Development of an Instrument for Measuring Attitudes towards Safe Motorcycle Driving Behaviors among Thai Adolescents

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ABSTRACT

This study was a part of the main study using an ecological context to develop instruments to measure factors influencing safe motorcycle driving behaviors among Thai adolescents. The study aimed to develop an instrument to specifically measure Thai adolescents' attitudes towards these behaviors. The participants were purposefully recruited from students studying in vocational certificate levels 1-3 from vocational and technical colleges in Chiang Mai, Thailand. The instrument development research design included two phases.

The first phase was scale construction. The relevant terms and concepts were clarified and defined based on a literature review. Thirty six items with a 4-point Likert-type scale were generated using data obtained from focus group discussions and the literature. Content validity was assured by six experts. The items' CVI ranged between .83 to 1.00 and the scale's CVI was .90. Then the instrument was critiqued by six students to ensure clarity and readability. After the students' review, the revised scale consisted of 35 items with 6-point Likert-type scale.

The second phase was a psychometric properties evaluation using 491 students. The construct validity was evaluated with exploratory factor analysis. Six dimensions were extracted from 25 items. The total explained variance was 58.94%. The scale's alpha coefficient was .89 and for each dimension the coefficient ranged between .72 and .83. These results indicate that the scale is valid and reliable and can be used to assess attitudes towards safe motorcycle driving behaviors among Thai adolescents.

Key words: Scale development, Attitude, Adolescent, Motorcycle driving behavior

INTRODUCTION

Motorcycle accidents account for about 80% of all road traffic accidents in Thailand (Kanchanasut, 2004; The Royal Thai Police, 2005). Each year, approximately 200,000 of the Thai population have motorcycle accidents. On average, 18 victims are killed every day by these serious accidents (National Health Foundation, 2007). Furthermore, the number of motorcycle accidents rises every year. The majority of motorcycle accidents occur among individuals aged 15-24 years and are typically males (Bohning and Na Ayutha, 1997; Klein, 2001; National Statistic Office, 2005). In fact, males have four to five as many of deaths from motorcycle accidents compared to females throughout their life span (Klein, 2001). Driving behaviors found to be associated with traffic accidents were driving at inappropriate or excessive speeds, use of alcohol and failure to use safety devices such as helmets (Suriyawongpaisal and Kanchanasut, 2003; The Royal Thai Police, 2004; Don't Drive Drunk Foundation, 2005; Narenthorn Center, 2005; Tanaboriboon and Satiennam, 2005).

The high incidence of motorcycle accidents is also associated with both environmental and human factors. Environmental factors include road conditions, traffic management, traffic policy, traffic law and law enforcement (Suriyawongpaisal et al., 2002; World Health Organization, 2004; Arrive Alive, 2005). Human factors were contributing elements in 95% of the accidents; particularly, unsafe driving behavior was a common element identified in those accidents (Ulleberg and Rundmo, 2003; Thai Health Promotion Foundation, 2007). Besides other factors such as age, gender, knowledge, parental and peer influence, drivers' attitudes were found to alter adolescents' driving behaviors (Reeder et al., 1992; Parker, Lajunen et al., 1998; Parker and Stradling, 2001; Coltheart, 2002; Laapotti et al., 2003; Ulleberg and Rundmo, 2003; Redshaw, 2004; Warner and Aberg, 2006). Lastly, adolescent tendency to thrill seek and be overconfident were also associated with traffic accidents (Kasantikul et al., 2005).

Based on the literature review, the significance and complexity of factors that influence motorcycle driving behaviors such as attitudes should be examined in order to better understand the contributing factors of safe motorcycle driving behaviors. After these factors are determined then programs for motorcycle accident prevention can be developed. However, these factors inclusive of attitude cannot be studied because of the lack of pre-existing, valid and reliable measurement tools. A significant portion of this study's effort was directed to the development of instruments for measuring safe motorcycle driving behaviors and factors influencing safe motorcycle driving behaviors among Thai adolescents within an ecological context.

OBJECTIVES

The study aimed to develop an instrument to measure Thai adolescents' attitudes towards safe motorcycle driving behaviors and to conduct psychometric evaluation of the newly-developed instrument. These driving behaviors included

obeying traffic laws and regulations, not drinking and driving and wearing a proper helmet while driving a motorcycle.

METHODS

Study settings

This research proposal was approved by the Research Ethics Review Committee of the Faculty of Nursing, Chiang Mai University. In addition, permission from each of the directors of the selected schools were obtained prior to the sample recruitment process. Eligible subjects were asked to voluntarily participate in the study. Participants who agreed to participate were informed and assured that the data would be kept strictly confidential and reported anonymously. Informed consent was obtained from adolescent subjects who reached the age of 18 and over. In addition, parental consent and adolescent's assent were obtained when subjects were under 18 years of age.

Participants

The population of this study were Thai adolescents who drive a motorcycle. The settings were two vocational and technical colleges with a male majority of students in Muang District, Chiang Mai, Thailand. A purposive sampling method was employed to recruit eligible subjects who met the following inclusion criteria: (1) being male or female age 15- 24 years (middle-late adolescence), (2) use of a motorcycle as the primary means of transportation in daily life and (3) willingness to participate in this study. During the data collection process, three sample groups participated in this study. The first group was assembled for the purpose of clarifying and defining concepts and to generate an item pool. Forty-four students were purposefully selected to participate in six focus group discussions. The second group was assembled for the process of reviewing the draft questionnaires† for clarity and readability. In total, six students, two students of each educational level were purposefully selected. In the third group, 491 students were recruited to evaluate the psychometric properties of the instrument. Purposive sampling and stratified random sampling methods were used to recruit participants from each college. A whole class of students in each level was randomly selected from all three levels. The characteristics of the first and third groups of students are presented in Table 1.

Table 1. Characteristics of the first and the third groups' participants

Characteristics	First group (n=44)		Third group (n=491)	
	Number	%	Number	%
Gender				
Male	34	77.27	380	77.39
Female	10	22.73	111	22.61
Age (year)	Range=15-20, Mean=16.68, SD=1.05		Range=15-22, Mean=17.80, SD=1.03	
15	5	11.35	1	0.21
16	15	34.10	46	9.37
17	15	34.10	151	30.75
18	8	18.18	152	30.96
19	-	-	123	25.05
≥ 20	1	2.27	13	2.64
Declined to submit age	-	-	5	1.02
Level of education : vocational certificate				
Level 1	17	38.64	165	33.60
Level 2	13	29.54	156	31.77
Level 3	14	31.82	170	34.62
Frequency of motorcycle driving (day/week)				
1-2	-	-	21	4.27
3-4	-	-	25	5.07
5-6	5	11.36	63	12.83
7	39	88.64	370	75.37
Declined to submit information	-	-	12	2.44
Purpose of driving motorcycle				
Commuting to and from school	41	93.18	385	78.41
Other	3	6.82	106	21.59
Distance driven on a motorcycle (kilometer/day)	Range 3-100, Mean=30, SD=20.26		Range=1-110, Mean=26.30, SD=20.90	
≤ 10	8	18.18	159	32.38
11-30	21	47.73	170	34.62
31-50	10	22.73	95	19.35
> 50	5	11.36	49	9.98
Declined to submit information	-	-	18	3.67
Role while motorcycle riding				
Driver	37	84.10	384	78.21
Passenger	7	15.90	107	21.79
Own a motorcycle				
Yes	43	97.70	468	95.32
No	1	2.30	23	4.68
Possess a driver's license				
Yes	22	50.00	297	60.49
No	22	50.00	194	39.51
Have a helmet				
Yes	39	88.64	456	92.87
No	5	11.36	35	7.13
Have been arrested/fined				
Yes	31	70.45	313	63.75
No	13	29.55	178	36.25
Cause for being arrested/fined*	(n=31)		(n=313)	
Not wearing a helmet	18	58.07	270	86.26
Not possessing†a valid license	7	22.58	67	21.41
Traffic violation	2	6.45	32	10.22
Others	4	12.90	26	8.31
Involved in a motorcycle accident previously				
Yes	38	86.36	332	67.62
No	6	13.64	159	32.38

*Some students were arrested with multiple causes.

Scale Development Procedures

To develop the scale, a methodological design was employed. The scale development consisted of two phases: 1) the construction of the initial scale and 2) the evaluation of its psychometric properties.

Phase I: Construction of the initial scale. Both qualitative and quantitative methods were initiated in steps 1-4. Step 1: Clarify and define the concept. Data obtained from the literature review were†used to develop guidelines to define the scope and organization of the concepts and the terms of the study. Step 2: Generating an item pool. The original draft of the instruments was generated in the Thai language. The data obtained from relevant literature reviews and six focus group discussions were analyzed and categorized by using a content analysis procedure. Then, items were clustered†into three subscales measuring three specific behaviors that†include obeying traffic law and regulations, not drinking and driving, and wearing a proper helmet. Step 3, a panel of six experts reviewed the first draft of instruments for content validity. The experts consisted of three nursing professors who are experts in the area of adolescent behaviors and experienced in instrument development, a psychology professor and expert in adolescent motorcycle driving behaviors, a pediatrician who is a specialist in child injury prevention and the school psychologist and teacher at a vocational college. Information provided by experts was used to determine an individual item's content validity index (I-CVI) and the scale's content validity index (S-CVI) (Polit and Beck, 2006). Then, in Step 4, six students were asked to complete the scale and evaluate its items for clarity, ease of understanding and length appropriateness of the overall questionnaire.

Phase II: Evaluation of psychometric properties of the instrument. A quantitative approach was employed for Step 5. In this step, field testing for item analysis, construct validity and internal consistency reliability was conducted with 491 students who volunteered to participate in this step. The package of questionnaires including a cover letter from the researcher, a consent form, the Demographic Data Collection Form and the newly-developed questionnaire was distributed to the students by the researcher and three trained assistants. After completing all questionnaires, these students were told to return them to the researcher or assistants who were present while the remaining students continued to complete their questionnaires. Those questionnaires that were returned incomplete, the researcher or the research assistants asked the students to complete them. Despite those efforts, some returned questionnaires were not completed in their entirety. Consequently, the number of returned, full completed questionnaires was 453 (92.26%).

Item analysis was performed to determine the characteristics of each item with respect to the entire scale. Each item was examined for three characteristics: descriptive statistic of items, discrimination power of items and item correlation. The criteria for retaining an item within the entire scale for this study were (1) inter-item correlation value between .30 and .70, (2) item- subscale correlation value of .50 or over, (3) an item-total correlation value above .30 (Nunnally, 1978) and (4) no substantial change of Cronbach's alpha when an item was removed

(Ferketich, 1991). Factor analysis was employed to examine the internal construct validity of the scale and to cluster interrelated items. Prior to performing factor analysis, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were applied to determine appropriateness for factor analysis. Exploratory factor analysis was performed with two different methods, then the method that resulted in the clearest, most†unambiguous response was selected.† The criteria for determining the best factor solution of factor extractions were (1) a factor with an eigenvalue of 1 or above, (2) an item with a factor loading cutoff point of .30 or greater, (3) no or few cross-loading or secondary loading items and (4) no factor with fewer than three items (Burns and Grove, 2001; DeVellis, 2003; Waltz et al., 2005).

RESULTS AND DISCUSSION

Construction of the Attitudes towards Motorcycle Driving Questionnaire (AMDQ)

Clarify and define concept. As shown in Table 2, the scope of each term was defined based on the literature review.

Table 2. Scope and definition of terms or concepts

Term	Scope and Definition
Safe motorcycle driving behaviors	An individual's actions in driving a motorcycle safely which are composed of three crucial behaviors including obeying traffic laws and regulations, not drinking and driving and wearing a proper helmet while driving a motorcycle.
Obeying traffic laws and regulations	Driving a motorcycle while following traffic laws and regulations in terms of driving with a valid license, driving within speed limits, driving with safe passing of other vehicles, e.g., checking roads, signaling lights and obeying rules and signs as well as avoiding distractions such as cell phone use.
Not drinking and driving	Delaying driving a motorcycle for one hour per alcohol beverage consumed.
Wearing a proper helmet	Wearing a helmet that meets safety standards, fits well and fastened properly whenever operating a motorcycle.
Attitude towards safe motorcycle driving behaviors	One's own evaluative assessment of safe motorcycle driving behaviors in relation to obeying traffic laws and regulations, not drinking and driving and wearing a proper helmet with some degree of approving or disapproving, valuing it as positive or negative, liked or disliked.

Generating an item pool. The original draft of the instrument was generated in the Thai language. The data obtained from relevant literature reviews and focus group discussions were analyzed and categorized using a content analysis procedure. The first draft of the instruments consisted of a total of 36 items. In addition, a 4-point Likert-type scale to denote degree of agreement was assigned as a response format of the AMDQ. The response statements ranged from strongly disagree to strongly agree.

Reviewing items by experts. The AMDQ with 36 items was submitted to the experts. All items were evaluated as mostly relevant or absolutely relevant to the concept. However, one item of wearing a proper helmet subscale (Athel2: *"Wearing a helmet while driving a motorbike does not help decrease a severity of injury"*) was suggested for deletion because of its redundancy. Therefore, 35 items remained with 15, 7 and 13 items of obeying traffic law and regulations, not drinking and driving and wearing a proper helmet subscales, respectively. The values of I-CVI of the remaining 35-items ranged from 0.83 to 1.00 and the S-CVI was 0.90. Furthermore, based on the expert's suggestions, the response choices were expanded from four to six response categories.

Determining the clarity and readability of the questionnaire. The instructions for answering the questionnaires were evaluated as unambiguous by the second group students. The formatting of the AMDQ was easy to understand for all students. Therefore, the scale's text†remained unchanged from the draft.

Psychometric Properties of the Scale

Results of item analysis. Discrimination power of items of this scale was investigated by using the split group response method. The item mean scores of the low score group (114 students) were compared with those of the high score group (115 students). This finding revealed that the t-values ranged from 4.34 to 17.52. All items were significant at a p value of .001. This revealed that the low score group responded to all items of the scale differently from the high score group. Therefore, all 35 items were good discriminators and appropriate to be retained in the scale.

Based on the results of item correlations which consisted of inter-item correlation, item-subscale correlation, corrected item-total correlation, coefficient alpha if an item was deleted, subscale-subscale correlation and subscale-total correlation procedures, eight items (Atreg1, Atreg2, Atreg12, Atdd16, Athel23, Athel24, Athel25 and Atreg26) were deleted. Therefore, the AMDQ scale was comprised of 27 items with an overall Cronbach's alpha of .90 and .84, .79 and .83, for the three subscales.

Results of exploratory factor analysis. Exploratory factor analysis was employed to examine the construct validity of the scale and to cluster interrelated items. The principal components analysis with varimax rotation method was performed first. The findings indicated that six dimensions were extracted and all 27 items remained. All 27 items had factor loading ranging from .30 to .84, in which seven items (Atreg5, Atreg9, Atreg14, Atdd22, Athel29, Athel30 and Athel31) loaded on two components. The picture of factor loading on each

component was unclear; nearly 25% of items did not single load in a specific component. The principal component with direct oblimin was then conducted. The results illustrated a similar picture to the first method with six components extracted. Among all 27 items, 26 items (except Atreg5) retrieved with factor loading ranging from .33 to .87 without any item loaded on two components. Based on the result of the first-order factor analysis, the principal components with direct oblimin method provided a clearer and†more stable picture of factor loading. Therefore, this method was chosen for further factor analysis since it provided the best opportunity to interpret the factor solution unambiguously.

The second-order factor analysis was applied to the 26 remaining items. The processes were duplicated as they were performed during the first-order analysis. The result of the second-order factor analysis with the principal components analysis with direct oblimin rotation method revealed that all 26 items remained in six components with eigenvalues ranging from 1.03 to 7.18 and accounted for 3.98% to 27.61% of variance. All six components together explained 58.31% of variance. However, among 26 items, Atreg14 *("Violating traffic regulations while driving a motorbike is enjoyable and exiting.")* loaded on two factors. This item was not specific to any driving behavior and it was difficult to determine on what component the item should be retained. Consequently, this item was considered for deletion and was ultimately deleted. Therefore, 25 items remained to undergo a third-order factor analysis with a similar process as the first-and second-order factor analyses.

The results of the third-order factor analysis, utilizing principal component analysis with direct oblimin rotation method, showed that all 25 items remained in six components with eigenvalues ranging from 1.03 to 6.83 and accounted for 4.12% to 27.32% of variance. The items that clustered under each of six dimensions with the corresponding item statements, their factor loadings and Cronbach's alpha of each dimension and the overall scale for the final scale of the AMDQ are shown in Table 3.

Table 3. Dimension associations and item statement of factor analysis of the AMDQ

Item Number	Item Statement	Factor Loading
Dimension 1: Attitude towards drunk driving and driving while using a mobile phone		
Atreg15	Using a mobile phone while driving does not adversely affect one's concentration while driving.	0.35
Atdd17	Riding a motorbike while drunk is a challenge to one's driving ability.	0.69
Atdd18	Driving while drunk is more fun than driving sober.	0.76
Atdd19	A person that doesn't ride drunk is a coward.	0.59
Atdd20	Riding a motorbike while drunk increases my alertness compared to riding while sober.	0.77
Atdd21	When I am drunk I ride a motorbike more carefully than when I ride sober.	0.69
Atdd22	Drinking alcohol has no effect on motorcycle driving ability.	0.45
	Eigenvalue = 6.83 Percent of variance = 27.32 Cronbach's alpha coefficient = 0.79	
Dimension 2: Attitude towards helmet use 1		
Athel31	Wearing a helmet while driving a motorbike makes a driver feel drowsy.	0.44
Athel32	Wearing a helmet while driving a motorbike messes up a driver's hair.	0.70
Athel33	Wearing a helmet while driving a motorbike decreases a driver's ability to hear.	0.86
Athel34	Wearing a helmet while driving a motorbike impairs one's vision.	0.82
Athel35	Wearing a helmet while driving a motorbike causes a burden to the driver because there is no convenient way to secure it at each destination.	0.49
	Eigenvalue = 2.43 Percent of variance = 9.70 Cronbach's alpha coefficient = 0.76	
Dimension 3: Attitude towards speed limit		
Atreg3	Driving a motorbike within the speed limit causes delays and lateness for school and appointments.	0.86
Atreg4	Continuing to drive a motorbike within the speed limit causes unnecessary and prolonged exposure to the sun, rain and wind.	0.84
	Eigenvalue = 1.90 Percent of variance = 7.61 Cronbach's alpha coefficient = 0.72	

Table 3. (Continued)

Item Number	Item Statement	Factor Loading
Dimension 4: Attitude towards helmet use 2		
Athel27	Putting on a helmet or taking off a helmet wastes too much time.	-0.81
Athel28	Wearing a helmet just to drive a motorbike is a waste of money.	-0.81
Athel29	Wearing a helmet while driving a motorbike is cumbersome.	-0.71
Athel30	Wearing a helmet while driving a motorbike is uncomfortable.	-0.64
	Eigenvalue = 1.34 Percent of variance = 5.35 Cronbach's alpha coefficient = 0.83	
Dimension 5: Attitude towards riding in the opposite direction		
Atreg10	Riding a motorbike against a one-way street gets me where I want to be faster.	-0.77
Atreg11	Riding a motorbike against a one-way street helps conserve gas.	-0.87
Atreg13	Riding a motorbike against a one-way street helps evade the police at the check point.	-0.55
	Eigenvalue = 4.78 Percent of variance = 1.20 Cronbach's alpha coefficient = 0.76	
Dimension 6: Attitude towards obedience of traffic light and lane		
Atreg6	Stopping at a red light is a waste of time.	-0.79
Atreg7	Stopping at a red light wastes fuel.	-0.78
Atreg8	Continuing to ride in the motorbike lane or the left side of the road forces the rider to unnecessarily reduce speed and wastes time.	-0.59
Atreg9	Continuing to ride a motorbike on the left side of the road increases the chance of a crash.	-0.52
	Eigenvalue = 1.03 Percent of variance = 4.12 Cronbach's alpha coefficient = 0.73	

Reliability of the AMDQ. The reliability of the AMDQ was evaluated with the Cronbach's alpha coefficient; the result for the entire scale was .89 and for each of the dimensions the coefficient values ranged between .72 and .83. These values surpassed the expected value (.70) for a newly-developed instrument (Hair et al., 1998; Burn and Grove, 2001). Reliability also indicates high internal consistency of the scale (Polit and Beck, 2004). This high internal consistency indicates that items of the AMDQ consistently measure the same construct and show high inter-correlation (Hair et al., 1998). These results indicate that this scale is particularly a reliable scale to assess attitudes towards safe motorcycle driving among Thai adolescent motorcyclists.

CONCLUSION AND IMPLICATIONS

The AMDQ was developed as a multidimensional scale that could effectively measure affective, cognitive and behavioral aspects of attitudes towards safe motorcycle driving behaviors. A 6-point Likert-type scale was used as the outcome space or format for this scale. The overall attitude score is the sum of scores from all six dimensions. In this aspect, all retained items have a negative connotation as it relates to safe motorcycle driving behaviors and, therefore, would need to be recoded before calculating the overall score. The total scale score of attitudes could range from 25 to 150. A higher score represents attitudes in favor of safe motorcycle driving behaviors. A lower score in any single dimension indicates a negative attitude against that particular driving behavior and reflects the need for improvement through education and training.

The newly-developed scale for measuring attitudes towards safe motorcycle driving provides a number of useful findings to expand the body of knowledge for nursing research and other related fields. The AMDQ with the acceptable reliability and validity will provide research tools for hypothesis testing studies, particularly those studies which aimed to investigate to what degree a subject's attitude contributes to safe motorcycle driving behaviors. Understanding adolescents' attitude towards driving behaviors is important when developing intervention programs for adolescents and working with them in settings such as schools.

LIMITATIONS

Limitations of this study are related to data collection and the research instrument itself. First, some of the participant samples drawn from the 44 participants in Step 2 of focus group discussions are recruited again†to participate in Step 5 of field testing. Second, the cross-sectional design of this study is a limitation for testing predictive criterion-related validity of this newly-developed scale. Lastly, this study could not test for concurrent or predictive criterion-related validity since there are no existing scales for comparison.

RECOMMENDATIONS

Although this newly-developed scale was proven to be valid and reliable, and can be used as a research tool for assessing attitudes towards safe motorcycle driving behaviors among Thai adolescents, it still needs further research that attempts to replicate this study's results, and further evaluates its psychometric properties. Furthermore, this newly-developed scale needs to be tested with adolescents in other settings and areas so that standardized scales can be developed and be appropriately used among Thai adolescents. In addition, a normative reference for this scale should be identified to facilitate the interpretation of the raw scores. The predictive or concurrent criterion-related validity should be tested with existing standardized scales as well as other psychometric properties such as efficiency or sensitivity of the scale should be tested in further research. Since

the sample reflected a mostly male-population, future researchers who intend to use this instrument should be aware that this scale was developed based on the perspectives of Thai male adolescents, and be cognizant of this possible limitation.

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