

## **Changes in health-related behaviors among children of the CABLE study in northern Taiwan over two years**

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**Abstract.** Children and Adolescent Behaviors in Long-term Evolution (CABLE) is a longitudinal study which commenced in 2001. The purpose of this study was to examine the prevalence of and changes in health-related behaviors over two years among primary school children in northern Taiwan. Children who always or frequently performed a positive health behavior or never performed a negative health behavior were defined as “having good behavior”. In contrast, children who never or seldom performed a positive health behavior or had on one or more occasions performed a negative health behavior were defined as “having bad behavior”. The difference between the rates of children who changed to have good behaviors and those who changed to have bad behaviors was used to evaluate the significance of changes in behaviors over time among the children.

Most of the positive health behaviors showed similar or increased rates over the two years. Decreased rates were only found for “wearing a motorcycle helmet” and “brushing teeth before sleeping”. However, the prevalence rates of performing negative health behaviors and the rates of children who changed to good or bad behaviors over the two years varied depending on the behavioral item and cohort. In conclusion, children should be encouraged to develop and maintain healthy behaviors and to decrease or cease unhealthy behaviors as early as possible. Further study into the underlying general trends in performing health-related behaviors among children should be conducted using data from a series of follow-up surveys in the future.

*Keywords :* Child, Health behavior, Behavior change, Lifestyle, Longitudinal study

### **Introduction**

A common theme in the literature is that chronic disease is one of the most important health problems in developed countries [WHO, 2003]. Some studies have focused on investigating long-term exposure to an unhealthy lifestyle during youth and risk factors for chronic diseases in adulthood [Robinson, 1999; Twisk, et. al., 1997; Wannamethee, et. al, 1992]. Large-scale and systematic surveys about health-related behaviors among adolescents, such as the Youth Risk Behavior Surveillance Survey (YRBSS) [Department of Health and Human Services Centers for Disease Control and Prevention, 2004] and The Health Behavior in School-Aged Children (HBSC) Study [WHO Regional Office for Europe, 2005], provide a large amount of information about the health behaviors of adolescents. Findings from these studies have assisted in the early detection of persons at risk enabling preventive strategies to be implemented at an early age.

According to a recent international report [Candace, et. al, 2004], high consumption of sweets and soft drinks is common among adolescents. A significant number of young people skip breakfast and consume inadequate amounts of fruit and vegetables. Experimentation with tobacco and alcohol is also common, and a substantial number of young people go on to

become regular smokers and drinkers. The general decrease in health sustaining behaviors and increase in potentially health damaging behaviors across age groups, when considered together with the data on age of onset, suggest that the critical period for primary prevention is early adolescence.

As concerns about the health of children and adolescents continue to escalate, it is important that information about lifestyle parameters during youth is obtained from longitudinal studies [Ishihara, et. al., 2003; Eisenmann, 2003]. In the absence of such studies, however, most information is obtained from studies that are retrospective in design [Spear and Kulbok, 2001; Norton, et. al., 2003; Thefeld, et. al., 2002]. In addition, most of the research to date has focused on problem behaviors rather than on healthy behaviors [Madarasova, et. al., 2003; Symons, et. al., 1997]. Since adolescence is a period of transition that includes experimentation with health damaging as well as health promoting behaviors, longitudinal study of health behaviors from childhood into adolescence could provide valuable information about optimal times and critical areas for intervention. Preventing children from developing negative health behaviors and encouraging them to adopt positive health behaviors has been the priority of health promotion efforts.

Children and Adolescent Behaviors in Long-term Evolution (CABLE) is the first prospective longitudinal study focusing on children's health lifestyles in Taiwan. It began with two cohorts aged 6 years (grade 1) and 9 years (grade 4) respectively. The annual surveys commenced in 2001 on a random sample of primary school students living in northern Taiwan. During this study, lifestyle parameters were measured longitudinally over two consecutive years (2001 and 2002), enabling the observation of changing patterns of both negative and positive health behaviors among two cohorts. The CABLE study report [Yen, et. al., 2002a; Yen, et. al., 2002b] indicated that the proportion of children with positive health behaviors was less than ideal and the proportion of children displaying negative health behaviors was by no means low.

## **Material and Methods**

*Sample* : Primary school students in grade one (cohort 1) and four (cohort 2) were recruited when the CABLE study commenced in 2001. Taipei City and Hsinchu County were purposively chosen to represent urban and rural areas in northern Taiwan respectively. There are 152 public primary schools in Taipei City and 79 in Hsinchu County. Based on the number of first grade students, schools were divided into small (50-199 students), medium-sized (200-399 students) and large (more than 400 students). To ensure that the numbers of children chosen from each type of school were roughly equivalent it was decided to randomly select six small schools, two medium-sized schools and one large school from each area. As shown in Table 1, a total of 3,584 grade one and 3,612 grade four students from 18 primary schools were selected.

Prior to participation, written informed consent was obtained from each student's parents. A total of 2,255 parents of cohort 1 and 2,118 parents of cohort 2 signed consent forms in 2001. The participation rates for the two cohorts were 62.9% and 58.6% respectively. There were 2,218 students from cohort 1 and 2,075 students from cohort 2 who completed the questionnaires in 2001. Among them, 2,082 students of cohort 1 (1,071 boys and 1,011 girls) and 1,873 students of cohort 2 (969 boys and 904 girls) were followed in 2002. The follow-up rates for the two cohorts were 94.0% and 90.4% respectively. A detailed description of the CABLE

study design can be found elsewhere [Yen, et. al., 2002b].

**Table 1.** Samples of two cohorts of CABLE study in 2001 and 2002

Items	Cohort1 (grade1 in 2001)	Cohort2 (grade 4 in 2001)
<i>Study population(n)</i>	40,764	42,106
<i>Sample chosen(n)</i>	3,584	3,612
<b>Survey in 2001:</b>		
Signed consent form(n)	2,255	2,118
Participation rate (%)	62.9	58.6
Sample completed(n)	2,218	2,075
Boys(n)	1,135	1,078
Girls(n)	1,083	997
Completion rate(%)	98.4	98.0
<b>Follow-up in 2002:</b>		
<i>Sample completed(n)</i>	2,082	1,873
Boys(n)	1,071	969
Girls(n)	1,011	904
Follow-up rate(%)	94.0	90.4

**Measures :** The CABLE instruments provide comprehensive measures that include questions about demographics, family relations, social support, health-related behaviors, school activities, and psycho-social and physical health. They were developed by referring to the instruments used in the Youth Risk Behavior Surveillance System [Department of Health and Human Services Centers for Disease Control and Prevention, 2004], Health Behavior in School-aged Children [WHO Regional Office for Europe, 2005], and another local study [Yen, et. al., 1999]. Different versions with the same content were designed for first graders, fourth graders and parents. In order to help children read complicated Chinese characters, pronunciation symbols were added to the first grade student questionnaires. The draft questionnaires were reviewed by specialists in health education, psychology, sociology, behavioral science, policy management, and primary school teachers. Using the revised questionnaires, a pilot study was carried out on the first and fourth grade students. Based on practical considerations and the results of the pilot study, the questionnaires were again modified and the final copy developed. In addition, an informed consent form was designed and approved by the Human Research Medical Ethics Committee of the National Health Research Institutes in Taiwan.

The 18 schools were divided into six groups. Each survey team consisted of a supervisor and 10 or more trained interviewers. Each team was responsible for three schools. Data was collected annually from October to December, the first semester of the academic year. Only those students whose parents agreed to their participation in the study were included. In each participating classroom, one interviewer explained the questionnaire and instructed the students how to

complete it. A second interviewer was responsible for keeping order in the classroom. The group supervisor visited all classes that were being surveyed and provided any assistance that was required. The first graders were given two class periods to complete the questionnaire while the fourth graders were given one class period. The interviewers gave the parent questionnaires to the students and requested them to bring back the completed parent questionnaires to their teacher the following day. Data was collected in subsequent years using the same procedures and a revised questionnaire with the same core questions.

*Analysis* : SAS Version 8.2 was used for statistical analysis. The health-related behaviors considered in the present study have two dimensions: positive health behaviors and negative health behaviors. The positive health behaviors include walking carefully, wearing a seatbelt, wearing a motorcycle helmet, washing hands before eating, brushing teeth before sleeping, eating breakfast, eating fruit and vegetables, drinking water, and doing exercise. The negative health behaviors include staying up late, eating food before sleeping, eating fast-food, suppressing urination, prolonged playing of video games, prolonged watching of television, using vulgar language, destroying things when angry, fighting with others, destroying public property, smoking cigarettes, drinking alcohol, and suicidal ideas. All students were asked to answer each question using a four point scale (1=never; 2=seldom; 3=many days; 4=every day). The Cronbach's alpha coefficients were 0.68 and 0.78 for the positive health behavior and negative health behavior scales respectively.

A  $\chi^2$  test was first applied to compare the differences in prevalence rates of each health-related behavior by year and cohort. In order to investigate patterns of change in the behaviors, children were classified into "having good behavior" or "having bad behavior" groups. The former group refers to children who either performed a positive health behavior or never performed a negative health behavior. The latter group refers to children who either performed a negative health behavior or never performed a positive health behavior. Based on the results of McNemar's  $\chi^2$  test, the difference between the proportion of children who changed from having bad behavior in 2001 to having good behavior in 2002 and those who changed from having good behavior in 2001 to having bad behavior in 2002 was used to evaluate significant change in behavior over time among children of the same cohort.

## **Results**

**Prevalence of positive health behaviors in 2001 and 2002** : The prevalence of positive health behaviors by cohort and year are shown in Table 2. Out of all the positive health behaviors, "doing exercise" had the lowest prevalence rates for both cohorts (61.4% in 2001 and 59.3% in 2002 for cohort 1; 62.4% in 2001 and 67.9% in 2002 for cohort 2). The other positive health behaviors with prevalence rates lower than 75% were "wearing a motorcycle helmet as a passenger" (74.7% in 2001 for cohort 1), "washing hands before eating" (74.8% in 2002 for cohort 1; 74.2% in 2001 for cohort 2), and "eating fruit and vegetables" (74.5% in 2001 and 72.5% in 2002 for cohort 1).

For each cohort, a  $\chi^2$  test was used to compare the change in rates between 2001 and 2002 for each behavioral item. It was expected that the prevalence rates of positive health behaviors would significantly increase between 2001 and 2002. For cohort 1, positive behaviors that increased were "walking carefully" (81.5%→90.5%), "using a seat-belt" (77.5%→88.2%), "wearing a motorcycle helmet as a passenger" (74.7%→78.0%) and "eating breakfast"

**Table 2.** Prevalence rates of children who always or frequently performed positive health behaviors by cohort and year

Items	Cohort 1		Diff	Cohort 2		Diff	Diff	
							Cohort 1 vs. Cohort 2	
	2001	2002	2001	2002	2001	2002	2001	2002
<i>Walking carefully</i>	81.6	90.5	***	80.5	94.9	***	non	***
<i>Using a seat-belt</i>	77.5	88.2	***	79.0	92.1	***	non	***
<i>Wearing a motorcycle helmet as a passenger</i>	74.7	78.0	*	76.4	79.1	*	non	***
<i>Washing hands before eating</i>	75.0	74.8	non	74.2	85.5	***	non	***
<i>Brushing teeth before sleeping</i>	<u>81.6</u>	<u>78.9</u>	*	76.9	82.4	***	***	**
<i>Eating breakfast</i>	88.3	91.2	***	86.3	93.1	***	*	*
<i>Eating fruit and vegetables</i>	74.5	72.5	non	80.9	86.4	***	***	***
<i>Drinking water</i>	81.5	81.9	non	85.2	90.2	***	**	***
<i>Doing exercise</i>	61.4	59.3	non	62.4	67.9	***	non	***

Diff : Test of difference between two groups by  $\chi^2$  test  
 non: non-significant \* p<0.05 \*\* p<0.01 \*\*\* p<0.001  
 \_\_: the rates of positive health behavior significantly decreased from 2001 to 2002.

(88.3%→91.2%). For cohort 2, the prevalence of all behavioral items showed significant increases between 2001 and 2002. The only item that was found to significantly decrease was “brushing teeth before sleeping” (81.6%→78.9%) in cohort 1.

For each year, a  $\chi^2$  test was used to compare the prevalence of each behavioral item between cohort 1 and cohort 2. In 2001, cohort 1 showed significantly higher rates than cohort 2 for the items “brushing teeth before sleeping” (81.6% vs. 76.9%) and “eating breakfast” (88.3% vs. 86.3%). However, cohort 2 showed significantly higher rates than cohort 1 for “eating fruit and vegetables” (80.9% vs. 74.5%) and “drinking water” (85.2% vs. 81.5%). In 2002, cohort 2 showed significantly higher rates than cohort 1 for all positive behavioral items.

*Change in positive health behaviors between 2001 and 2002* : Changes in positive health behaviors among children were investigated by classifying the children as follows: children who always or frequently performed a positive health behavior were defined as “having good behavior” and those who never or seldom performed a positive health behavior were defined as “having bad behavior”. Based on this principle, all children were then classified into the following groups: 1. maintaining good behavior (good in both 2001 and 2002); 2. negative change (having good behavior in 2001 but having bad behavior in 2002); 3. positive change (having bad behavior in 2001 but having good behavior in 2002); 4. maintaining bad behavior (bad in both 2001 and 2002). As the first and fourth groups maintained the same behavior over one year, only the differences in the second and third groups was tested using McNemar's  $\chi^2$  test. The results for cohort 1 and cohort 2 are shown in Table 3.

Out of all the positive behaviors, “doing exercise” had the lowest rates of maintaining good behavior (40.4% for cohort 1; 50.0% for cohort 2) and the highest rates of maintaining bad behavior (19.4% for cohort 1 and 18.6% for cohort 2). “Eating fruit and vegetables” (57.4%)

**Table 3.** Comparison of changes in performing positive health behaviors between two years for cohort 1 and cohort 2 by McNemar's  $\chi^2$  tests

Items	Cohort 1					Cohort 2				
	good	--	+	bad	McNemar's $\chi^2$	good	--	+	bad	McNemar's $\chi^2$
<i>Walking carefully</i>	75.5	6.4	15.2	2.9	72.97 ***	78.3	2.9	17.0	1.8	187.35 ***
<i>Using a seat-belt</i>	69.4	8.3	18.6	3.8	81.42 ***	74.6	4.9	18.0	2.5	138.29 ***
<i>Wearing a motorcycle helmet</i>	60.8	12.9	15.8	10.5	4.28 *	63.2	9.6	15.6	11.5	17.36 ***
<i>Washing hands before eating</i>	60.2	14.5	15.2	10.1	0.32 non	67.4	6.8	19.3	6.5	111.48 ***
<i>Brushing teeth before sleeping</i>	70.4	11.1	9.8	8.8	1.70 non	71.1	6.0	12.2	10.7	40.38 ***
<i>Eating breakfast</i>	82.3	6.0	9.6	2.0	16.60 ***	83.2	3.8	10.2	2.8	53.84 ***
<i>Eating fruit and vegetables</i>	57.4	17.4	15.7	9.5	1.80 non	75.2	6.4	13.3	5.2	45.34 ***
<i>Drinking water</i>	69.5	11.8	13.5	5.2	2.09 non	79.6	5.6	11.2	3.6	35.78 ***
<i>Doing exercise</i>	40.4	21.1	19.1	19.4	1.94 non	50.0	12.2	19.3	18.6	30.03 ***

non : non-significant \*  $p < 0.05$  \*\*  $p < 0.01$  \*\*\*  $p < 0.001$   
 good : maintaining good both in 2001 and 2002  
 -- : negative change (good in 2001 but bad in 2002)  
 + : positive change (bad in 2001 but good in 2002)  
 bad : maintaining bad both in 2001 and 2002

for cohort 1 was another positive behavior where less than 60% of students maintained good behavior. According to the results of the McNemar's  $\chi^2$  test, there was a significantly higher proportion of children who underwent positive change compared to negative change for the behaviors of "walking carefully", "using a seat-belt", "wearing a motorcycle helmet as a passenger" and "eating breakfast" in cohort 1. A significantly higher proportion of positive change than negative change was found in all behavioral items for cohort 2.

Prevalence of negative health behaviors in 2001 and 2002 : The prevalence of negative health behaviors by cohort and year are shown in Table 4. Out of all the negative behaviors, "staying up late" had the highest prevalence rates for both cohorts (65.7% in 2001 and 64.7% in 2002 for cohort 1; 82.7% in 2001 and 81.7% in 2002 for cohort 2). The other negative health behavioral items with prevalence rates higher than 60% were "eating food before sleeping" (69.0% in 2001 and 67.6% in 2002 for cohort 2), "eating fast-food" (61.1% in 2001 for cohort 1; 64.9% in 2001 and 65.6% in 2002 for cohort 2) and "prolonged watching of television" (68.1% in 2001 and 60.8% in 2002 for cohort 2).

For each cohort, a  $\chi^2$  test was used to compare the change in rates between 2001 and 2002 for each behavioral item. It was expected that the prevalence rates of negative health behaviors would significantly decrease over time. Negative behaviors that were found to decrease over the study period were "eating fast-food" for cohort 1, "suppressing urination" for both cohorts, "prolonged playing of video games" for both cohorts, "prolonged watching of television" for both cohorts, "destroying things when angry" for cohort 2, "fighting with others" for cohort 2,

**Table 4.** Prevalence rates of children who on one or more occasions performed negative health behaviors by cohort and year

Items	Cohort 1		Diff	Cohort 2		Diff	Diff	
	2001	2002		2001	2002		Cohort 1 vs. Cohort 2	
							2001	2002
<i>Staying up late</i>	65.7	64.7	non	82.7	81.7	non	***	***
<i>Eating food before sleeping</i>	57.8	58.4	non	69.0	67.6	non	***	***
<i>Eating fast-food</i>	61.1	51.9	***	64.9	65.6	non	**	***
<i>Suppressing urination</i>	47.6	38.7	***	54.4	47.2	***	***	***
<i>Prolonged playing of video games</i>	43.8	28.3	***	42.9	34.0	***	non	***
<i>Prolonged watching of TV</i>	59.7	49.7	***	68.1	60.8	***	***	***
<i>Using vulgar language</i>	<u>28.6</u>	<u>34.0</u>	***	59.4	59.1	non	***	***
<i>Destroying things when angry</i>	18.7	17.9	non	28.4	22.7	***	***	***
<i>Fighting with others</i>	<u>31.0</u>	<u>34.0</u>	*	54.6	38.6	***	***	***
<i>Destroying public property</i>	6.8	7.3	non	7.4	7.3	non	non	non
<i>Smoking cigarettes</i>	8.1	5.9	**	7.3	5.6	*	non	non
<i>Drinking alcohol</i>	<u>28.1</u>	<u>31.1</u>	*	33.0	25.4	***	***	***
<i>Having suicidal ideas</i>	<u>11.4</u>	<u>14.3</u>	**	19.8	19.1	non	***	***

Diff : Test of difference between two groups by  $\chi^2$  test

non : non-significant \* p<0.05 \*\* p<0.01 \*\*\* p<0.001

— : the rates of negative health behavior significantly increased from 2001 to 2002.

“smoking cigarettes” for both cohorts, and “drinking alcohol” for cohort 2. However, disappointingly the prevalence of several negative health behaviors showed a significant increase including “using vulgar language” (28.6%→34.0% for cohort 1), “fighting with others” (31.0%→34.0% for cohort 1), “drinking alcohol” (28.1%→31.1% for cohort 1) and “having suicidal ideas” (11.4%→14.3% for cohort 1).

For each year, a  $\chi^2$  test was used to compare the prevalence of each behavioral item between cohort 1 and cohort 2. It was found that there was no significant difference between the two cohorts for “prolonged playing of video games” in 2001, and on “destroying public property” and “smoking cigarettes” in both 2001 and 2002. Apart from the item of “drinking alcohol”, cohort 2 showed significantly higher rates than cohort 1 of the remaining behavioral items.

*Change in negative health behaviors between 2001 and 2002* : Changes in negative health behaviors among children were investigated by classifying the children as follows: children who never performed a negative health behavior were defined as “having good behavior” and those who had on one or more occasions performed a negative health behavior were defined as “having bad behavior”. Based on this principle, all children were then classified into the following groups: 1. maintaining bad behavior (bad in both 2001 and 2002); 2. positive change (having bad behavior in 2001 but having good behavior in 2002); 3. negative change (having good behavior in 2001 but having bad behavior in 2002); 4. maintaining good behavior (good in both 2001 and 2002). As those in groups one and four maintained the same behavioral

patterns over time, only the differences in the positive change group and negative change group were tested by McNemar's  $\chi^2$  test. The results for cohort 1 and cohort 2 are shown in Table 5.

**Table 5.** Comparison of changes in performing negative health behaviors between two years for cohort 1 and cohort 2 by McNemar's  $\chi^2$  test

Items	Cohort 1					Cohort 2				
	good	--	+	bad	McNemar's $\chi^2$	good	--	+	bad	McNemar's $\chi^2$
<i>Staying up late</i>	13.4	21.0	21.5	44.1	0.11 non	6.5	11.2	11.7	70.7	0.23 non
<i>Eating food before sleep</i>	20.4	21.8	20.5	37.4	0.90 non	15.8	15.5	16.6	52.2	0.67 non
<i>Eating fast-food</i>	21.5	17.4	25.9	35.2	35.08 ***	17.2	18.1	18.5	46.3	0.09 non
<i>Suppressing urination</i>	34.1	18.0	26.6	21.3	34.44 ***	30.9	15.1	22.4	31.6	26.42 ***
<i>Prolonged playing of video games</i>	43.4	12.8	28.1	15.7	116.77 ***	45.3	11.5	20.5	22.8	47.36 ***
<i>Prolonged watching of TV</i>	24.4	15.9	26.2	33.6	51.59 ***	19.3	12.5	19.7	48.6	29.63 ***
<i>Using vulgar language</i>	52.4	<u>18.9</u>	<u>13.1</u>	15.7	22.02 ***	24.0	17.0	15.6	43.3	1.11 non
<i>Destroying things when angry</i>	69.2	12.2	13.0	5.6	0.63 non	61.0	11.3	16.8	10.9	20.28 ***
<i>Fighting with others</i>	51.2	<u>17.7</u>	<u>15.2</u>	15.9	3.99 *	33.4	12.1	28.2	26.3	119.68 ***
<i>Destroying public property</i>	87.6	5.4	5.5	1.5	0.02 non	87.1	5.9	5.6	1.5	0.12 non
<i>Smoking cigarettes</i>	88.7	3.2	5.8	2.3	15.68 ***	90.1	2.6	4.1	3.2	6.73 **
<i>Drinking alcohol</i>	57.1	<u>14.8</u>	<u>11.4</u>	16.8	9.04 **	58.0	9.8	15.7	16.5	25.83 ***
<i>Having suicidal ideas</i>	78.0	<u>10.5</u>	<u>6.8</u>	4.7	16.61 ***	71.3	9.3	8.6	10.9	0.43 non

non : non-significant \* p<0.05 \*\*p<0.01 \*\*\* p<0.001

good : maintaining good both in 2001 and 2002

-- : negative change (good in 2001but bad in 2002)

+ : positive change (bad in 2001but good in 2002)

bad : maintaining bad both in 2001and 2002

— : negative change group showed significantly higher rate than positive change group.

Out of all the negative health behaviors, “staying up late” had the highest rates of maintaining bad behavior (44.1% for cohort 1 and 70.7% for cohort 2) and the lowest rates of maintaining good behavior (13.4% for cohort 1 and 6.5% for cohort 2). Other behavioral items in cohort 1 where more than 30% of students maintained bad behavior included “eating food before sleep” (37.4%), “eating fast-food” (35.2%) and “prolonged watching of television” (33.6%) . For cohort 2, items with higher rates of maintaining bad behavior were “eating food before sleep” (52.2%), “eating fast-food” (46.3%), “suppressing urination” (31.6%), “prolonged watching of television” (48.6%) and “using vulgar language” (43.3%).

There was a significantly higher proportion of children who underwent positive change than negative change for the following behaviors: “eating fast food” for cohort 1 , “suppressing urination” for both cohorts, “prolonged playing of video games” for both cohorts, “prolonged watching of television” for both cohorts, “destroying things when angry” for both cohorts , “fighting with others” for cohort 2, “smoking cigarettes” for both cohorts, and “drinking alcohol” for cohort 2. In contrast, a significantly higher proportion of children underwent negative

change than positive change only in cohort 1 for the following behaviors: “using vulgar language” (18.9% vs. 13.1%), “fighting with others” (17.7% vs. 15.2%), “drinking alcohol” (14.8% vs. 11.4%) and “having suicidal ideas” (10.5% vs. 6.8).

## **Discussion**

Health-related behaviors are fundamental to public health. They have an influence on the risks of morbidity and mortality, and therefore altering such behaviors can reduce these risks. Disease prevention and health promotion should be implemented as early as possible both in childhood and adolescence. Previous studies have focused on a specific health behavior [Yen, et. al., 1997; Chen, et. al., 2003], two health behaviors [Felton, et. al., 1999; Chen and Yen, et. al., 1999], or a set of health behaviors [Yen, et. al., 1999; Wardle, et. al., 2003]. The CABLE study is unique in that it has tracked health lifestyle parameters since 2001 with follow-up data collected from two cohorts of primary school students in northern Taiwan [Yen, et. al., 2002b].

The aim of the present study was to provide a comprehensive view of the prevalence and change of children's health-related behaviors between 2001 and 2002. It was found that positive health behaviors (apart from brushing teeth before sleeping for cohort 1) showed similar or increased rates over the two years. The prevalence of maintaining positive health behaviors over the two years varied from 40.4% to 83.2% depending on the behavioral item and cohort. Positive health behaviors with a low prevalence that need to be increased include “doing exercise”, “eating fruit and vegetables”, “washing hands before eating”, and “wearing a motorcycle helmet as a passenger”. Children should be encouraged to develop and maintain positive health behaviors. However, it is also important to focus more on children who cease performing positive health behaviors. For example, strategies for preventing decreases in “brushing teeth before sleeping” should be developed and implemented for cohort 1. Further study into the underlying general trends in performing positive health behaviors among children should be conducted using data from a series of follow-up surveys in the future.

Negative health behaviors with higher prevalence levels are an important area of attention. These include “staying up late”, “eating food before sleeping”, “eating fast-food” and “prolonged watching of television”. Out of the 13 negative health behaviors, 4 items in cohort 1 and 6 items in cohort 2 were maintained at similar rates over the two years. Children should be encouraged to decrease or cease these unhealthy behaviors as soon as possible. Particular attention should be paid to cohort 1, as a significant increase in “using vulgar language”, “fighting with others”, “drinking alcohol”, and “having suicidal ideas” was found in this group. Since these behaviors are a risk to health, it is vital that such negative trends are curtailed.

In contrast, 5 items in cohort 1 and 7 items in cohort 2 showed some decrease over the two years. The percentages of children who performed positively during the two years varied from 4.3% (never stayed up late) to 92.2% (never smoked cigarettes) depending on the behavioral item, cohort and area. Although the large difference in rates indicates that each negative health behavior is unique, it is worthwhile promoting this positive trend in avoiding negative health behaviors.

Information obtained from this study is useful for improving understanding of the observed changes in health behaviors among the two cohorts of children. Although time had a limited effect on changes in the rates of performing health behaviors, there was a slight cohort effect which is worth exploring further. Based on the findings of this study, continuous assessment

of behavioral changes among children through their development would be of great value. There are some limitations to this study. Firstly, all of the data sets used for this study were collected at the end of the corresponding years. The computed proportion of children who were performing a specific behavior from these data sets had to be interpolated to represent the end-of-year prevalence levels. Errors might have been introduced if there were significant seasonal changes in the performance of health-related behaviors. Secondly, data used for this study were from a follow-up survey. Although the duration of time between two measurements was only one year, there could have been over-reporting of good behaviors and underreporting of bad behaviors because of the effect of testing or social desirability concerns. Even though such over and underreporting might have little effect on secular trends if it occurred randomly, caution should be used when referring to changes in proportions over time. Aside from these limitations, this study is the first to use a prospective survey to follow the distribution of a set of health behaviors among primary school children in Taiwan.

## Conclusions

Most children's positive health behaviors showed similar or increased rates over the two years. The prevalence rates of performing negative health behaviors and the proportion of children who changed to good or bad behaviors over the two years varied depending on the behavioral item and cohort. In order to promote health, children should be encouraged to develop and maintain healthy behaviors and to decrease or cease unhealthy behaviors as soon as possible.

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## Authors' Contributions

Lee-Lan Yen has organized and led the CABLE research team. She contributed to the study design and wrote the paper. Ling-Yen Pan contributed to implementation of survey and gave opinions and suggestions on paper writing. Wen-Chi Wu conducted statistical analysis and dealt with administrative affairs. All authors read and approved the final manuscript.