Article

Title **Reliability and validity of the Center for Epidemiologic Studies Depression (CES-D) scale for adolescents in Lao PDR**

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Abstract

This study aimed to develop a Laotian adolescent version of the Center for Epidemiologic Studies Depression Scale (CES-D), determine its reliability and validity, and examine its factorial properties. The study targeted at 7,554 students in lower secondary schools and teacher training colleges in Lao PDR. Self-administered questionnaires were collected from 2012 to 2014. Exploratory factor analysis performed in three age groups using the *weighted least square mean* and variance *adjusted* estimation with robust maximum likelihood methods. The factor structure for each age group was the same; therefore, data from the full sample were analyzed further. The model was then tested by

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confirmatory factor analysis. A 2-factor model was determined as a common model among the age groups by using paralleled analysis. We determined a best-fitting structure comprising two factors: "Negative affect" and "Positive affect." The Cronbach's alpha was .81. "Effort" items loaded on the "Somatic and retarded activity" factor in the original model but loaded on the "Positive affect" factor in the adolescent model. "Depressed affect," "Somatic and retarded activity," and "Interpersonal" items were combined into the "Negative affect" factor in the adolescent model.

Keywords: adolescents, depression, Laos, psychometric testing

1. Introduction

One in six people are aged 10–19 years [1]. Mental health disorders commonly emerge during adolescence [2], and mental health disorders account for 16% of the global burden of disease and injury in 10–19 years [3]. Further, previous research has reported that half of all mental health disorders start by the mid-teens [2,4]. In order to prevent mental health disorders in adolescents, early detection and treatment are essential. However, children's and adolescents' mental health needs have been neglected, especially in low- and middle-income countries [5].

Mental health disorders are emerging public health issues, especially in developing Asian countries. Nearly half of all people who have mental health disorders live in South-East Asia and Western Pacific regions [6]. Lao PDR is one of the least developed countries in South-East Asia; however, it is now undergoing rapid development and, thus, drastic changes are affecting people's lifestyles. A previous study reported that these changes might give rise to physical and mental disorders [7]. Physical, emotional, and social changes can relate to mental health in adolescents [3].

In Laos, the proportion of adolescents aged 10-19 makes up 20% of the total population [8]. Moreover, the net enrollment rate for secondary education in Laos, which was 40.0% in 2000, has improved to 60.0% in 2018 [9]. Regarding the response to adolescents' health, including mental health disorders, the government of Laos expanded its target of school health activities from primary to secondary schools in its revised national school health policy [10]. Moreover, the government of Laos

added the importance of providing a healthy psychosocial environment in school as one of the components of the revised school health policy [10]. However, in Laos, less attention has been paid to mental health problems, and there is a lack of appropriate tools to assess mental health disorders in adolescents. The World Health Organization (WHO) has advocated strengthening adolescent health as an important agenda for the next decade [11]. Besides, risk and protective factors for adolescent mental health-related to various health problems and behaviors. Therefore, a population-based survey on mental health may help maintain good adolescent health and early detection of mental health disorders. Besides, the early detection of mental health disorders can promote early interventions for other adolescent health disorders and health risks.

Previous research on Laotian high school students estimated the prevalence of depression in clinical setting [12]. However, this study used the Beck Depression Inventory [13].

The Center for Epidemiologic Studies Depression Scale (CES-D) is a 20-item questionnaire for detecting depression. The CES-D has been translated and used in many countries for epidemiological research. Radloff's original CES-D compose four factors: "Depressed affect," "Somatic and retarded activity," "Positive affect," and "Interpersonal." This instrument is one of the most frequently used to evaluate the depressive situation in community samples [14]. Tomokawa et al. [15] developed a CES-D Laotian version and confirmed its validity and reliability. However, this Laotian version has only been examined with adult population samples and, thus, its applicability to other age groups is unknown.

There are various versions of the CES-D for adolescents, and the factor structures of the developed models have been tested. Results have indicated that the factor structure and number of factors differ among the developed CES-D models. For example, research on factor analysis with Filipino American adolescent samples reported two-factor solutions [16]. However, studies on Native American Indian adolescents [17], Chinese American adolescents [18], mainland Chinese adolescents [19], Malaysian adolescents [20] and Chinese and Korean adolescents [21], and have reported three-factor solutions. Four-factor solutions were found in studies with Anglo-American and Mexican

American youths [22], young Chinese children [23], and Taiwanese adolescents [24]. A five-factor structure was reported in a study on Chinese American college students [25]. These differences in the number of factors may indicate differences in mental health characteristics across countries and cultures. Thus, it is necessary to develop a CES-D for Laotian adolescents. However, CES-D for Laotian adolescents has not yet developed. Therefore, this study aimed to develop a CES-D for Laotian adolescents, investigate its reliability and validity, and examine its factorial properties.

2. Materials and Methods

2.1. Participants

This study included students in ten secondary schools (grades 2 to 7) and two teacher training colleges (grades 1 to 4) in the provinces of Luangprabang (northern area), Savannakhet (south-central area), and Champasak (southern area) in Lao PDR from 2012 to 2014.

2.2. Research tools

Participants evaluated their mental health situation in the past week with a self-administered questionnaire — the Laotian CES-D for adolescents — which was developed by modifying the existing Laotian CES-D for adults [15]. The CES-D for Laotian adolescents includes 20 items, with a 4-point Likert scale. Four items are reverse scored. In the development of the Laotian CES-D for adolescents, items relating to the factors that were excluded in a previous study on the Laotian CES-D for adults — "Bothered," "As good," "Keeping mind," "Effort," and "Unfriendly" — were modified in terms of translation between Laos and English to employ phrases that better matched the intended meanings of the items.

2.3. Statistical analysis

Data were analyzed by SPSS (Version 21.0) and Mplus (8.3). The statistical significance was set at $p<.05$. Cronbach's alpha coefficient was calculated and evaluated the internal consistency and item homogeneity.

There are several different definitions of the age range of adolescents. The WHO defines "very young adolescents" is children aged 10-14 years [26] , "adolescents" as individuals aged 10-19 years, and “youth” as those aged 15-24 years [27]. The United Nations Children's Fund (UNICEF) applies the age range of 10-19 years to "adolescents," and the adolescent population is divided into two groups in the UNICEF definition: early adolescence (10-14 years) and late adolescence (15-19 years) [28]. Meanwhile, a previous study defined adolescence with an age range of 10–24 years that corresponds more closely to adolescent growth of their life stage than 10-19 years [29]. However, in the Laotian education system, secondary school starts at the age of 11, and the participants of this study included only individuals aged more than ten years. Therefore, in this study, we targeted students aged 11-24 years and defined this age group as “adolescent.” Further, in statistical analyses, we divided the data into three age groups, namely, early adolescence (11-14 years), late adolescence (15-19 years), and young adulthood (20-24 years), and analyzed the data of each group separately, and then aggregated the sample data (11-24 years).

First, we performed exploratory factor analysis (EFA) for each age group, using the *weighted least square mean* and variance *adjusted* estimation. Considering the resulting eigenvalues and the interpretability of factors, we identified a 3-factor model. However, the early adolescents' model differed in model structure from those for the other two age groups. Therefore, we then performed a parallel analysis to determine the number of factors in each age group. Based on this analysis results, we suspected that the number of factors was two in all age groups. Then, we conducted EFA and confirmed that all groups had a two-factor structure. Next, multi-group analysis (11-14 years, 15-19 years, and 20-24 years) was performed using a two-factor structure as a configurable model. In the multi-group analysis, we examined whether the factor structure, that is, the number of factors and the factor loading patterns of the items related to the factors, was the same. Based on the result of the multi-group analysis, we determined that a 2-factor model was common among age groups. The 2-factor model for the aggregated data from all three groups tested with confirmatory factor analysis (CFA).

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Model fit was evaluated with a chi-square test, root mean square error of approximation (RMSEA), standardized root mean square residual (SRMR), and comparative fit index (CFI). RMSEA values less than .05 indicate good fit, and values as high as .08 represent acceptable errors of approximation in the population [30]. RMSEA values ranging from .08 - .10 indicate moderate fit and values greater than .10 indicate a poor fit. A value of less than .08 is generally considered a good fit [31]. Values for CFI range from 0 - 1.00, with values greater than .95 considered representative of a good model fit [32].

Ethical approval was obtained from the Committee of Tokyo Gakugei University (No. 158) and the National Ethics Committee for Health Research in Lao PDR (No. 172). We researched with the agreement of the Ministry of Education and Sports in Lao PDR and the National University of Laos. Written informed consent was obtained from the student. Before distributing the questionnaire, we explained the aims, procedures, and potential risks and benefits of this study to school directors and classroom teachers and obtained their approval. After that, we provided the same information to participating students in their native Laotian dialect. We also explained to them that participation was voluntary, and they could withdraw at any time. Besides, we explained that participation in the survey was not related to school performance evaluation.

3. Results

3.1. Participant characteristics

Data were collected from 7,554 students (aged 11-24 years), of whom 3,391 (44.9%) were males and 4,163 (55.1%) were females. The average age for the total sample was 17.8±2.7 years; the average age was 18.0±2.8 for males and 17.7±2.6 for females. The number of participants in each age group was 789 (10.4%) for the early adolescents (11-14 years), 4,631 (61.3%) for the late adolescents (15-19 years), and 2,134 (28.2%) for the young adults (20-24 years). Table1 shows participants' characteristics by prefecture.

Table 1. Participants' characteristics

Prefecture	Area	Sex	Number		%		Age	
Luang Prabang	North	Male	1148	2700	42.5	35.7	19.4±2.6	19.0±2.6
		Female	1552		57.5		18.7±2.4	
Savannakhet	South-central	Male	648	1419	45.7	18.8	17.8±1.6	17.5±1.5
		Female	771		54.3		17.3±1.4	
Champasak	South	Male	1595	3435	46.4	45.5	17.0±2.8	16.9±2.9
		Female	1840		53.6		16.9±2.9	

3.2. Descriptive statistics

Table 2 shows the means and standard deviations for the developed CES-D for adolescents by age group and the aggregated sample.

Table 2. Means and standard deviations of the developed CES-D for adolescents for each age group and the aggregated sample

Item	Early Adolescents 11-14 years		Late Adolescents 15-19 years		Young Adults 20-24 years		Aggregated sample (11-24years)	
	Mean	*SD*	Mean	*SD*	Mean	*SD*	Mean	*SD*
1. Bothered	0.75	0.91	0.82	0.87	0.91	0.89	0.84	0.88
2. Poor appetite	0.80	0.90	0.92	0.92	0.84	0.90	0.89	0.91
3. Blues	0.49	0.82	0.70	0.91	0.79	0.90	0.70	0.90
4. As good	1.50	0.97	1.34	0.92	1.19	0.89	1.32	0.92
5. Keeping mind	1.08	0.93	1.29	0.94	1.40	0.90	1.30	0.93
6. Depressed	0.74	0.90	1.03	0.96	1.19	0.93	1.04	0.96
7. Effort	1.79	1.04	2.02	0.98	2.31	0.87	2.08	0.97
8. Hopeful	0.78	0.95	0.57	0.83	0.30	0.66	0.52	0.82
9. Failure	0.91	0.97	1.26	1.00	1.43	0.94	1.27	0.99
10. Fearful	1.28	0.96	1.33	0.96	1.43	0.93	1.36	0.96
11. Sleep	0.90	0.98	1.06	0.99	1.19	0.96	1.08	0.98
12. Happy	0.56	0.96	0.57	0.93	0.55	0.90	0.56	0.92
13. Talked less	0.89	0.96	1.16	0.97	1.18	0.94	1.14	0.97
14. Lonely	0.79	0.97	1.07	0.99	1.17	0.97	1.07	0.99
15. Unfriendly	0.75	0.91	0.86	0.96	0.80	0.93	0.83	0.94
16. Enjoyed	0.82	0.87	0.93	0.88	1.10	0.90	0.96	0.89
17. Crying	0.75	0.95	0.82	0.95	0.80	0.94	0.81	0.95
18. Sad	0.80	0.90	1.06	0.93	1.19	0.90	1.07	0.92
19. Dislike	0.72	0.86	0.75	0.87	0.65	0.80	0.72	0.85
20. Get going	1.10	0.96	1.25	0.94	1.29	0.89	1.25	0.93
Total score	17.9	8.30	20.8	8.7	21.8	7.90	20.8	8.5

3.3. Factor structure of the Laotian CES-D for adolescents

3.3.1. Results of EFA by age group.

Table 3 shows the results of EFA by age group. We decided upon a 3-factor model for all three age groups. However, the factor structure for early adolescents differed from that of the other two age groups. Factor 1 in the model for early adolescents included five items, while Factor 1 for late adolescents and young adults included 12 items. Similarly, Factor 2 in the model for early adolescents included ten items, while Factor 2 for late adolescents and young adults included three items. Factor 3 included the same five items for all three age groups.

Table 3. Results for the exploratory factor analysis by age groups in Laotian adolescents

Item	Early Adolescents (11-14 years)			Late Adolescents (15-19 years)			Young Adults (20-24 years)		
	F1	F2	F3	F1	F2	F3	F1	F2	F3
1. Bothered	●			●			●		
2. Poor appetite	●			●			●		
3. Blues	●			●			●		
4. As good			●			●			●
5. Keeping mind	●			●			●		
6. Depressed		●		●			●		
7. Effort			●			●			●
8. Hopeful			●			●			●
9. Failure		●		●			●		
10. Fearful		●		●			●		
11. Sleep		●		●			●		
12. Happy			●			●			●
13. Talked less		●		●			●		
14. Lonely		●		●			●		
15. Unfriendly		●			●			●	
16. Enjoyed			●			●			●
17. Crying		●		●			●		
18. Sad		●		●			●		
19. Dislike		●			●			●	
20. Get going	●				●			●	

[1]F1: Factor1, F2: Factor2, F3: Factor3

3.3.2. Results of parallel analysis.

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Figure1 shows the results of the parallel analysis. Based on this analysis, we assumed a 2-factor model as a common model among the age groups and adopted a common solution for all three age groups.

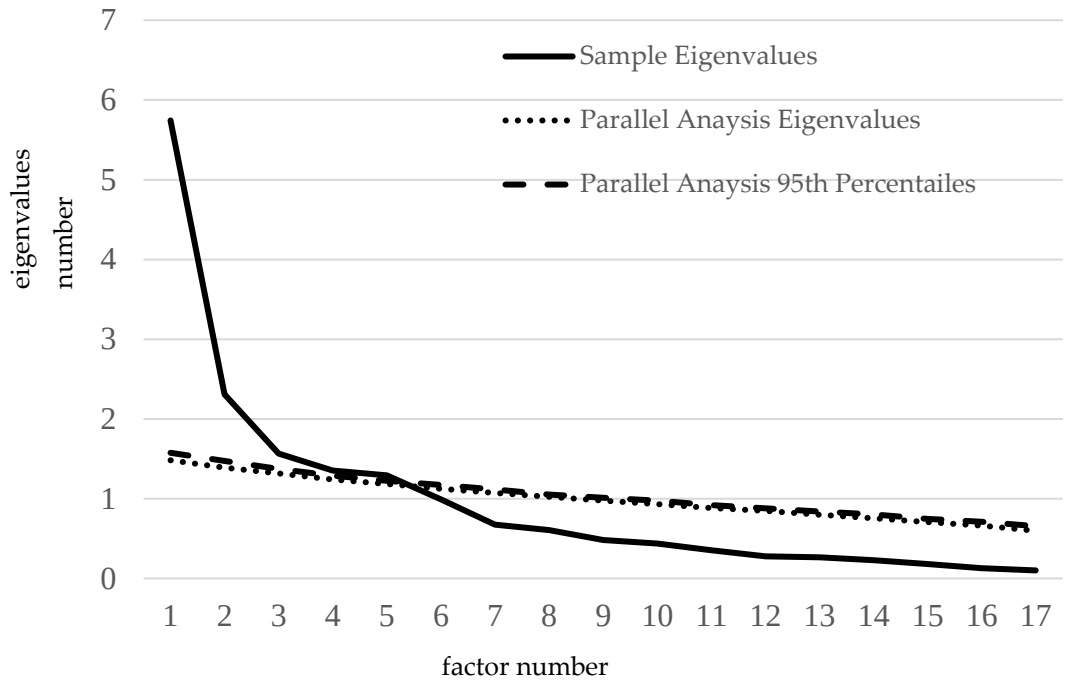

Figure 1: Results of parallel analysis with aggregated data across the three age groups

3.3.3. Results of multi-group analysis.

Results of the multi-group analysis indicated good fit (χ^2 = 5648.636, df = 619, p<.01, RMSEA = .059, 90% confidence interval [CI]: .058–.061), p<.01, CFI = .912, and SRMR = .058). Based on the results of the multi-group analysis, we determined that a 2-factor model was a common model among the age groups.

3.3.4. Results of CFA.

As a result of CFA, we confirmed that the 2-factor model, which had been identified in the multi-group analysis, was the best fitting structure for the aggregated data with all three age groups. The best-fitting structure comprised two factors: “Negative affect” (F1) and “Positive affect” (F2) (Table 4). The first factor contained 15 items, and it had to combine items indicating “Depressed affect,”

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"Somatic and retarded activity," and "Interpersonal." The second factor contained five items: "Positive affect" and "Somatic and retarded activity." Results of the CFA with the 2-factor model indicated good fit (χ^2 = 5808.733, df = 169, p<.01, RMSEA = .066, 90% confidence interval [CI]: .065–.068), p = .01, CFI = .911, and SRMR = .056). Cronbach's alpha coefficient was .81. Regarding factor correlations, there was a significant correlation between factor scores for "Negative affect" and "Positive affect" (r = .137, SE = .020, p<.05). Therefore, we concluded that the developed model could be applied as a scale for depressive symptoms among Laotian adolescents.

Although the Laotian adult model [15] consists of three factors, the Laotian adolescent model consisted of two factors. The "Effort" item loaded on the "Somatic and retarded activity" factor in Radloff's model [14], while it was excluded in the Laotian adult model and loaded on the "Positive affect" factor in the Laotian adolescent model. Moreover, "Depressed affect," "Somatic and retarded activity," and "Interpersonal" items were combined into one factor ("Negative affect") in the Laotian adolescent model.

Table 4. Solution for the confirmatory factor analysis in Laotian adolescents

	Factor 1: Negative Affects	Factor 2: Positive Affects
1. Bothered	0.475*	0.016
2. Poor appetite	0.482*	0.004
3. Blues	0.594*	0.000
5. Keeping mind	0.462*	0.139*
6. Depressed	0.733*	0.020
9. Failure	0.615*	0.037*
10. Fearful	0.555*	0.086*
11. Sleep	0.570*	0.037*
13. Talked less	0.448*	0.056*
14. Lonely	0.734*	0.017
17. Crying	0.598*	0.021
18. Sad	0.766*	0.004
20. Get going	0.555*	0.034*
15. Unfriendly	0.578*	0.083*

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19. Dislike	0.628*	0.098*
7. Effort	0.158*	0.544*
4. As good_(r)	0.013	0.464*
8. Hopeful_(r)	0.063*	0.643*
12. Happy_(r)	-0.124*	0.568*
16. Enjoyed_(r)	-0.264*	0.419*

[1] Fit indices: Chi-Square Test of Model Fit (Value: 5808.733, Degrees of Freedom: 169, p<.01), RMSEA (Estimate .066, 90 Percent C.I.: .065-.068, Probability RMSEA <= .05: p<.01), SRMR: .056, CFI: .911
[2] (r): reverse-scored item
[3] * significant at 5% level

4. Discussion

This study developed a CES-D for Laotian adolescents and examined its reliability, validity, and factorial properties. As a result, we found a 2-factor structure consisting of "Negative affect" and "Positive affect" as the best fitting model for the Laotian adolescent.

In the following discussion, we focus on the differences between the Laotian adolescent model, the Laotian adult model, Radloff's model, and other adolescent models in Asia.

We identified three differences between the Laotian adult model and the Laotian adolescent model. First, the Laotian adult model comprises three factors: "Sadness/loneliness," "Psychosomatic symptoms," and "Lack of positive affect" [15], while the Laotian adolescent model consists of two factors. Second, interpersonal items behaved differently in the two models. "Dislike" and "Unfriendly" loaded on "Negative" items in the adolescent model, but "Dislike" loaded on "Sadness/loneliness," and "Unfriendly" was excluded from the adult model. Third, the "Effort" item, indicating "Somatic and retarded activity," was combined with the items "Happy," "Enjoyed," "Hopeful," and "As good as" in the Laotian adolescent model, and the aggregate of these items formed "Positive affect," as in Radloff's model, but unlike the adult model, in which "As good as" was excluded because of its low loading. This may be why the Laotian adolescent model developed in this study consisted of factors similar to the Depression Self-Rating Scale for Children (DSRS-C), which was developed for children rather than adults [33].

A possible reason why the Laotian adolescent model is composed of two factors, namely "Negative affect" and "Positive affect," is that, in general, in adults' somatization results in physical

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symptoms as a result of suppression of mental depressive mood. On the other hand, in adolescents, mental function and sociality are still immature and developing, and thus, mental depressive mood and physical symptoms often remain undifferentiated or not fully differentiated [34]. In addition, it is thought that the factors that differentiate such experiences of depression are the influence of developmental factors and social culture, and the nature of the event that causes depression (the stressor) [35]. Other possible reasons for the differences between the adults and adolescents model are that the translation of the CES-D for adolescents was improved compared with the model for adults. Besides, the size of the adolescent sample was much larger than that of the adult sample.

In the comparison between Radloff's model and the Laotian adolescent model, we identified three differences. First, Radloff's model comprises four factors, whereas the Laotian adolescent model comprises two factors. Second, items in "Depressive affect," "Somatic and retarded activity," and "Interpersonal" were distinguished as individual factors in Radloff's model, while items in these three factors were combined into one factor ("Negative affect") in the Laotian adolescent model. Third, the Laotian adolescent model combined the "Effort" item that indicates "Somatic and retarded activity" with other items indicating "Positive affect" as one factor.

As for the second point, the lack of distinction between "Depressed affect" items and "Somatic and retarded activity" items are one of the same characteristics as reported in several previous studies with adolescent samples in Asia [16,18,20,21,25]. In addition, the Laotian adolescent samples did not distinguish "Unfriendly" and "Dislike" as "Interpersonal." These results supported the findings of previous studies with samples of Filipino American adolescents [16], Taiwanese adolescents [24], Mainland Chinese adolescents [19], Malaysian adolescents [20], and Korean adolescents [21]. These previous studies could not distinguish the "Depressed affect" and "Somatic and retarded activity" items from the interpersonal items.

Moreover, regarding the third point, the "Effort" item indicating "Somatic and retarded activity" loaded on "Positive affect" in the Laotian adolescent model. This is one of Laotian CES-D models' features, although we cannot find any explanation based on the available literature. As a possible

interpretation of the reason for the different loading of "Effort," the meaning of the "Effort" item may have a positive nuance because of the cultural and expressive characteristics of the Lao language. When developing the CES-D in a language other than English, it is necessary to carefully consider the meaning and nuances of every word, phrase, sentence, expression, and cultural context behind the language.

Besides, a possible reason for the overlap between "Depressive affect" and "Somatic retarded activity" items in the adolescent model is that Laotians may tend to regard somatic symptoms as depressive affective symptoms, and report them in such a manner and, what is more. Laotian people may show somatic symptoms and related psychological symptoms, as is confirmed by other studies in Asian samples [36,37], including the Laotian adult population [15].

There are several limitations to this study. First, the sample covered only three areas of Lao PDR, and none of the three were remote areas. Therefore, the sample is not representative of the general Laotian adolescent population. In general, adolescents are at higher risk of mental health disorders because of their fragile living conditions, stigma, discrimination, or exclusion because of belonging to minority ethnic or sexual backgrounds or other discriminated groups, or lack of access to quality support and services [3]. Therefore, it is needed to examine if the developed CES-D applies to Laotian adolescents who live in remote areas or under other living conditions, including adolescents with disadvantages such as belonging to minority groups. Second, it is necessary to clarify depressive tendencies in Laotian adolescents and factors related to these tendencies in future studies. Multiple factors ranging from socioeconomic problems to the quality of children's home life or relationships with friends and guardians are recognized as risks to mental health [3]. Clarifying factors related to adolescent mental health in the Laotian context will contribute to developing effective mental health programs in Laos.

5. Conclusions

This study developed a Laotian version of CES-D for adolescent, and examined its reliability and validity as well as factorial properties. As a result of this study, we determined a best-fitting structure

comprising two factors: “Negative affect” and “Positive affect.” “Effort” items loaded on the “Somatic and retarded activity” factor in the original model but loaded on the “Positive affect” factor in the adolescent model. “Depressed affect,” “Somatic and retarded activity,” and “Interpersonal” items were combined into the “Negative affect” factor in the adolescent model.

Author Contributions:

Conceptualization, Sachi Tomokawa and Takashi Asakura; Formal analysis, Sachi Tomokawa and Takashi Asakura; Funding acquisition, Sachi Tomokawa; Investigation, Sachi Tomokawa, Takashi Asakura and Kimihiro Miyake; Methodology, Sachi Tomokawa, Takashi Asakura, Ngouay Keosada, Vannasouk Bouasangthong , Vanthala Souvanhxay, Kethsana Kanyasan and Kimihiro Miyake; Project administration, Sachi Tomokawa, Ngouay Keosada, Vannasouk Bouasangthong , Vanthala Souvanhxay, Kethsana Kanyasan, Sithane Soukhavong and Khamseng Thalangsy ; Resources, Sachi Tomokawa; Supervision, Takashi Asakura, Sithane Soukhavong, Khamseng Thalangsy and Kazuhiko Moji; Writing – original draft, Sachi Tomokawa and Kimihiro Miyake; Writing – review & editing, Sachi Tomokawa, Takashi Asakura, Ngouay Keosada, Vannasouk Bouasangthong , Vanthala Souvanhxay, Kethsana Kanyasan, Kimihiro Miyake, Sithane Soukhavong, Khamseng Thalangsy and Kazuhiko Moji. All authors have read and agreed to the published version of the manuscript.

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