, the comparative fit index (CFI) was greater than 0.9, and the root mean square residual (RMSEA) was less than 0.08 [37]. In the case of a poor fit, modification indices were observed to identify additional parameters that improved the goodness of fit of the models. Covariances were permitted to be freely estimated, and cross-loading items (i.e., items that loaded 0.40 on two or more factors) were eliminated in the modified models [38].

2.4.5 Questionnaire development

An anonymous, self-administered Arabic questionnaire was developed, which included a brief introduction to the study's objectives and instructions on how to complete the questionnaire. The questionnaire comprised mainly closed-ended questions and consisted of three main sections: (a) socio-demographic characteristics; (b) traffic-related variables; and (c) the DBQ scale.

The first section collected socio-demographic data on the participants, including gender, age, marital status, profession, education level, and place of residence. The second section covered traffic-related variables, where drivers were asked about their driving experience and annual mileage. The third section of the questionnaire included the previously mentioned adapted Arabic version of the DBQ, which was intended to objectively assess Lebanese aberrant drivers' behaviors. It consisted of 45 items categorized into four domains intended to measure the main forms of self-reported aberrant behaviors. Each item described a particular aberrant driving behavior, and participants were asked to consider their driving behavior and report the frequency of engagement in these behaviors on a six-point Likert scale (0 = never; 1 = hardly ever; 2 = occasionally; 3 = quite often; 4 = frequently; 5 = nearly all the time). Item scores were summed, with higher scores indicating more frequent aberrant behavior.

2.4.6 Data collection procedure

As no updated official list of drivers was available, potential respondents were recruited from public places such as shopping malls and parking stations through a face-to-face approach. Four well-trained data collectors, who were students majoring in traffic studies at the Lebanese Higher Technical School, were responsible for disseminating the questionnaires. The entire procedure involved administering preliminary questions to assess the eligibility of the participant based on the preset inclusion criteria. Before participation, the study objectives and general instructions were delivered orally by data collectors to the eligible participants. Written informed consent was obtained from eligible respondents who were willing to complete the questionnaire. No reward was given to the drivers for their involvement in the study, which was entirely voluntary. Drivers were also free to withdraw from the study at any time. Since the study was observational, participants' anonymity and confidentiality were respected. Completing the questionnaire took around 10–15 min.

2.5 Statistical analysis

The collected data was entered and analyzed using the statistical software SPSS (Statistical Package for Social Sciences), version 24.0. Since missing data constituted less than 10% of the total database, it was not substituted. Before analysis,

the distribution of each DBQ item was checked for normality. Descriptive analyses were conducted using counts and percentages for categorical variables and mean and standard deviation for continuous measures. A bivariate analysis was conducted using the ANOVA test to compare the means of DBQ subscales and the categorical variables. Pearson correlation was used to examine linear correlation between continuous variables. All variables that showed a p-value less than 0.2 in the bivariate analysis were included in the model as independent variables. Four stepwise linear regressions were performed, taking the DBQ subscales as the dependent variable and the sociodemographic and traffic variables as independent measures. To perform linear regression, the aforementioned variables had to be modified and the number of categories was reduced (categories were merged in cases where there was no significant difference). Significance was set at p-value less than 0.05.

3 Results

3.1 Baseline information

A total of 1102 questionnaires were collected, resulting in a response rate of 80.71%. The age of participants ranged from 18 to 82, with a mean age of 34.64 ± 12.33 years. Of the total participants, 68.4% were male. Around 57.6% of the participants had an education level higher than secondary education and were employed in a job other than professional driving. The mean driving experience was 13.46 ± 10.76 years. Additionally, more than 30% of respondents reported driving a distance of over 10,000 km annually (Table 1). Notably, 43.2% of surveyed drivers reported being involved in road traffic collisions, and 46.8% reported receiving penalties for traffic violations within the past three years (Table 1).

3.2 DBQ-L items

All items had an appropriate intra-class correlation (ICC) with other items, and none of the 45 items was deleted. The high level of internal consistency for the 45 items, suggested that they were homogenous. The DBQ scale has good reliability (Cronbach's $\alpha = 0.892$). Table 2 showed the mean and the standard deviation of all 45 items of the DBQ scale.

3.3 Flooring and ceiling results

No floor or ceiling effects were detected since all the dimensions had low values of bottom and ceiling effects (< 15%). Ten respondents obtained the highest status scores of 10%.

3.4 Test–retest reliability

The value of the Pearson correlation ((Pearson's r) was satisfactory ($0.82 \geq 0.70$). Furthermore, the mean difference and 95% LOA were calculated as 3.18 (–5.18 to 12.14) after 21 days.

3.5 Exploratory factor analysis

The original sample was split into 2 samples using random sampling. A sample of 580 drivers was used for conducting exploratory analysis. Initially, using varimax rotation, items converged over a solution of four factors that had eigenvalues over 1.0 and the examination of the scree plot suggested that the four-factor solution was the most interpretable one. (Factor 1 = Aggressive violations, Factor 2 = Simple/ordinary violation, Factor 3 = Errors and Factor 4 = Lapses). The result of the KMO test (KMO = 0.935) was satisfactory and that of Bartlett's test was highly significant ($p < 0.001$). The total variance explained was 75.36%, and the Cronbach's $\alpha = 0.892$. Parallel analysis (PA) revealed also that the four factors explained 75% of the total variance would have been selected. Both analyses yielded the same results in terms of the higher factor coefficient for each of the items selected. Table 3 presented the loadings of the 45 items on each of these four factors. The first factor explains 28.45% of the total variance and consists of 15 items measuring lapses. The second factor includes 15 items that tapped drivers' errors and accounted for 21.94% of the variance. We labeled this factor as "errors". The third factor includes 10 items about simple traffic violations and accounted for 17.41% of the variance and was named "Ordinary violations". The fourth factor included 5 items that tapped aggressive reactions to driving situations. This factor accounted for 7.55% of the variance and was named "Aggressive violations". Of note, one item related

Table 1 Socio-demographics characteristics of surveyed Lebanese drivers (N=1102)

	N	%
Gender		
Male	754	68.40%
Female	348	31.60%
Age (mean \pm S.D)	34.64 \pm 12.33	
Marital status		
Single	466	42.30%
Married	576	52.30%
Other (widowed, separated)	60	5.60%
Education level		
Secondary and below	468	42.40%
University or above	634	57.60%
Occupation		
Student	272	24.70%
Professional driver (taxi)	116	10.50%
Working other than a professional driver	630	57.20%
Other (not working, housewife)	84	7.60%
Years of driving experience (mean \pm S.D)	13.46 \pm 10.76	
Annual mileage (Km)		
< 6000 km	524	47.5%
6000–10000 km	242	22.00%
> 10,000 km	336	30.50%
Road traffic crashes in the previous 3 years		
No	626	56.80%
Yes	476	43.20%
Number of RTCs in the previous 3 years	0.76 \pm 1.488	
Fines in the last 3 years		
No	586	53.20%
Yes	516	46.80%
Number of fines in the previous 3 years	0.7 \pm 1.078	

S.D Standard deviation, *n* frequency, % percentage, RTCs road traffic crashes, *km* Kilometers

to ordinary violation (DBQ33: Cut the corner on a right-hand turn and have to swerve violently to avoid an oncoming vehicle) loaded in the “aggressive violation component.

3.6 Reliability analyses and inter-correlations between factors

Table 4 shows the reliability estimates for the study. The α -values obtained from the subscales ranged between 0.68 and 0.814, indicating good internal consistency. The overall reliability of the DBQ-L scale was also good, with an α of 0.85. Similarly, all the subscales were reliable, with alpha reliabilities for aggressive violations, ordinary violations, errors, and lapses subscales being 0.68, 0.79, 0.81, and 0.73, respectively. Skewness estimates for the four factors ranged from 0.075 to 0.967, and kurtosis estimates ranged from 0.521 to 0.714, allowing for the use of parametrical correlational analyses. Males ranked higher than females in the subscales of DBQ-L related to violations, particularly the one related to aggressive violations. Of the four subscales, the highest item mean was for aggressive violations, followed by ordinary violations, lapses, and then errors. The correlation between DBQ-L factors ranged from 0.435 to 0.572, with most of them being highly statistically significant ($p < 0.001$) and having a moderate correlation (see Annex, Table S2).

Table 2 Mean and standard deviation of the Lebanese version of the Driver Behavior Questionnaire items

#		All drivers (n= 1102)	
		Mean	S.D
DBQ1	Attempt to drive away from traffic lights	2.52	0.708
DBQ2	Check your speedometer and discover that you are unknowingly traveling faster than the legal limit	2.55	0.711
DBQ3	Lock yourself out of your car with the keys still inside	2.52	0.687
DBQ4	Drive as fast along country roads at night on dipped lights as on a full beam	2.55	0.731
DBQ5	Attempt to drive away without first having switched on the ignition	2.54	0.584
DBQ6	Drive especially close or "flash" the car in front as a signal for that driver to go faster or get out of your way	2.67	0.677
DBQ7	Forget where you left your car in a car parking	2.53	0.714
DBQ8	Distracted or preoccupied, realize belatedly that the vehicle ahead has slowed, and have to slam on the brakes to avoid a collision	2.55	0.637
DBQ9	Intend to switch on the windshield wipers, but switch on the lights instead, or vice versa	2.64	0.723
DBQ10	Turn left onto the main road into the path of an oncoming vehicle that you hadn't seen, or whose speed you had misjudged	2.58	0.577
DBQ11	Misjudge your gap in a car park and nearly (or actually) hit an adjoining vehicle	2.57	0.524
DBQ12	"Wake up" to realize that you have no clear recollection of the road along which you have just traveled	2.50	0.680
DBQ13	Miss your exit on a motorway and have to make a lengthy detour	2.42	0.624
DBQ14	Forget which gear you are currently in and have to check with your hand	2.49	0.739
DBQ15	Stuck behind a slow-moving vehicle on a two-lane highway, you are driven by frustration to try to overtake in risky circumstances	2.50	0.573
DBQ16	Intending to drive to destination A, you, "wake up" to find yourself on route to B, where the latter is the more usual journey	2.50	0.720
DBQ17	Take a chance and cross on lights that have turned red	2.56	0.797
DBQ18	Angered by another driver's behavior, you give chase to give him/her a piece of your mind	2.61	0.607
DBQ19	Have an aversion to a particular class of road user and indicate your hostility by whatever means you can	2.61	0.547
DBQ20	Try to overtake without first checking your mirror, and then get hooted at by the car behind which has already begun its overtaking maneuver	2.63	0.543
DBQ21	Deliberately disregard the speed limits late at night or very early in the morning	2.52	0.715
DBQ22	Forget when your road tax/insurance expires and discover that you are driving illegally	2.57	0.783
DBQ23	Lost in thought, you forget that your lights are on the full beam until, "flashed" by other motorists	2.52	0.786
DBQ24	In a queue of vehicles turning left onto the main road, pay such close attention to the traffic approaching from the right that you nearly hit the car in front	2.48	0.758
DBQ25	Drive back from a party, restaurant, or pub, even though you realize that you may be over the legal blood-alcohol limit	2.52	0.814
DBQ26	Lost in thought or distracted, you fail to notice someone waiting and crossing a pelican crossing light that has just turned red	2.59	0.634
DBQ27	Park in a no parking zone and risk a fine	2.58	0.706
DBQ28	Misjudge the speed of the oncoming vehicle when overtaking	2.56	0.685
DBQ29	Hit something when reversing that you had not previously seen	2.50	0.718
DBQ30	Plan your route badly, so that you meet traffic congestion you could have avoided	2.60	0.632
DBQ31	Overtake a single line of stationary or slow-moving vehicles, only to discover that they were queuing to get through a one-lane gap or roadwork lights	2.57	0.549

Table 2 (continued)

#		All drivers (n = 1102)	
		Mean	S.D
DBQ32	Cut the corner on a right-hand turn and have to swerve violently to avoid an oncoming vehicle	2.54	0.571
DBQ33	Get into the wrong lane at a roundabout or approaching a road junction	2.53	0.671
DBQ34	Fail to read the signs correctly, and exit from a roundabout on the wrong road	2.54	0.704
DBQ35	Fail to give way when a vehicle is signaling its intention to pull out	2.53	0.687
DBQ36	Ignore „give way“ signs, and narrowly avoid colliding with traffic having right of way	2.53	0.614
DBQ37	Fail to check your mirror before pulling out, changing lanes, turning, etc	2.57	0.587
DBQ38	Attempt to overtake a vehicle that you hadn't noticed was signaling its intention to turn right	2.55	0.574
DBQ39	Deliberately drive the wrong way down a deserted one-way street	2.62	0.801
DBQ40	Disregard red lights when driving late at night along empty roads	2.60	0.760
DBQ41	Drive with only „half-an-eye“ on the road while using the mobile, changing radio channels, turning on the air conditioner...	2.58	0.761
DBQ42	Get involved in unofficial „races“ with other drivers	2.56	0.760
DBQ43	Race“ oncoming vehicles for a one-car gap on a narrow or obstructed road	2.57	0.666
DBQ44	Brake too quickly on a slippery road and/or steer the wrong way in a skid	2.55	0.606
DBQ45	Misjudge your crossing interval when turning right and narrowly miss a collision	2.55	0.586

Table 3 Four-factor solution of DBQ-L items, eigenvalues, and Cronbach's alpha coefficients, and variance of the DBQ subscales both among Lebanese drivers

#		DBQ components		
		Lapses	Errors	Aggressive violations
DBQ34	Fail to read the signs correctly, and exit from a roundabout on the wrong road	0.923		
DBQ12	"Wake up" to realize that you have no clear recollection of the road along which you have just traveled	0.899		
DBQ33	Get into the wrong lane at a roundabout or approaching a road junction	0.896		
DBQ3	Lock yourself out of your car with the keys still inside	0.886		
DBQ23	Lost in thought, you forget that your lights are on the full beam until „flashed“ by other motorists	0.884		
DBQ23	Check your speedometer and discover that you are unknowingly traveling faster than the legal limit	0.884		
DBQ13	Miss your exit on a motorway and have to make a lengthy detour	0.866		
DBQ1	Attempt to drive away from traffic lights	0.862		
DBQ24	In a queue of vehicles turning left onto the main road, pay such close attention to the traffic approaching from the right that you nearly hit the car in front	0.851		
DBQ22	Forget when your road tax/insurance expires and discover that you are driving illegally	0.847		
DBQ16	Intending to drive to destination A, you „wake up“ to find yourself on route to B, where the latter is the more usual journey	0.842		
DBQ29	Hit something when reversing that you had not previously seen	0.840		
DBQ14	Forget which gear you are currently in and have to check with your hand	0.826		
DBQ35	Fail to give way when a vehicle is signaling its intention to pull out	0.807		
DBQ9	Intend to switch on the windscreen wipers, but switch on the lights instead, or vice versa	0.805		
DBQ11	Misjudge your gap in a car park and nearly (or actually) hit an adjoining vehicle	0.944		
DBQ10	Turn left onto the main road into the path of an oncoming vehicle that you hadn't seen, or whose speed you had misjudged	0.927		
DBQ26	Lost in thought or distracted, you fail to notice someone waiting and crossing a pelican crossing light that has just turned red	0.917		
DBQ45	Misjudge your crossing interval when turning right and narrowly miss a collision	0.902		
DBQ5	Attempt to drive away without first having switched on the ignition	0.842		
DBQ38	Attempt to overtake a vehicle that you hadn't noticed was signaling its intention to turn right	0.839		
DBQ28	Misjudge the speed of the oncoming vehicle when overtaking	0.825		
DBQ7	Forget where you left your car in a car parking	0.812		
DBQ20	Try to overtake without first checking your mirror, and then get hooted at by the car behind which has already begun its overtaking maneuver	0.807		
DBQ36	Ignore „give way“ signs, and narrowly avoid colliding with traffic having right of way	0.802		
DBQ44	Brake too quickly on a slippery road and/or steer the wrong way in a skid	0.802		
DBQ8	Distracted or preoccupied, realize belatedly that the vehicle ahead has slowed, and have to slam on the brakes to avoid a collision	0.789		
DBQ37	Fail to check your mirror before pulling out; changing lanes, turning, etc	0.787		
DBQ31	Overtake a single line of stationary or slow-moving vehicles, only to discover that they were queuing to get through a one-lane gap or roadwork lights	0.786		
DBQ30	Plan your route badly, so that you meet traffic congestion you could have avoided	0.775		
DBQ40	Disregard red lights when driving late at night along empty roads	0.953		

Table 3 (continued)

#		DBQ components			
		Lapses	Errors	Ordinary violations	Aggressive violations
DBQ17	Take a chance and cross on lights that have turned red			0.941	
DBQ4	Drive as fast along country roads at night on dipped lights as on full beam			0.931	
DBQ21	Deliberately disregard the speed limits late at night or very early in the morning			0.929	
DBQ41	Drive with only „half-an-eye“ on the road while using the mobile, changing radio channel, turning on A.C etc			0.925	
DBQ25	Drive back from a party, restaurant, or pub, even though you realize that you may be over the legal blood-alcohol limit			0.923	
DBQ39	Deliberately drive the wrong way down a deserted one-way street			0.921	
DBQ42	Get involved in unofficial „races“ with other drivers			0.886	
DBQ27	Park in a no parking zone and risk a fine			0.867	
DBQ43	Race“ oncoming vehicles for a one-car gap on a narrow or obstructed road			0.744	
DBQ33	Cut the corner on a right-hand turn and have to swerve violently to avoid an oncoming vehicle				0.908
DBQ18	Angered by another driver's behavior, you give chase to give him/her a piece of your mind				0.864
DBQ15	Stuck behind a slow-moving vehicle on a two-lane highway, you are driven by frustration to try to overtake in risky circumstances				0.858
DBQ19	Have an aversion to a particular class of road user and indicate your hostility by whatever means you can				0.854
DBQ6	Drive especially close or „flash“ the car in front as a signal for that driver to go faster or get out of your way	12.80	9.87	7.84	0.682
	Eigenvalue				3.40
	Cronbach alpha	0.73	0.81	0.79	0.680
	Variance (%)	28.445	21.942	17.416	7.553

Factor loadings below .30 were omitted for the sake of clarity, 75.36% of the variance was explained, Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization

Table 4 Summary statistics for the DBQ-L subscales

#	Number of items	Item mean	All drivers (n = 1102)							Male (n = 754)		Female (n = 348)	
			Scale Mean	S. D	Min	Max	Alpha α	Skewness	Kurtosis	Mean	S. D	Mean	S. D
Aggressive violations	5	2.99	14.98	2.04	11	24	0.68	0.075	0.654	15.03	2.11	14.8	1.9
Ordinary violations	10	2.65	26.56	4.72	19	49	0.79	0.213	0.634	26.46	4.69	25.8	4.79
Errors	15	2.21	33.27	5.9	23	57	0.81	0.967	0.589	33.23	5.84	33.34	6.08
Lapses	15	2.52	37.8	4.8	28	65	0.73	0.579	0.521	37.84	4.97	37.73	4.43
DBQ-L scale	45	2.51	113.14	14.5	91	188	0.85	0.336	0.714	113.0	14.8	113.3	14.89

N.B: S.D refers to standard deviation, alpha referred to Cronbach alpha, min for minimum and max for maximum, Vehicle/Env refers to the vehicle and environment dimension

3.7 Confirmatory factor analysis

The default model resulting from the exploratory analysis was not acceptable based on the fit indicators shown in Table 5. High correlation between errors (e2 and e1, e3 and e4, e1 and e5) was found using modification indices. Therefore, several model specifications were performed to adjust the model for a better fit. These included drawing eight covariates between the following errors: e8–e15, e1–e9, e16–e18, e18–e30, e27–e29, e21–e22, e16–e17, and e17–e18, respectively. The model used in confirmatory factor analyses is presented schematically in Annex, Figure S1. This resulted in a better fit than the default model. The model fit measures of the data analysis were as follows: $\chi^2 = 3929.5$, $\chi^2/df = 4.221 < 5$; NFI = 0.912 > 0.9, CFI = 0.907 > 0.9, GFI = 0.906 > 0.9, AGFI = 0.902 > 0.9, RMSEA = 0.071 < 0.08, therefore suggesting a reasonable model fit.

3.8 DBQ-L and socio-demographic variables

As a result of bivariate analysis, gender differences revealed that men reported a higher tendency to commit aggressive violations ($p = 0.048 < 0.05$) and ordinary violations ($p = 0.049 < 0.05$) than women. Cohen's d was very small, indicating a limited effect size. However, errors and lapses did not reveal significant differences between men and women. Moreover, the occupation and educational level of the surveyed drivers significantly affected the four dimensions of aberrant behaviors (aggressive violations, ordinary violations, errors, and lapses). Drivers with a secondary educational level or less were more prone to involve in aggressive and ordinary violations, errors, and lapses behavior than their counterparts with the highest educational level. In regards to the relations between DBQ-L, age, and driving experience, Pearson correlations revealed that ordinary violation ($r = -0.559$, $p < 0.001$) and lapses ($r = -0.544$, $p < 0.001$) were negatively correlated with age. Younger age is related to an increase in ordinary violations and lapse subscales. However, errors ($r = 0.442$, $p < 0.001$) were positively associated with age and had a different pattern where errors decreased for young drivers. In addition, aggressive violations ($p < 0.001$), ordinary violations ($p < 0.001$), errors ($p < 0.001$), and lapses ($p = 0.016 < 0.001$) increased with annual mileage. Despite violations ($r = -0.142$, $p < 0.001$) and lapses ($r = -0.135$, $p < 0.001$) decreasing with driving experience, errors were found to increase with driving experience ($r = 0.161$, $p < 0.001$) (Annex, Table S3).

3.9 Multivariable analysis

In terms of aggressive violations, older age, female gender, large driving experience and high education level were found negatively associated with the Lebanese driver's involvement in aggressive violations. However, increased annual mileage and being professional driver were both positively associated with aggressive violations among these drivers. Similar

Table 5 Model fit indicators for DBQ-L

	χ^2	χ^2/df	NFI	CFI	GFI	AGFI	SRMR	RMSEA
Model based on EFA result	5939.232	6.325	0.822	0.845	0.703	0.736	0.0456	0.097
Adapted model	3929.514	4.221	0.912	0.907	0.906	0.902	0.048	0.071

associations were found between the overmentioned sociodemographic characteristics and ordinary violations. As for errors, professional and older drivers and those who had an increased mileage were more prone to be involved in erroneous behavior when driving. However, larger driving experience and higher education level were found negatively associated with such an erroneous behavior. Lapses were also found positively associated with increased annual mileage and being professional drivers and negatively associated with larger driving experience and higher education level (Table 6).

4 Discussion

Given that human factors, including driver behavior, are major contributors to RTCs [5–7], improving driver behavior is one of the overriding goals of road safety. DBQ is a prominent measurement scale based on self-reported behavior, which has been used in many countries to efficiently examine drivers' aberrant behaviors, despite minor cultural nuances. Thus, there is an urgent need for an accurately translated and rigorously validated tool to assess driver aberrant behavior and its associated risk in Lebanon and Arabic-speaking communities.

Our findings indicate that the DBQ-L has adequate psychometric properties, revealing good reliability across all subscales. The DBQ-L factorial structure was comparable to the structure proposed by Harrison et al. [39], revealing four dimensions, namely aggressive violations, ordinary violations, errors, and lapses. Despite small differences in the theoretical four-factor structure of the DBQ, the overall factor structure has been confirmed in different samples [8, 16, 40, 41]. The four factors also had acceptable reliabilities, with the lowest one shown in the subscale related to "aggressive

Table 6 Linear regression for each of the DBQ-L subscale

		Standardized coef- ficients beta	t	Sig.	F	Sig.
Aggressive violations	Age	−0.081	−1.499	0.034	4.891	<0.001
	Gender (female vs male)	−0.003	−0.109	0.024		
	Driving experience (large vs small)	−0.010	−0.184	0.044		
	Education level (high vs low)	−0.029	−0.909	0.363		
	Annual mileage	0.058	1.785	0.045		
	Occupation (Professional driver vs nonprofessional driver)	0.126	3.902	<0.001		
Ordinary violations	Age	−0.052	−1.003	0.016	20.856	<0.001
	Gender (female vs male)	−0.069	−2.237	0.025		
	Driving experience (large vs small)	−0.163	−3.026	0.003		
	Education level (high vs low)	−0.071	−2.309	0.021		
	Annual mileage	0.128	4.061	<0.001		
	Occupation (Professional driver vs nonprofessional driver)	0.227	7.304	<0.001		
Errors	Age	0.019	0.357	0.021	23.247	<0.001
	Gender (female vs male)	0.031	1.004	0.315		
	Driving experience (large vs small)	−0.236	−4.410	<0.001		
	Education level (high vs low)	−0.087	−2.849	0.004		
	Annual mileage	0.075	2.396	0.017		
	Occupation (Professional driver vs nonprofessional driver)	0.244	7.874	0.000		
Lapses	Age	0.054	1.005	0.315	10.855	<0.001
	Gender (female vs male)	−0.012	−0.375	0.708		
	Driving experience (large vs small)	−0.248	−4.502	<0.001		
	Education level (high vs low)	−0.089	−2.836	0.005		
	Annual mileage	0.104	3.215	0.001		
	Occupation (Professional driver vs nonprofessional driver)	0.098	3.075	0.002		

violation". The DBQ-L multidimensional structure is statistically supported by satisfactory fit indices when running a confirmatory analysis. The factorial solution of the DBQ-L also matches the meaning of the four broad facets of the 28-item version among Australian drivers [42]. However, other studies have established diverse item and factor structures that fit their data better using other forms of the DBQ, such as the 32-item four-factor Swedish DBQ [43]; the 22-item four-factor Persian DBQ [43], and the 50-item four-factor solution based on data from drivers in Australia [12]. Such discrepancies in factor configuration could be attributed to the misunderstanding and different interpretations of certain items by participants.

Of the four subscales, the highest item mean score was for aggressive violations, followed by ordinary violations, lapses, and then errors. Our results were inconsistent with the findings of a study conducted among Australian drivers that showed the highest mean score was for lapses, followed by aggressive violations and violations. The scores for the current sample were higher than those found by Harrison et al. [39]. In addition, the frequencies of the DBQ responses among Lebanese drivers ranged from "never" to "hardly ever" and rarely "occasionally," which was in line with the findings of previous studies [12, 19, 40]. However, Lebanese drivers, in general, scored higher in all DBQ items than Arab Gulf drivers (Qatari and United Arab Emirati) [16], much higher than British [17], Australian [12], Finnish and Dutch [8], and even higher than Greek and Turkish (e.g., [23]) drivers. This is consistent with a tendency found in the study by Ozkan et al. [23]. The DBQ factor structure might become more indistinct as the occurrence of the behaviors gets higher when moving from West/North to East/South. The interpretation of errors and aggressive violations factors differs from country to country. Shinar et al. suggested that aggressive driving would be highly influenced by the cultural context [44], violations are affected by contextual factors [17] and errors are mainly related to the cognitive processes of the individual or the lack of supportive social and physical context [23].

No floor or ceiling effects were detected for the DBQ-L. This indicates a good distribution of scores for the -DBQ-L, good content validity, and additional support of adequate reliability. In the present study, the obtained internal consistency indicates good homogeneity of items of the adapted questionnaire, which is a significant feature of a questionnaire, especially if all items are assessing the same concept. The test-retest reliability of the DBQ-L was found good as well.

Gender differences revealed that men reported a higher tendency to commit aggressive violations and ordinary violations. Similar results were found in previous studies that also reported that men exhibited violation behaviors more frequently than women [12, 17, 19, 39, 45] and when considered separately, aggressive violations [39]. In our study, no significant difference across gender was found concerning self-reported errors. This was consistent with the findings of the study conducted by Reason et al. [17]. Of note, some studies have reported a higher tendency in females to report lapses [17, 24, 45, 46] which were not consistent with our study.

Younger age increased annual mileage, and less driving experience were found to be related to an increased violation score. Hence, violations decreased with age and increased with larger driving experience. Similar results were reported by a study conducted among Australian drivers [42]. However, the increase of violations with experience could be anticipated since beginner drivers lack confidence in their driving performance and are still in the phase of building confidence, hence avoiding perpetrating traffic violations [47]. When they get more experience, they feel more familiar with the traffic environment and increased traffic violations.

In regard to aggressive violations and lapses, they increased with the distance traveled annually. Remarkably, lapses increased also with the younger age. However, drivers who have more driving exposure are more prone to aberrant behavior including all its aspects (violations, errors...) [17, 47]. Higher education was found to be related to a decreased aberrant behavior (violations, errors...) Drivers with a secondary educational level or less were more prone to involve in aggressive and ordinary violations, errors, and lapses behavior than their counterparts with the highest educational level. Being a professional driver increases the likelihood to report violations, errors, and lapses. This could be understood under the umbrella of high exposure to traffic and longer driving periods.

Errors showed a different pattern, where it was found that errors decreased for young drivers and increased with age and with larger driving experience. Compared to a previous study, errors were found to decrease for young drivers but remained quite unchanged with age within the older samples [42]. Concerning the confounding roles of age and experience, a more specific insight was provided by Wells et al. Their results showed that compared to drivers with 6, 12, 24, and 36 months of experience, older drivers had consistently lower violation scores than younger drivers. In this case, the effects of experience on errors could be explained by the fact that novice drivers are still in the learning phase, hence improving their skills and reducing their driving errors. A driving simulator study about errors and violations during the training of pre-licensed drivers showed similar results [47]. At a later age, acquired driving skills can be weakened, and a further increase in errors could be expected.

4.1 Strengths and limitations of the study

This study is the first to examine the reliability and factor structure of the DBQ in a large and diverse sample of Lebanese drivers, and to investigate its relationship with socio-demographic characteristics. The validated scale used demonstrated very good to excellent reliability, and the sample size had adequate power for conducting the factorial analysis. However, several limitations related to methodological and qualitative biases should be acknowledged. Firstly, the study's cross-sectional design does not allow for deriving causal relationships of the main associations. Although the sample was stratified by gender, age, and geographical regions, selection bias might be present due to the use of the convenience sampling technique, as the sample included a high percentage of university-educated participants. Thus, there are concerns related to the representativeness of the sample. Additionally, the data were based solely on drivers' self-reported behavior without any observation. Similar to research in this area, concerns remain regarding the reliability of the reported behavior due to the self-report methodology, including the propensity of participants to provide socially desirable responses, particularly for answers related to positive and aggressive driving behaviors [48]. Of note, Lajunen and Summala directly examined DBQ responses and found that the influence of social desirability on responses is not considerable, especially when completed in privacy [8]. Sullman and Taylor (2010) have also shown that social desirability is only a minor issue in DBQ responses and aberrant driving behaviors [49]. Furthermore, it has been found that the driving behaviors measured with DBQ are strongly linked with observed driver behaviors on the road [50]. Given that participants in the current study completed the questionnaires anonymously and were assured of the confidentiality of their responses, the impact of social desirability on responses is expected to be minimal. Future studies linking self-report data with participants' driving records are recommended. Additionally, the target group of the present study was Lebanese drivers. Although Syrian and Palestinian refugees might represent a notable proportion of the drivers' population in our country, the present study was restricted to Lebanese drivers due to difficulties in data collection and probable differences in the behavior of drivers originating from different countries, even though they share the same traffic environment. Finally, residual confounding is still possible. In summary, further research is required to establish the concurrent and predictive validity of the DBQ scale for the Lebanese setting, as well as the factorial invariance of the DBQ across gender, age groups, and driver profiles. Identifying additional factors associated with traffic offenses and crash involvement among both private and professional drivers can only benefit current road safety initiatives.

4.2 Implications

These findings offer valuable insights for policymakers, educators, and safety advocates, underscoring the need for targeted interventions to address specific risk factors and reduce violations and erroneous behaviors, thereby improving road safety. Understanding the intricate dynamics of driver behavior across various demographics and experience levels is crucial for developing effective strategies to reduce road accidents and enhance overall traffic safety. Effective countermeasures targeting aberrant driver behavior such as strict law enforcement, driver education, booster driving sessions, counseling, and training programs in multifaceted driving situations are recommended to avoid driver violations and distractions, and reduce their involvement in RTCs. Further studies examining the extent to which each of the DBQ subscales can predict crash involvement are recommended. This will provide key information for road safety strategies to reduce violations and aberrant behaviors.

5 Conclusion

The Lebanese version of DBQ, with its confirmed multifactorial structure, is a reliable and valid instrument appropriate for use in the Lebanese driving context to measure aberrant driving behaviors. Notably, the study identifies distinct patterns of behavior among drivers highlighting gender differences where men tend to exhibit a higher propensity for aggressive and ordinary violations compared to their female counterparts. Additionally, age and experience played crucial roles in shaping driver behavior with younger, high-mileage drivers more prone to ordinary violations and lapses. Education level emerged as another influential factor, with drivers at higher educational levels exhibiting fewer risky behaviors across all DBQ subscales. The role of being a professional driver was associated with an increased likelihood of reporting violations, errors, and lapses, highlighting the importance of addressing risky behavior in this group. These findings offer valuable insights for policymakers, educators, and safety advocates, as they underscore the need for targeted interventions to

address specific risk factors and improve road safety. Further studies are needed to examine the invariance of DBQ structure across age, gender, and occupation of Lebanese drivers and its ability to predict RTCs in each category.

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Declarations

Ethics approval and consent to participate Written informed consent was obtained for each participant. They were reassured that their participation is voluntary and that they were free to withdraw at any time. In addition, all information was gathered anonymously and handled confidentially. The study design assured adequate protection of study participants, and neither included clinical data about patients nor configured itself as a clinical trial.

Consent for publication Not applicable.

Competing interests The authors declare that they have no competing interests.

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