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ORIGINAL ARTICLE

Screening Performance of the Korean Version of the Gambling Problem Severity Subscale of the Canadian Adolescent Gambling Index (CAGI GPSS)

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Abstract
The CAGI GPSS is the only instrument that was specifically developed to measure adolescent problem gambling. The purpose of this study is to evaluate the screening performance of the Korean version of the CAGI GPSS. The Korean version of the CAGI GPSS was validated with 1456 adolescents in South Korea. The results indicated that the Korean version of the CAGI GPSS was a unidimensional instrument, like its English version, and that it showed satisfactory internal consistency reliability and convergent validity. The Korean version of the CAGI GPSS demonstrated optimal performances at a cut-off score of 5. The cut-off score of 5 found in this study should be used to identify adolescents in school settings who had gambling problems. However, the sensitivity and specificity results should be interpreted with caution, because the adolescents included in the reference group might not represent all adolescents with gambling problems. Further evaluation is needed to heighten the values of the Korean version of the CAGI GPSS.

Keywords Korean adolescents · Gambling problems · CAGI GPSS · Sensitivity · Specificity

The prevalence of problem gambling in South Korea seems to be higher than in other countries. According to a recent survey (Gallup Korea 2018a, b), the prevalence rate of

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problem gambling measured using the Korean version of the Problem Gambling Severity Index (PGSI) among the general population aged over 20 years old is 5.3%. In this survey, problem gambling referred to both moderate risk gambling (4.2%) and high-risk problem gambling (1.1%). The prevalence rate of problem gambling in Canada has been measured at 3.3% using PGSI, including 2.6% for moderate-risk problem gamblers and 0.7% for high-risk problem gamblers (Malatest and Associates Ltd 2014). In Australia, values of 0.5–0.8% for problem gambling and 1.5–2.9% for moderate risk gambling have been reported (Dowling et al. 2015). In England, the prevalence rate of problem gambling has been shown to be 2.0%, while New Zealand has shown a rate of 1.7% (Williams et al. 2012). In the USA, the rates were found to be 2.8% in New Mexico and 3.2% in Iowa (Williams et al. 2012).

The worldwide lifetime prevalence rates of problem gambling among youth aged 10–24 have been shown to range from 1.6 to 5.6%, while the past-year adolescent prevalence rates across the world have been shown to range from 0.2 to 5.6% (Calado et al. 2016). Caution should be taken in interpreting these rates because different studies used different instruments such as the CAGI, the Diagnostic Statistical Manual IV (DSM-IV) and the South Oaks Gambling Screen-Revised for adolescents (SOGS-RA) to assess problem gambling, and some studies used local samples, and others used national samples (Calado et al. 2016). In a national survey (Gallup Korea 2018a, b) on adolescent gambling activities in South Korea, the prevalence rates of problem gambling, as defined as a score of at least 6 on the Gambling Problem Severity Subscale of the Canadian Adolescent Gambling Index (CAGI GPSS), were found to be 1.5% among in-school adolescents and 8.5% among out-of-school adolescents. A recent study (Turner et al. 2018) conducted with Canadian adolescents aged 13–20 years used the CAGI GPSS to measure adolescent problem gambling. The prevalence rate of problem gambling in that study was measured at 1%. Based on the worldwide prevalence rates of adolescent problem gambling reported by existing studies, significant attention should be paid to Korean adolescent problem gambling.

It is known that adolescent gambling is related to other forms of problem behaviours, such as increased involvement in other addictive behaviours, mental health problems and delinquency and crime. For example, adolescents with gambling problems are more likely to begin drinking regularly at earlier ages and indicate having alcohol problems (Rahman et al. 2014). More adolescents who were classified by the DSM-IV diagnostic criteria as at-risk/problem gambling reported heavy drinking, an earlier onset of smoking cigarettes and never attempting to quit smoking compared with those classified as low-risk gambling (Weinberger et al. 2015). Adolescent gambling problems have been found to be related to a number of mental health problems. For example, in a longitudinal study (Sagoe et al. 2017) conducted with Norwegian adolescents, adolescents' levels of gambling and various mental health symptoms were measured at the ages of 17, 18 and 19. Adolescents abstaining from gambling at all measurements had the lowest level of mental health problems at all endpoints, whereas risk-and-problem gamblers had higher mental health problems on all indicators including loneliness, aggression, anxiety and depression. A study (Richard and Derevensky 2017) conducted in the USA also found that all mental health problems were related to increase in gambling frequency. Since adolescents need money to gamble, adolescents who gamble may be involved in criminal activities to fund their gambling activities. This is supported by data indicating that adolescents with problem gambling are more likely to participate in shoplifting, stealing money and selling drugs (Magoon et al. 2005). It has been reported that some adolescents with gambling problems in South Korea post fake items on websites, steal money or valuables from their

parents and obtain money from friends by force in order to fund their gambling activities (Oh 2018).

The above phenomenon supports what Jessor and Jessor's (1977) problem behaviour theory suggests regarding the connection between dysfunctional behaviours. According to problem behaviour theory, adolescents who have one form of problem behaviours are more likely to have other forms of problem behaviours as well. Therefore, early identification of adolescents who have problem gambling is very important in order to help stop them from engaging in other problem behaviours. In order to early identify such adolescents, reliable and valid screening instruments are needed. The CAGI appears to be an excellent screening instrument that can be used to identify adolescents with gambling problems. There are four instruments that can be used to measure gambling problems among adolescents (Stinchfield 2010): the SOGS-RA, the DSM-IV (Multiple Response format) adapted for Juveniles (DSM-IV-J; DSM-IV-MR-J), Massachusetts Gambling Screen (MAGS) and CAGI GPSS. Among these, CAGI GPSS is the only instrument specifically developed for an adolescent population (Edgren et al. 2016). This is because the other instruments were originally developed for an adult population and modified for adolescents. There is an argument that adolescents tend to over-endorse questionnaire items because they do not understand the items (Wiebe et al. 2005). This may lead to measurement problems like lowered reliability and validity.

The CAGI is a self-report instrument that measures the adverse psychosocial consequences of gambling in adolescent populations. The CAGI consists of 24 items covering the consequences of gambling. The 24 items are composed of five subscales: (a) gambling problem severity, (b) psychological consequences, (c) social consequences, (d) financial consequences and (e) loss of control (Turner et al. 2018). The first subscale, referred to as the CAGI GPSS, is composed of nine items from three consequences subscales and the loss of control subscale. The CAGI GPSS include items dealing with the effects of gambling on peer relationships and financial consequences in a developmentally appropriate manner (Dodig 2013). The CAGI GPSS has been validated as a reliable and valid instrument in a general population survey of adolescents in Canada (Turner et al. 2018).

The CAGI GPSS has been used in national surveys on adolescent gambling in South Korea (Gallup Korea 2015, 2018a, b). Although the other instruments mentioned above, particularly the SOGS-RA, have been used in several studies, the choice of instrument for national surveys has been the CAGI GPSS. A previous study translated the CAGI GPSS into Korean and analysed its factor structure (Gallup Korea 2015). However, the screening performance of the Korean version of the CAGI GPSS has yet to be analysed. Screening instruments like the CAGI GPSS should show good performance to discriminate those with the condition of interest and those without the condition. The performance can be evaluated by computing the sensitivity and specificity. Sensitivity is 'the percentage correctly classified as having the condition', and specificity is 'the percentage correctly classified as not having the condition' (Cherpitel 1999, p. 708) for current gambling problems. The primary purpose of this study was to evaluate the sensitivity and specificity of the Korean version of the CAGI GPSS with a community sample. The reason why the sensitivity and specificity were computed with a community sample is that the CAGI GPSS has often been used with samples drawn from a general adolescent population in South Korea. In addition, it is very difficult to recruit adolescents diagnosed with gambling disorders in South Korea. The validation of the Korean version of the CAGI GPSS through this study would enhance its utility with a general population of adolescents in South Korea.

Method

Sample and Sampling Procedure

The sample of this study consisted of adolescents in middle (7th–9th grade) and high schools (10th–12th grade). In South Korea, students in 7th–9th grade are considered middle school students while those in 10th–12th grade are considered high school students. The sampling was conducted by a professional social research agency which had a pool of adolescents who participated in research panels. Since the research panels were composed of adolescents from a variety of regions in South Korea, collecting data from adolescents who resided in a variety of regions was easy. The research panels were asked to respond to the questionnaire items of this study online. Online surveys have advantages of collecting large amounts of data in a relatively short period of time (Research Lifeline 2012). Data collected from online surveys can also be loaded directly into data entry software, which saves time and resources associated with the data entry process and lowers the probability of data entry error (Research Lifeline 2012). All of the respondents provided written informed consent and this study received the approval from the Institutional Review Board of the first authors' university.

Initially, a total of 1472 students completed this survey. Out of these respondents, 16 cases were dropped during the data cleaning process due to their inconsistent responses, which resulted in a total of 1456 respondents. Table 1 shows the demographic characteristics of the sample of this study. Among the respondents, 44.2% were male students and 55.8% were female students. On average, respondents were 16.56 years of age with the standard deviation of 1.24. In terms of grade, 21.9% of participants were middle school students (7, 8 and 9th grade) and 78.1% were high school students (10, 11 and 12th grade). Due to the uneven composition of the research panels by grade, high school students were overrepresented.

Measures

The nine items of the CAGI GPSS were translated into Korean by the authors of the previous study (2015) (the items can be found at http://www.kcgp.or.kr which is the web address of the Korean Center on Gambling Problems). Before developing the Korean version of the CAGI GPSS, the authors obtained permission for the translation into Korean from Dr. Stinchfield,

Table 1 Demographic characteristics of the sample

		(n = 1456)
Demographic Characteristics	N	%
Gender		
Male	643	44.2
Female	813	55.8
Grade		
7	3	.2
8	98	6.7
9	219	15.1
10	269	18.5
11	411	28.3
12	455	31.3
Age		
m = 16.56, sd = 1.24		
min = 14, max = 18		

one of the authors of the CAGI. The nine items of the CAGI GPSS derived two items (Items 4 and 7) from the psychological consequences subscale, three items (items 1, 2 and 6) from the social consequences subscale, two items (Items 8 and 9) from the financial consequences subscale and two items (Items 3 and 5) from the loss of control subscale of the CAGI. Items 1–7 of the CAGI GPSS are answered on a 4-point rate scale ranging from 'never' (0), 'sometimes' (1), 'most of the time' (2) and 'almost always' (3), while items 8 and 9 are answered between 'never' (0), '1–3 times' (1), '4–6 times' (2) and '7 or more times' (3). The total score of the CAGI GPSS ranges from 0 to 27. The total score was categorized as 0–1 = no problem, 2–5 = low-to- moderate severity and 6+ = high severity. The CAGI GPSS has a time frame of the past 3 months. However, a past year time frame was used for the Korean version of the CAGI GPSS due to the fact that a 3-month period of time was not considered sufficient to detect a sufficient number of adolescents with gambling problems. Either a past year time frame or a 3-month time frame has been used for the DSM-IV Pathological Gambling Criteria (Tremblay et al. 2010; Fisher 2000).

SOGS-RA and the revised Problem-Oriented Screening Instrument for Teenagers (POSIT) substance use/abuse scale were included in the survey questionnaire. SOGS-RA is an instrument used to measure the signs and symptoms of adolescent gambling problems over the past year (Stinchfield et al. 2017). The SOGS-RA has 12 items measuring several aspects, such as loss of control over the game; action taken to recover monetary losses; interference with family, school and relational life; guilt feelings about the money spent; and consequences of gambling. A total score of 4 or greater on the SOGS-RA is considered problem gambling (Winters et al. 1993, 1995). The revised POSIT substance use/abuse scale is an instrument used to identify substance-abusing adolescents (Latimer et al. 1997). The scale has 11 items and has been found to be reliable and valid in a sample of adolescents in Korea (Kim 2010). The scale demonstrated its optimal performance at a cut-off score of 1, which was the score recommended by its developer to screen for substance-abusing adolescents in school settings (Kim 2010).

Data Analysis

Before evaluating the sensitivity and specificity of the Korean version of the CAGI GPSS, confirmatory factor analysis (CFA) was used to confirm its unidimensional factor structure. The goodness of fit was using multiple fit indexes, including chi-square, root mean square error of approximation (RMSEA), the Comparative Fit Index (CFI) and the Tucker Lewis Index (TLI). In order to demonstrate a good fit, the ratio of chi-square to the degrees of freedom should not exceed 3.0, the values of CFI and TLI should both be .90 or higher, and RMSEA should be less than .06 (Sun 2005).

The internal consistency reliability of the Korean version of the CAGI GPSS was assessed by calculating Cronbach's alpha coefficient, the corrected item-to-total correlation and the inter-item correlation. Its convergent construct validity was assessed in a variety of ways, including examining factor loadings, the values of variance extracted and the construct reliability (Hair et al. 2006). The Pearson correlations between the Korean version of the CAGI GPSS, the SOGS-RA and the POSIT were also analysed. They were all expected to have positive correlations.

A screening instrument being evaluated should be compared against a gold standard. However, a proxy gold standard was used because it was impossible to have clinical samples composed of adolescents diagnosed with gambling disorder. The SOGS-RA was used as a proxy gold standard. The SOGS-RA has been used in Korea. Therefore, the sensitivity and

specificity of the Korean version of the CAGI GPSS were calculated for the SOGS-RA at each possible cut-off score. As mentioned earlier, the SOGS-RA score of 4 or greater are considered problem gambling (Winters et al. 1995). In order to determine the optimal cut-off scores of the Korean version of the CAGI GPSS, various methods of selecting cut-off scores were used. For each possible cut-off score of the CAGI GPSS, various indices such as sensitivity, specificity and hit rate were calculated and compared.

CFA was conducted with Mplus 8 (Muthén and Muthén 1998-2015) using a weighted least square estimator (WLSMV) because the item variables were ordinal scales (four-point Likert scale). All other statistical analyses were conducted using STATA 14 (StataCorp 2015).

Results

Item Statistics

The Korean version of the CAGI GPSS consists of nine items scored on a 4-point Likert scale ranging from 'not at all (0)' to 'almost always (3)'. As shown in Table 2, the overall mean scores of the items were found to be low, ranging from .008 to .076. Among these items, item 4 had the highest mean score while item 9 had the lowest.

Mardia's test for multivariate normality showed that the variables were not assumed to be normally distributed (Skewness = 647.83, $p < .001$; Kurtosis = 1546.59, $p < .001$). However, WLSMV, the estimator that we used for CFA, does not make distributional assumptions on the observed variables (Li 2016).

Confirmatory Factor Analysis

According to a previous study (Kim et al. 2017), the Korean version of the CAGI GPSS has been identified as a unidimensional scale. Thus, confirmatory factor analysis (CFA) was used to validate the one-factor structure of the CAGI GPSS.

Table 2 Descriptive statistics of items

Items	Mean	SD	Skew.	Kurt.
1. How often have you skipped practice or dropped out of activities due to your gambling?	.022	.173	8.72	85.55
2. How often have you skipped hanging out with friends who do not gamble to hang out with friends who do gamble?	.017	.149	9.71	106.63
3. How often have you planned your gambling activities?	.038	.229	7.02	58.95
4. How often have you felt bad about the way you gamble?	.076	.318	4.93	31.02
5. How often have you gone back another day to try to win back the money you lost while gambling?	.053	.283	6.10	43.90
6. How often have you hidden your gambling from your parents, other family members, or teachers?	.057	.329	6.58	49.38
7. How often have you felt that you might have a problem with gambling?	.029	.223	9.19	97.93
8. How often have you taken money that you were supposed to spend on lunch, clothing, movies, etc., and used it for gambling or for paying off gambling debts?	.046	.256	7.05	63.59
9. How often have you stolen money or other things of value in order to gamble or to pay off your gambling debts?	.008	.090	10.87	119.34

Table 3 Factor loadings and fit indices

Item number	Factor loadings (Standardized)					
1	.909					
2	.945					
3	.865					
4	.945					
5	.921					
6	.934					
7	.931					
8	.873					
9	.792					
	χ^2	*df*	χ^2/df	RMSEA	CFI	TLI
CAGI GPSS	71.990	27	2.666	.034	.995	.994

As shown in Table 3, all of the fit indices indicated a good overall model fit (χ^2/df = 2.666, RESEA = .034, CFI = .995, TLI = .994) and the adequate factor loadings associated with both CAGI GPSS. All factor loadings were found to be statistically significant, ranging from .792 to .945 for the CAGI GPSS.

Reliability

In order to estimate the internal consistency of the CAGI GPSS, Cronbach's alphas, item-total correlations and inter-item correlations were calculated. According to Hair et al. (2006), the lower limits for Cronbach's alpha, item-total correlation and inter-item correlation are suggested to be .70, .50 and .30, respectively. The Cronbach's alpha of the CAGI GPSS was found to be .880, indicating that the model is more than acceptable (Table 4). However, while all of the items of the CAGI GPSS exceeded the lower limit for the item-total correlation, item 9 of the CAGI GPSS failed to meet the criterion. Item 9 was also found to have relatively lower inter-item correlations with items 3, 4, 6 and 7 (Table 4).

Validity

The score on the Korean versions of the CAGI GPSS was moderately positively correlated with scores on both the SOGS-RA (r = .772) and the POSIT (r = .405).

Table 4 Inter-item, item-total correlations and Cronbach's alpha

	Inter-item correlation									Item-total correlation	Cronbach Alpha
	1	2	3	4	5	6	7	8	9		
1	1.000									.657	.880
2	.731*	1.000								.682	
3	.481*	.480*	1.000							.716	
4	.420*	.419*	.561*	1.000						.828	
5	.468*	.464*	.475*	.694*	1.000					.809	
6	.376*	.412*	.506*	.652*	.622*	1.000				.819	
7	.446*	.498*	.460*	.596*	.561*	.630*	1.000			.772	
8	.396*	.480*	.460*	.512*	.495*	.561*	.527*	1.000		.741	
9	.340*	.345*	.216*	.217*	.304*	.261*	.226*	.398*	1.000	.417	

*p < .05

Table 5 Comparison of indices for each cut-off score of the CAGI GPSS

Cut-off score	SOGS_RA		Sensitivity	Specificity	Hit rate
	<4	4+			
0	1316	0	1.00	.00	.02
1	57	2	1.00	.92	.92
2	18	2	.92	.96	.95
3	13	1	.84	.97	.97
4	9	0	.80	.98	.97
5	7	2	.80	.98	.98
6	3	0	.73	.99	.98
7	3	4	.73	.99	.99
8	2	1	.57	.99	.98
9	1	2	.53	.99	.99
10	1	3	.46	.99	.98
11	0	1	.34	1.00	.98
12	0	4	.30	1.00	.98
15	0	2	.15	1.00	.98
17	0	2	.07	1.00	.98
>17	0	0	.00	1.00	.98

These relationships indicate that the Korean versions of the CAGI GPSS have convergent validity.

In addition, the Average Variance Extracted (AVE) and Construct Reliability (CR) were calculated in order to assess the convergent validity of each scale. According to Hair et al. (2006), a factor loading of .5 or higher, an AVE of .5 or higher and a CR of .7 or higher are recommended for adequate convergent validity. Along with the adequate factor loadings previously shown in Table 3, the scale has more than adequate values for AVE being .902 and CR being .830.

Cut-off Score Selection

Tables 5 shows the various indices for each cut-off score of the instrument indicating statistical measures of the classification accuracy. The minimum criterion of .80 of sensitivity, specificity, and hit rate was used (Stinchfield et al. 2017). Judged by balancing among the three indices, it was determined that a score of 5 was the optimal cut-off value. With a score of 5, sensitivity exceeded .80, and specificity and hit rate became highest among the cut-off values with their sensitivity above .80.

When using a cut-off score of 5, the CAGI GPSS was able to correctly identify 80% of respondents whose score was 4 or more on the SOGS-RA and 98% of respondents whose score was below 4 (Table 5).

In addition, the prevalence rate of gambling problem using both the CAGI GPSS was represented in Table 6. The rate was found to be 2.61% which was slightly higher than the rate

Table 6 Prevalence rates of gambling problem using the CAGI GPSS

Cut-off score	Frequency	Percent
< 5	1418	97.39
5 +	38	2.61
Column total	1456	100.00

reported in a national survey (Gallup Korea 2018a, b). The difference may occur due to the use of the different cut-off scores.

Conclusion

The CAGI GPSS is the first screening instrument specifically developed for adolescent problem gambling (Turner et al. 2018). The CAGI GPSS has been used in national surveys on adolescent gambling in South Korea. It was expected that a comprehensive assessment of the CAGI GPSS, including its sensitivity and specificity, would enhance its screening performance.

The Korean versions of the CAGI GPSS have demonstrated evidence of reliable and valid instrument for measuring problem gambling among Korean adolescents. This study was the first one using a sample of Korean adolescents to explore the cut-off scores of the instruments using sensitivity, specificity and ROC curve analysis. A cut-off score of 5 on the CAGI GPSS was found to be the optimal value. The English version of the CAGI GPSS has a slightly higher cut-off score which is 6 (Tremblay et al. 2010; Stinchfield et al. 2017). The difference may occur due to the reference groups used in those studies. While the English versions of the CAGI GPSS used groups of adolescents who met either the DSM-IV pathological gambling criteria (Tremblay et al. 2010) or the DSM-5 gambling disorder criteria (Stinchfield et al. 2017), this study used a group of students who scored 4 or higher on the SOGS-RA. Therefore, caution should be taken in interpreting the sensitivity and specificity results in this study because the adolescents included in the reference group might not represent the entire group of adolescents with gambling problems. The cut-off score of 5 found in this study could come to be applied to identify adolescents in school settings who have gambling problems. If future studies evaluate the Korean version of the CAGI GPSS with clinical samples that satisfy the DSM-5 gambling disorder criteria, the value of the Korean version of the CAGI GPSS would be heightened. In addition, it should be noted that the cut-off score of 5 on the CAGI GPSS should be limited to the Korean adolescents participated in this study. Before the cut-off score applies to other adolescent populations in other countries, further evaluations should to be conducted.

Finally, the Korean versions of the CAGI GPSS could be used in both practice and research. Helping professionals in schools and social service agencies could use these instruments to early detect adolescents with gambling problems and refer them to appropriate agencies offering preventive services in order to prevent them from having more serious gambling problems or engaging in gambling-related criminal activities. Researchers could use these instruments to investigate the relationships between adolescent problem gambling and other addictive behaviours and identify various factors affecting adolescent gambling.

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Compliance with Ethical Standards

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