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Factor analysis of driver behavior questionnaire (DBQ) in public transportation bus company: investigation of the relationship between DBQ factors and crashes

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ABSTRACT

The main objectives of the present study are to evaluate the validity and reliability of the driver behavior questionnaire (DBQ) among professional bus drivers and to investigate the relationship between the DBQ factors, demographic and driving variables with self-reported crashes involvement. DBQ has been investigated based on content and construct validity in order to examine the panelists' viewpoints and underlying dimensions through exploratory factor analysis (EFA). The questionnaires (DBQ, demographic and driving information) completed by 168 male professional bus drivers. EFA was performed with extraction method of the principal axis factoring (PAF) and varimax rotation. In order to survey the relationship between the DBQ factors, demographic and driving variables with self-reported crashes, Pearson correlation test was used. The results of factor analysis showed four factors: risky violation, slip and lapse, highway violation, and mistake which all cover 45.1% of the total variance. There were a negative significant correlation between risky violation and mileage, as well as a positive significant correlation between highway violations and

crashes involvement. 15-items of the DBQ will be a relatively suitable measure for studying bus drivers' behavior in the future research directions. Improving cultural aspects related to the public expectations of the bus drivers play an effective role in reducing some violations of the bus drivers.

1. Introduction

The WHO statistics show that Iran suffers one of the highest rates of morbidity and mortality due to traffic accidents throughout the world, which occurs among professional and nonprofessional drivers, motorcyclists, pedestrians, etc (Attarchi et al. 2011). Rumar (1985) has estimated that the most important factor in 90–95% of traffic crashes is human actions (Lajunen, Parker, and Summala 2004). Driver behavior is a proximal factor in the road traffic injuries causation chain (Motevalian et al. 2011). Reason and his colleagues divided human risk behavior to errors and violations, and developed a survey instrument, driver behavior questionnaire (DBQ), to measure these concepts in driver behavior (Reason et al. 1990).

1.1. Some of studies the DBQ factors and its relation with crash involvement

The DBQ was widely used for measuring both driving style and relationship between driving behavior and crash involvement (De Winter and Dodou 2010). Different studies conducted in other countries regarding factor analysis for example, include: seven factors of mistakes, highway violations, negligence, aggressive violations, lapses, social disregard, and parking violation were obtained in a sample of Greek drivers (Kontogiannis, Kossiavelou, and Marmaras 2002), four factors of errors, lapses, violation, and aggressive violations were obtained from truck drivers in New Zealand (Sullman, Meadows, and Pajo 2002) and also Finnish drivers (Lajunen, Parker, and Summala 2004), three factors of errors, highway violations, and aggressive driving violations were identified in a sample of Australian fleet drivers (Davey et al. 2007), four factors of errors, pushing-speeding, violation, lapses, and aggression-speeding violations were found among Qatar drivers (Bener, Özkan, and Lajunen 2008), five factors of emotional violations, risky violation, self-willed violations, inexperience errors, and distraction errors were produced among Beijing drivers (Shi et al. 2010), six factors of speed violation, traffic errors, safety violations, traffic violation, stunts, and control errors were shown in a sample of Motorcycle riders behavior in Iran (Motevalian et al. 2011), four factors of unfocused errors, confused errors, emotional violation, and reckless violations were shown across Danish drivers (Martinussen et al. 2013).

Studies accomplished in the context relationship between the DBQ factors with crash involvement, for example include: the relation of errors and violation of DBQ with accident involvement was investigated (De Winter and Dodou 2010), the association between DBQ scores and accident rates was also done (Zhao et al. 2012).

1.2. Definition of errors and violations based on previous research

Based on aberrant driver behavior identified in previous studies, errors reflect performance limits of the drivers such as those related to perception, attention, and information processing abilities (De Winter and Dodou 2010). Errors were differentiated into slips and lapses (i.e., the behavior was not what was intended)(Elliott and Baughan 2004; Shi et al. 2010) and mistakes. Slips are related to attention deficits while lapses largely involve failures of memory (Özkan and Lajunen 2005). Mistakes were defined as the departure of planned actions from some satisfactory paths towards a desired goal (i.e., the intention to behave was not appropriate) (Elliott and Baughan 2004; Shi et al. 2010). Violations (deliberate behaviors) represent the style which the driver chooses to drive and the habits established after years of driving (De Winter and Dodou 2010).

1.3. Definition of professional drivers and the objectives of study

Professional drivers can be defined as those workers whose main task is to operate a motor vehicle in traffic conditions. This includes chauffeurs and bus, truck, tram, trolley, taxi, and ambulance drivers (Tamrin et al. 2011). The non-availability of a comprehensive body of research regarding the DBQ for professional bus drivers and especially the lack of survey in Iran public transport necessary and justify doing factor analysis of the DBQ and examining the relationship between the modified DBQ and self-report crash involvement.

There is evidence that the DBQ factor structure may be different for those who are driving in a work-related context (Sullman, Meadows, and Pajo 2002). Therefore, the main objectives of the present study are as follows:

-Examining the validity and reliability of the DBQ among public transport bus drivers

-Surveying the relationship of the DBQ factors, demographic variables, and driving exposure (Kilometer and time driving) with self-reported crash involvement

2. Materials and Methods

2.1. Participants and procedure

The study subjects were bus drivers of public transportation company. This company works under Tehran municipality for the public transportation of Tehran citizens and inhabitants in the suburbs in order to decrease city traffic. In this study, 628 bus drivers were randomly selected by line supervisors of bus company (normal and Bus Rapid Transportation routes) based on personnel code. An identification code was added to the questionnaire (demographic, driving information and DBQ) in order to match the responses. The researchers held almost thirty sessions with the drivers in 15 to 20 person groups and provided them with a description of the study in order to complete of the questionnaires. They also asked drivers if they would be interested in participating in this research. Almost 1.6% drivers (equivalent with 10 subjects) did not agree to participate in this study. The majority of drivers (618 people) agreed to participate in study. They were asked to fill out the questionnaire anonymously and to return them after completing in the session. Among those drivers who had agreed to participate in the study, 62 subjects (about 10%) missed information. In other words, the 90% of completed response rate participation was amicable. In order to remove the effects of any disease and family problems on crashes, reports of 388 subjects (equal 61.7%) were not used in the study because of disease and domestic problems. So, the behaviors of 168 (i.e., 26.7%) subjects of drivers were studied.

2.2. Measures

2.2.1.. Demographic and exposure measures

Participants answered questions about age, education, marital status, total driving experience, driving experience in the bus company as a bus driver, driving time per week, annual mileage, and the number of crashes (personal injury or property damage) they had within the last three years.

2.2.2. Manchester drivers' behavior questionnaire (MDBQ)

We used 50 items version of Manchester Drivers Behavior Questionnaire (MDBQ) (Oreyzi and Haghayegh 2007), which was translated from English to Persian by Oreyzi and his colleague. Then, all urban drivers with B certificate in Esfahan were asked to fill it in. The validation study of Persian version of this questionnaire showed acceptable psychometric properties (Oreyzi and Haghayegh, 2007). But to be used for professional bus drivers, this questionnaire needs some change with respect to their condition in comparison with general drivers. Therefore, in the revised version for bus drivers, according to suggestion of 3-experts from Health, Safety and Environment (HSE) in bus Company, 5-items of DBQ were left out because those rarely happened for public transportation drivers. The 5-items include: intending to drive to destination A instead destination B, misreading the signs and exiting from a roundabout on the wrong road, illegal driving due to insurance or road tax on all, parking on a doubled-yellow line and risking a fine, feeling unsure about the route I am driving. Thereupon, 45 items of that version of questionnaire were used.

2.3. Statistical analyses

2.3.1. Face and content validity

Face validity means that the instrument looks, on the face of it, as if it measures the construct of interest. Experts or lay people were asked to review the instrument for syntax, organization, appropriateness, and confirmation in order to flow logically (DeVon et al. 2007). Content validity will be indicated if the items in the tool sample the complete range of the attribute under study. A panel of content experts was then asked to review the potential scale items and validate the appropriateness of them as indicators of the construct (DeVon et al. 2007).

Given that items from the DBQ will be used for occupational drivers in bus lines, items for special groups should be revised. So, in this study, survey of the item aspects, i.e. level of difficulty, ambiguity, necessary, and relevant items in questionnaire are needed.

Lawshe proposed a method wherein experts would rate each item on a 3-point scale. The content validity ratio (CVR) is likely to be then computed through scores ranging from 0 (not necessary) to 2 (useful necessary). The process should be done on each individual scale item of the CVR (Lawshe 1975). The following formula is used to calculate CVR for each item:

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

ne=The number of experts who rated an item as "essential."
N=The total number of experts.

Acceptable range in the CVR depends on the number of experts of the panel which, in the present study, was based on the judgments of the 15 panelists. Experts panel include: psychologist, senior drivers, bus health safety environment (HSE), occupational health professors, and Ph.D. Thus, according to criterion values provided by Lawshe (1975), CVR is equal to or larger than 0.49 for 15 panelists. In other words, CVR obtained from the above-mentioned formula should be equal to or larger than the CVR value of 0.49 for each item (Lawshe 1975).

The score for the entire instrument is called the Content Validity Index (CVI). It is simply the mean score of those retained items having CVR≥0.49 according to the following formula (DeVon et al. 2007; Lawshe 1975).

$$CVI = \frac{\sum CVR \; for \; all \; retained \; items}{retained \; items \; numbers}$$

2.3.2. Reliability and construct validity

For test–retest reliability, 35 subjects were asked to fill out the questionnaire for the second time after almost two months. Test-retest reliability was calculated using Pearson correlation (the value ≥ 0.70 was considered satisfactory) for judging the correlation between the retest and the initial study. The test-retest results raise the issue as to whether or not there is a differential stability to the constructs being measured by the subscales (Dula 2003).

Construct validity is the degree to which an instrument measures the construct that is intended to measure (Cronbach and Meehl 1955). One way to evaluate the construct validity of an instrument is factor analysis (DeVon et al. 2007). The two tests of Kaiser-Meyer-Olkin (KMO) and Bartlett should be administered prior to factor analysis in order to recognize the proportionate data for factor analysis. The KMO measure of sampling adequacy shows that high KMO (valued between 0.5 and 1.0) is appropriate for factor analysis. Bartlett test should be large enough to be significant (Olawale and Garwe 2010).

To examine the appropriateness of the factor structure, the principal axis factoring (PAF) method (Dorn 2008) with varimax rotation was performed on retained items from the DBQ through SPSS to test aberrant drivers' behavior dimensions. Then based on Eigenvalues >1 and scree plot, it was decided on the number of factors. Eventually, to be included in the factor, the number of items representing each common factor was required to reach the minimum value of three variables in that factor and a minimum factor loading of 0.40 per item (Shi et al. 2010).

In order to evaluate the internal consistency of the driver's behavior questionnaire scale scores, the Cronbach's alpha reliability coefficients were calculated. Internal-scale reliability was applied to those groups of items that measured one factor (Cox and Cheyne 2000).

3. Results

3.1. Demographic characteristics

The mean and the standard deviation for the age of the participants were 39.3 ± 5.1 years old while the range was from 30 to 50 years. All participants were male from whom 99.4% was married. 63.7% of drivers enjoyed the education degree of high school and above (namely diploma and associate bachelor degree). The exposure characteristic of the bus drivers in public transportation system are presented in Table 1.

Table 1
Demographics and exposure Characteristics of study sample (n=168).

Variables (scale)	Mean (S.D)
age	39.3(5.1)
Total of driving experience (year)	16.5 (5.6)
Driving experience in the bus company (year)	11.2 (3.7)
Driving time per week (hour)	59.1 (5.7)
Annual mileage (km)	34650.3 (12473)
Accident involved in the last 3 years (number)	2.9 (3.1)

3.2. Face and content validity

Through the face validity process, according to experts' opinions during a personal session, some incomprehensible and ambiguous words or phrases were identified which needed modification and rewording.

In the content validity ratio, items did not meet the 0.49 level of endorsement required to establish content validity using a panel of 15 experts. Based on the CVR, 19 items with CVR<0.49 were dropped (see Table 2). Consequently, a revised version of DBQ containing 26 items was generated for the next steps. CVI was obtained 0.758 through the formula below.

$$CVI = \frac{\sum 1 \times 2 + 0.87 \times 8 + 0.73 \times 9 + 0.60 \times 7}{26} = 0.758$$

Table 2
DBQ factors and the number of rejected items according to experts' opinions.

Items / Primary Factors	The items of each factor	The items rejected with CVR<0.49
Lapse	9	4
Mistake	3	1
Unintentional violation	2	2
Intentional violation	31	12
Total	45	19

3.4. Exploratory factor analysis (EFA)

Measure of sampling adequacy Kaiser-Meyer-Olkin (KMO) was 0.801. Bartlett test (Approx. chi-square=1423, df=325 and P-value<0.001) was large and significant; therefore, the data are suitable for factor analysis.

Eight factors having an eigenvalue of greater than one were extracted, which constituted 62.8% of the total variance. The sets of eight items with factor loading > 0.40, eigenvalue of greater than one and amounts of variance explained were reported in Table 3.

First factor: Five items loaded on this factor. The most of these items were related to behavior deliberate, highly risky and non-emotional (Shi et al. 2010) that recognized as "Risky Violation" which estimated for 22.9% variance. Table 3 shows that five items of risky violation had the highest factor loadings in first factor.

Second factor: This factor contained four items which focuses on attention and memory failures (Lajunen, Parker, and Summala 2004) therefore is referred to as "slip and lapses".

Third factor: Three items loaded on this factor that more consist of behaviors such as running red lights (Shi et al. 2010) so, it is identified as "Highway violations".

Fourth factor: This factor includes three item that is error of intention (Özkan and Lajunen 2005) and failures of judgment (Kontogiannis, Kossiavelou, and Marmaras 2002) thus, it is named "mistake".

Factors of five, six and seven are composed of only two items and factor eight have only one item therefore, they are not interpreted (Russell 2002). Then, these factors (including 7-items) were excluded from list of factors because they have less than three variables. Consequently, four factors (including 15 items) related to driver behavior questionnaire were obtained: (1) Risky violation; (2) Slip and lapses; (3) Highway violations and (4) Mistake. The four items 4, 7, 12 and 22 has not been loaded on any factors.

Table 3
Results of the exploratory factor analysis with varimax rotation for the DBQ scales.

Items	Factors							
	1	2	3	4	5	6	7	8
Incorrect estimate of the car speed in versus when overtake						0.74		
no checking mirror before overtaking, etc		0.63						
Get out of the car without pulling the handbrake				0.47				
Doing activities such as using a mobile, listening to music, eating and drinking water, talking, etc when driving								
Get out of the mainstream due to Distractibility		0.47						
Brake too quickly due to Intellectual conflict and lack of attention to deceleration of the car in front		0.47						
Fail to check the car mirror before moving to the left and right and resulting in accident								
Lack of attention to the sign of the car in behind for turning right when your overtake				0.48				
Brake too quickly due to inattention to pedestrian entry from the back of the bus or car				0.54				
Brake too quickly on a slippery street that cause of precession				0.62				
Collision to the car of adjacent when stopped due to incorrect distance estimate							0.46	
Collision to the car or person when go back								
Increase the speed limit due to inattention						0.41		
Fail to notice a pedestrian in lineation or passing of the car from red light because focusing in your opinions		0.50						
Disregard the speed limit in early morning or late at night					0.51			
Do not keep enough distance from the car in front and repeat of the signaling with lights or horn	0.78							

Mount and dismount of the passengers outside the station	0.78						
To overtake from a low-speed car on a narrow street	0.76						
Crossing the continuous line, precession and overtake in order to avoid colliding with traffic	0.78						
Overtake in a dangerous situation in a two-way path because slow moving car in front	0.84						
Not allow to pass the car that Signaling with lights							0.62
Race with other user or colleague on the street							
Disregard the speed limit when overtaking in order to avoid collisions with car versus						0.51	
To pass from red lights at late night		0.51					
Cross from traffic lights at the start of redden		0.48					
Driver fast to pass a yellow light turning to red		0.72					
Amount of variance explained	22.9	11.0	6.36	4.89	4.62	4.56	4.31	4.16
Eigenvalues>1	5.95	2.86	1.65	1.27	1.20	1.18	1.12	1.08

Extraction Method: Principal axis factoring; Rotation Method: Varimax with Kaiser Normalization
[a]Rotation converged in 8 iterations
For the sake of clarity, factor loadings less than 0.4 have been omitted.
Unloading items of 4, 7, 12 and 22

3.5. Reliability and internal-scale consistency

Pearson correlation for test-retest reliability between the retest and initial study was obtained 0.69 (almost 0.7), which is acceptable. The alpha coefficient of 0.83 for the DBQ total scales indicates a good internal reliability for the questionnaire.

Mean, standard deviation, and number of items for each factor are shown in Table 4. Internal reliability was calculated. Thereafter, a Cronbach's α>0.6 rule for factors was used (Shi et al. 2010) and those factors having an alpha less than 0.6 were rejected (see Table 4).

Table 4
Mean scores for the DBQ factors and alpha correlation.

Factors	Mean	SD	Items	Alpha (α)
Risky violation	2.9	4.1	16,17,18,19,20	0.90
Slip and lapse	2.5	2.0	2,5,6,14	0.65
Highway violation	1.7	1.8	24,25,26	0.71
Mistake	3.1	3.1	8,9,10	0.61
Factor 5	0.9	1.1	3,15	0.25
Factor 6	1.6	1.6	1,13	0.51
Factor 7	0.5	0.8	11,23	0.42
Factor 8	1.0	1.1	21	-

3.6. Correlation between variables with crashes involvement

The results related to the relationships of demographic variables, driving information, and drivers' behaviors with self-report crash involvement in the last three years are available in Table 5.

Table 5
Pearson correlation matrix between predictive variables with self-report crash.

	Age	Total driving experience	Bus experience	Driving time in week	Annual mileage	Maximum speed	Risky violation	Slip and lapses	Highway violation	Mistake

	Age	Total driving experience	Bus experience	Driving time in week	Annual mileage	Maximum speed	Risky violation	Slip and lapses	Highway violation	Mistake
Age										
Total driving experience	**0.623									
Bus experience	**0.544	**0.500								
Driving time in week	0.070	0.018	0.084							
Annual mileage	-0.113	-0.051	-0.091	**0.321						
Maximum speed	-0.108	-0.123	-0.105	-0.039	**0.226					
Risky violation	-0.077	-0.075	-0.056	-0.076	**-0.201	-0.026				
Slip and lapses	-0.054	0.031	-0.048	-0.037	-0.028	0.002	0.000			
Highway violation	0.017	-0.110	-0.051	-0.047	-0.041	0.054	0.000	0.000		
Mistake	-0.030	-0.030	0.060	0.028	0.019	-0.057	0.000	0.000	0.000	
Accident in previous 3 years	-0.023	-0.051	-0.091	0.001	-0.024	-0.124	0.086	0.099	0.159*	0.066

**Correlation is significant at the 0.01 level.
*Correlation is significant at the 0.05 level .

As expected, there is a correlation between driver's age and both total driving experience and bus experience. In this regard, older drivers generally had more experience. Also both experiences (Total and bus) together were significantly and directly in association with each other.

There was significant correlation between driving duration in weekdays and annual mileage that naturally means the more driving time, the more traveled kilometers. Maximum speed while driving was also significantly correlated with annual mileage. In other words, the drivers who reported more kilometers of driving in three years ago preferred the higher speed in driving.

There is a negative significant relationship between risky violations and annual mileage. That is risky violations have been mentioned by drivers who travel less kilometers. As such, there is a positive significant relationship between accidents in three years ago and highway violations.

4. Discussion

Researches in Iran have been conducted among motorcycle riders and general driving population while work-related drivers had different patterns from aberrant driving behaviors. Similarly, DBQ factor structure was different when researchers were concentrated on work-related drivers

Persian version of the MDBQ translated by Oreyzi (2007) was distributed among all of the drivers while target group in this study were bus drivers who were treated by certain types of work conditions (e.g. working time about 8-10 hours in a day without rest, driving in routes of relatively long 20 Km in one-half ways during 1.2-1.5 hours with crowd, handling bus with length about 17 m, etc.) in public transport company. So, it was different aberrant drivers' behaviors that had items deleted in MDBQ based on experts' opinions, as previously mentioned in section Manchester Drivers Behavior Questionnaire.

The score of CVR reflects panelists' viewpoints that deleted aggressive violations such as hostility and anger followed by aversion and chase because drivers work in public settings with special routes assigned to them and they handle general population. The deletion or replacement of items are also observed in other studies (af Wåhlberg, Dorn, and Kline 2011).

Acceptable level of CVI showed that 26 residual items in questionnaire for measuring drivers' behavior was relevant. Repeatability pointed appropriate levels of reliability. It means there was low variation in measurements taken by instrument on the same items. The results of Cronbach's alpha for standardized total items showed good internal consistency. Therefore, findings in Iran indicate that four factors structure of the DBQ has the potential of usability in studies by means of distributing versions of the DBQ among bus drivers of public transport company.

A four-factor solution was extracted using EFA. The first factor consisted risky violation that were similar to the factor being found in a previous study (Shi et al. 2010). This violation may occur due to high traffic volume on the streets of Tehran, elderly passengers' requests for mounting and dismounting

outside the station, hurrying for the completion of the count of the sweep in routes determined by the bus company.

The second factor was unwitting deviation of action, intention, and memory failure (slip and lapses). Lapses were also observed in other studies (Martinussen et al. 2013; Zhao et al. 2012). Inattention and distraction among bus drivers can occur owing to work pressure, economic problems, scant rest between traversed routes, inappropriate meetings of some officials, poor facilities, etc.

The third factor consisted highway violation which Davey (2007) found in his study. These violations can occur due to rush for compensating for the lack of time in order to traverse number of routes determined by the bus company.

The fourth factor included failures of intention and judgment (mistake). Lapses and error factor (mistake), in this study, are in line with those of previous research (Sullman, Meadows, and Pajo 2002; Lajunen, Parker, and Summala 2004; Bener, Özkan, and Lajunen 2008; Zhao et al. 2012; Martinussen et al. 2013). Mistakes can occur owing to non-compliance of the traffic rules and regulations pertaining to special lines (i.e. BRT).

In this study, the rate of tailgating, exceeding the speed limit, running red lights, overtaking and focusing on gaining advantage are categorized in risky violation and highway violation. This result does not confirm other studies (aggressive and ordinary violation in the study Lajunen and colleagues 2004; emotional and reckless violation in the study Martinussen and colleagues 2013). Differences in social and cultural context of the Iranians and other countries road traffic system can vindicate the differences perceived in DBQ factors. Also, the disparity between this study and others may be due to the conduction of this research on a different group of drivers.

In this study, the significant and negative relationship between risky violation and annual mileage indicates that the drivers who have worked in the usual (normal) lines traversed less kilometers. However, they committed the violations of more possibility of not keeping the necessary distance from the front car, mounting and dismounting passengers out of the station, overtaking the slow moving vehicles, etc. Conversely, drivers in BRT (bus rapid transport) routes that travel more mileage usually committed less risky violations because they were driving in relatively straight routes and specified confines with barriers. This result is contrary to findings of Sullman (2004) about aggressive violation and mileage.

The tendency towards higher scores on highway violation factor of the drivers showed that a meaningful and positive correlation existed between highway violations and involvements in accidents during three years ago. Hereby, aberrant behaviors such as passing red lights were more likely to cause a crash. The result of this research is in line with that of Zaho and colleague (2012), i.e. a positive relationship between violations and accident rates in study.

Driving skills and styles reduce errors and violations. Driving skills include those information processing and motor skills which improve with practice and training, i.e. with driving experience (Bener, Özkan, and Lajunen 2008). While errors may be reduced via participation in skill-based training courses in the deployment of attention resources (Lawton et al. 1997), such interventions were unlikely to be successful in reducing violations that were largely motivational based. Driving style concerns individual driving habits, i.e. the way a driver chooses to drive and does not necessarily get safer with driving experience (Bener, Özkan, and Lajunen 2008). Therefore violations could be minimized by attempting to change attitudes, beliefs and social norms (Kontogiannis, Kossiavelou, and Marmaras 2002).

4.1. Limitations

Some limitations of the study were time-consuming data gathering because of individual and groups' sessions and at least thirty sessions for completion of the questionnaire in order to minimize missing information. In relation to the study sample, there was no representation of female drivers. Because of societal culture and job difficulty, females don't work on buses in Iran. In this study, in order to survey aberrant drivers' behaviors the effects of the fatigue, consumption of medicine, mental and physical diseases were controlled. So the rate of participants (388 subject, equal almost 63%) was extracted from the study, consequently 168 people (namely 27%) participated in this research which this issue was difficult availability to samples because almost two-thirds of the subjects were disease.

4.2. Conclusion

Totally, this study described that a 15-item DBQ had relatively good validity and reliability to be used for studying bus drivers in the future research. This questionnaire can be used to distinguish the behaviors connected with higher risk of traffic crashes and corrective interventions to reduce injuries from traffics. If the bus drivers' behaviors are studied several times at appropriate intervals, it will provide a basis for the evaluation of interventions as well. The relationship between unsafe driver behaviors with crashes involvement indicates that driving accidents can be reduced through highway violation decline. Using BRT lines with compliance to rules pertaining to these routes can be effective in risky violation reduction. Improving cultural aspects related to public expectations of the bus drivers is an effective role in reducing some violations of the bus drivers such as dismounting passengers out of the station.

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