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Effectiveness of health education in improving knowledge, practice and belief related to clonorchiasis in children

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ABSTRACT

Clonorchiasis is caused by the ingestion of raw freshwater fish containing *Clonorchis sinensis* larvae. Health education is crucial in sustainable control of clonorchiasis but extremely challenging when dealing with adults. To investigate if education in children would be a beneficial long-term approach, a cluster-controlled trial was implemented in two primary schools between 2017 and 2019 in Binyang county, Guangxi, China. A baseline survey was conducted in both schools, and then comprehensive education activities were implemented in the interventional one. Six and 12 months later, all pupils were subjected to a survey to assess the potential change of knowledge, practice and belief related to clonorchiasis. Finally, 247 pupils in interventional school and 151 ones in control were eligible for analysis. In the interventional school, the percentage of pupils with knowledge on transmission route, early symptoms, complications and carcinogenicity increased from 15.0% to 78.5% ($p < 0.001$), from 6.5% to 36.8% ($p < 0.001$), from 4.0% to 93.9% ($p < 0.001$) and from 4.5% to 49.4% ($p < 0.001$) after 12 months. In this school, 16 pupils (6.5%) had eaten raw freshwater fish during the year immediately before the baseline survey, a number that decreased to 3 (1.2%) ($p = 0.002$) 12 months later. The percentage of students had the belief on the ability not to eat raw freshwater fish in the future was 70.9% at the baseline and 97.2% 12 months later ($p < 0.001$). Although knowledge related to clonorchiasis also increased in the control school, the absolute percentage of changes was lower; in particular, practice and belief had not changed.

1. Introduction

Clonorchiasis, caused by ingestion of *Clonorchis sinensis* larvae in raw freshwater fish, causes diverse symptoms, such as abdominal pain and diarrhoea during the early stage of infection (Chen et al., 1994; Kim et al., 1982), followed by liver and biliary complications, *e.g.*, gallstone and cholecystitis (Choi et al., 2008; Qiao et al., 2012). If untreated, *C. sinensis* infection could cause fatal cholangiocarcinoma (Bouvard et al., 2009; Qian and Zhou, 2017). Morbidity is directly related to the worm burden, usually indicated by stool examination and calculation of the parasite eggs (Kim et al., 2011; Qian et al., 2019c).

Clonorchiasis is highly endemic in East Asia (Qian et al., 2016), with an estimated 15 million people infected in China, Republic of Korea, Vietnam and part of Russia (Doanh and Nawa, 2016; Jeong et al., 2016; Qian et al., 2012). Particularly, the majority of those infected (about 13 million) live in China, most of whom are distributed in south-eastern and north-eastern regions (Fang et al., 2008; Qian et al., 2012). Unlike the significant control and even elimination of other parasitic diseases, *e.g.*, lymphatic filariasis (Fang and Zhang, 2019), schistosomiasis (Chen et al., 2018a), malaria (Feng et al., 2018) and soil-transmitted helminthiases (Chen and Zang, 2015), clonorchiasis is still highly prevalent in China, which is attributed to the habit, particularly among men, of consuming raw freshwater fish (Qian and Zhou, 2019).

Chemotherapy with praziquantel is recommended for tackling clonorchiasis and other food-borne trematodiasis in order to control the morbidity (WHO, 2012). This strategy is effective in the short term but

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requires multiple treatments to prevent reinfection (Choi et al., 2010; Ge and Wang, 2009). Thus, behavioural change through health education is usually advocated. However, adults indulge in eating raw freshwater fish and continue this habit in spite of knowing the risk which shows that health education does not work well (Qian et al., 2013). The practice is usually established gradually in childhood who has less knowledge of the problem. Therefore, it can be argued that behavioural intervention among children would stand a good chance overall, as they would be expected to continue avoiding to ingest raw freshwater fish when they reach adulthood. To test this hypothesis, a cluster-controlled trial was planned to explore the effectiveness of education in children in term of knowledge, practice and belief related to clonorchiasis. Short-term effect (within six months) has been reported (Qian et al., 2019a), and we were interested in studying if this effect would remain after 12 months.

2. Materials and methods

2.1. Study design and areas

This study was a cluster-controlled trial which included one village primary school situated in Pinglong (intervention arm) and one school situated in the village of Longgong (control arm). Both schools are located in Binyang county, Guangxi Zhuang Autonomous Region in south-eastern China. Binyang county is located in the south of Guangxi where clonorchiasis is highly endemic (Jiang et al., 2015; Liang et al., 2009). The time line was the following: baseline survey - health education - 6-month follow-up survey - 12-month final evaluation survey to assess the effectiveness and sustainability.

2.2. Baseline survey

During November and December 2017, a baseline multiple-choice questionnaire survey was implemented to capture students' knowledge, practice and belief related to clonorchiasis. The general knowledge contents included two parts on transmission route and harm, respectively. In transmission route, one correct and five non-related answers were provided. In harm, three correct and three non-related answers were provided, and the three right answers referred to early symptoms, chronic complications and carcinogenicity, respectively. In addition, the pupils were asked about the frequency of eating raw freshwater fish in the past year and whether they felt that they had the ability not to eat raw freshwater fish in future, which included three alternatives (yes, no and uncertain).

2.3. Intervention

A 6.5 min long education cartoon film, called 'a changing life of liver fluke', introducing basic knowledge on the life cycle, transmission route, harm, prevention and control of *C. sinensis* was shown. Bulletin boards and educational brochures consisting of extracted information and pictures from the cartoon were also produced.

Between June and September 2018, comprehensive education activities were implemented in the school selected for interventions. Bulletin boards were erected in public areas. A special lesson was given to demonstrate the educational cartoon film and then an educational brochure was distributed to each student. Drawing and essay writing competitions with respect to control and prevention of clonorchiasis were carried out in Grades 1–3 and 4–5, respectively. In September 2018, the cartoon was demonstrated again to strengthen the case.

2.4. Evaluation surveys

Mid-term and long-term evaluation surveys were implemented six months and 12 months after the interventions in December 2018 and June 2019. The questionnaire in mid-term survey was same to that at baseline in knowledge and belief. However, here the pupils were asked to report consumption of raw freshwater fish during the past six months. The questionnaire used after 12 months was in all aspects the same as the baseline one.

2.5. Ethics

The study was approved by the ethics committees in the National Institute of Parasitic Diseases, Chinese Center for Disease Control and Prevention. The objectives, procedures and potential risks of this study were orally explained and informed to the principals of the schools and all participants and informed consent was also obtained.

2.6. Data analysis

In knowledge on transmission route, only selection of the one correct answer and non-selection of the other non-related answers was accepted as knowledge on transmission route. For the harm item, the following algorithm was applied: correct and wrong answers were assigned 1 and -1, respectively and the figures were added to arrive at the total score. When the total score was positive, *i.e.* > 0 and one out of the three correct answers on harm (early symptoms, chronic complications and carcinogenicity) was selected, then this piece of knowledge was judged as possessed by the student. Only those pupils who participated in all three surveys were included in the final analysis. The composition of gender and age in the two groups (intervention and control) was compared by Chi-square test and Student's t-test. McNemar test was applied to compare the difference in knowledge between the surveys (baseline, mid-term and long-term). McNemar test was also used to compare the difference with regard to eating raw freshwater fish during the past year. The frequency in eating raw freshwater fish was first transformed logarithmically, and then the Student's t-test was employed to test the difference between surveys at baseline and after 12 months. McNemar-Bowker test was used to analyse the difference in belief between the three surveys.

3. Results

3.1. Characteristics of participants

In the school where interventions had been carried out, there were 294 students in Grades 1–5, out of which 247 students participated in all three surveys. In the control school, there were 165 students in Grades 1–5, out of which 151 students joined all three surveys.

There were 126 boys and 121 girls in interventional school, while the corresponding numbers were 76 and 75 in the control school ($\chi^2 = 0.017$, $p = 0.895$). The ages of the pupils ranged between 6–12 years, with an average of 9 in both schools ($t = -0.889$, $p = 0.374$).

3.2. Change with respect to knowledge

In the school where interventions had been carried out, the percentage of pupils with knowledge on transmission was 15.0% at the baseline, which had increased to 92.3% at mid-term and then decreased to 78.5% 12 months later, with baseline *vs* mid-term; baseline *vs* long-term; and mid-term *vs* long-term all at the level of $p < 0.001$(Table 1 and Fig. 1). The absolute percentage change was 77.3% from the baseline to mid-term survey and 63.6% from the baseline to long-term survey. In the control school, the percentage was 9.3% at the baseline, 57.0% at the mid-term and 35.1% at the long-term survey, all at the level of $p < 0.001$. Thus, the absolute percentage change was 47.7% from the baseline to mid-term survey and 25.8% from the baseline to long-term survey.

In interventional school, the percentage of pupils with knowledge of the early symptoms was 6.5% at baseline, which then increased to 43.7% at mid-term and decreased to 36.8% after 12 months ($p < 0.001$,

Table. 1
Pupils' knowledge on transmission route and harm in three surveys.

Knowledge	Group	No.	Baseline survey (%)	Mid-term survey (%)	Long-term survey (%)
Transmission route	Intervention	247	37 (15.0)	228 (92.3)	194 (78.5)
	Control	151	14 (9.3)	86 (57.0)	53 (35.1)
Early symptoms	Intervention	247	16 (6.5)	108 (43.7)	91 (36.8)
	Control	151	1 (0.7)	49 (32.5)	46 (30.5)
Complications	Intervention	247	10 (4.0)	234 (94.7)	232 (93.9)
	Control	151	4 (2.6)	63 (41.7)	51 (33.8)
Carcinogenicity	Intervention	247	11 (4.5)	144 (58.3)	122 (49.4)
	Control	151	4 (2.6)	31 (20.5)	26 (17.2)

baseline *vs* mid-term; $p < 0.001$, baseline *vs* long-term; $p = 0.060$, mid-term *vs* long-term). Thus, the absolute percentage change was 37.2% from the baseline to mid-term survey and 30.4% from the baseline to long-term survey. In the control school, the percentage was 0.7% at the baseline, 32.5% at the mid-term survey and 30.5% at the long-term survey ($p < 0.001$, baseline *vs* mid-term; $p < 0.001$, baseline *vs* long-term; $p = 0.780$, mid-term *vs* long-term). Thus, the absolute percentage change was 31.8% from the baseline to mid-term survey and 29.8% from the baseline to long-term survey.

In interventional school, the percentage of pupils with knowledge on complications was 4.0% at baseline, which then increased to 94.7% at mid-term and changed to 93.9% at long-term survey ($p < 0.001$, baseline *vs* mid-term; $p < 0.001$, baseline *vs* long-term; $p = 0.839$, mid-term *vs* long-term). Thus, the absolute percentage change was 90.7% from the baseline to mid-term survey and 89.9% from the baseline to long-term survey. In control school, the percentage was 2.6% at baseline, 41.7% at mid-term survey and 33.8% at long-term survey ($p < 0.001$, baseline *vs* mid-term; $p < 0.001$, baseline *vs* long-term; $p = 0.141$, mid-term *vs* long-term). Thus, the absolute percentage change was 39.1% from the baseline to mid-term survey and 31.1% from the baseline to long-term survey.

In interventional school, the percentage of pupils with knowledge of carcinogenicity was 4.5% at baseline, which increased to 58.3% at mid-term and decreased to 49.4% after 12 months ($p < 0.001$, baseline *vs* mid-term; $P<0.001$, baseline *vs* long-term; $p = 0.030$, mid-term *vs* long-term). Thus, the absolute percentage change was 53.8% from the baseline to mid-term survey and 44.9% from the baseline to long-term survey. In control school, the percentage was 2.6% at baseline, 20.5% at mid-term and 17.2% at long-term survey ($p < 0.001$, baseline *vs* mid-term; $p < 0.001$, baseline *vs* long-term; $p = 0.522$, mid-term *vs* long-term). Thus, the absolute percentage change was 17.9% from the baseline to mid-term survey and 14.6% from the baseline to long-term survey.

3.2. Change in practice

Among 247 students in interventional school, 16 (6.5%) had eaten raw freshwater fish during past one year at baseline, which decreased to 3 (1.2%) at the long-term survey ($p = 0.002$). Among those 16 pupils, one (6.3%) went on eating raw freshwater fish at the long-term survey. Among the 231 students who had not done so during the past year at the baseline, 2 (0.9%) did so in the past year at the long-term survey. The frequency of eating raw freshwater fish among those who had eaten this during the past year was 1.3 times at the baseline and 1.6 times at the long-term survey ($t = -0.591$, $p = 0.562$).

In the control group, 34 (22.5%) pupils had eaten raw freshwater fish during the past year at the baseline, while it was 27 (17.9%) at the long-term survey ($p = 0.189$). Among 34 pupils, 20 (58.8%) went on doing so at the long-term survey. Among 117 pupils who had not eaten raw freshwater fish during the past year at baseline, 7 (6.0%) did so at the long-term survey. The frequency of eating raw freshwater fish was 1.6 times at the baseline and 1.8 times at the long-term survey among those who had eaten during past one year ($t = -0.796$, $p = 0.429$).

3.4. Change in beliefs

In the school where interventions had been carried out, the percentage of pupils with the belief not to ingest raw freshwater fish was 70.9% at baseline, which then increased to 97.2% at the mid-term

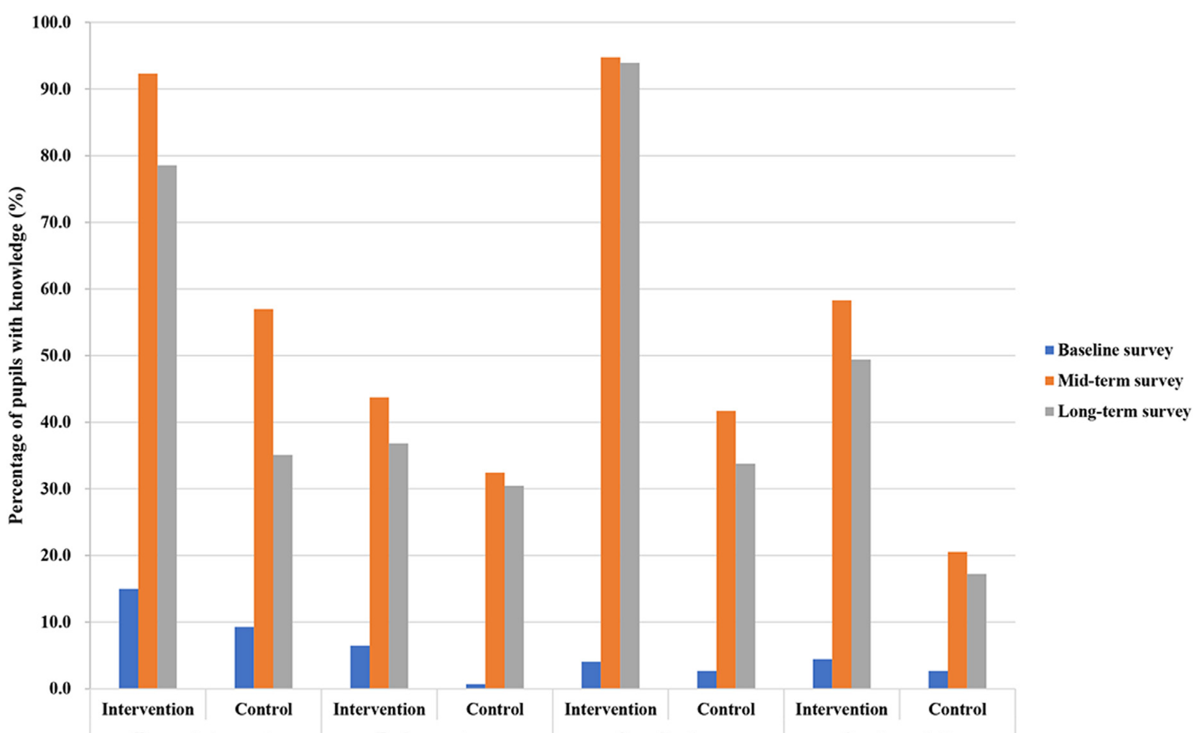

Fig. 1. Change of pupils' knowledge on transmission route and harm in three surveys.

Table. 2
Pupils' belief not to eat raw freshwater fish in future in three surveys.

Group	No.	Baseline survey			Mid-term survey			Long-term survey		
		Yes (%)	No (%)	Uncertain (%)	Yes (%)	No (%)	Uncertain (%)	Yes (%)	No (%)	Uncertain (%)
Intervention	247	175 (70.9)	43 (17.4)	29 (11.7)	240 (97.2)	5 (2.0)	2 (0.8)	240 (97.2)	2 (0.8)	5 (2.0)
Control	151	120 (79.5)	7 (4.6)	24 (15.9)	126 (83.4)	4 (2.6)	21 (13.9)	125 (82.8)	2 (1.3)	24 (15.9)

survey and kept at 97.2% at the long-term survey (Table 2). The difference was significant between the baseline and the mid-term surveys ($w = 60.800$, $p < 0.001$) and so was the difference between the baseline and the long-term surveys ($w = 58.915$, $p < 0.001$). There existed no difference between the mid-term and the long-term surveys ($w = 3.086$, $p = 0.214$).

In the control school, the percentage of pupils with the belief was 79.5% at the baseline, 83.4% at the mid-term survey and 82.8% at the long-term survey. The difference was insignificant between three surveys ($w = 3.111$, $p = 0.375$, baseline *vs* mid-term; $w = 3.419$, $p = 0.331$, baseline *vs* long-term; $w = 2.048$, $p = 0.563$, mid-term *vs* long-term).

4. Discussion

Current strategy against clonorchiasis predominantly depends on chemotherapy, which is usually unsustainable since people (especially adults) indulge in eating raw freshwater fish which results in reinfection, and it is hard to change this practice (Choi et al., 2010; Ge and Wang, 2009; Qian et al., 2013). In order to explore a new sustainable and cost-effective strategy, information, education and communication techniques are important (Qian and Zhou, 2019). In this study we evaluated the effectiveness and sustainability of educational strategy to improve the knowledge, practice and belief related to clonorchiasis in primary school children.

Overall, the knowledge on clonorchiasis at the baseline was very low in pupils in both schools, especially in relation to the harm. This is consistent with results by other reports (Chen et al., 2018b; Qian et al., 2013), which demonstrates a lack of education on clonorchiasis in endemic areas. Although the percentage and frequency were not high, some students began to eat raw freshwater fish. Thus, attention should also be paid to school children and their habits in relation to clonorchiasis. Encouragingly, most students in both schools believed that they would follow the advice given when asked not to eat raw freshwater fish. This demonstrates the high plasticity of children with regard to behaviour, which provides the potential for educational intervention.

Through comprehensive educational programmes, knowledge on the transmission and harm caused by *C. sinensis* infection increased significantly in the school where health education was provided. Thus, our strategy promoted learning on the prevention of clonorchiasis in school children. However, some part of the acquired knowledge decreased from the mid-term to the long-term survey without further intervention, which demonstrated the need for continuous education. Improvement of knowledge was also shown in the control group, but the absolute percentage change was lower than that in school subjected to our interventions. On the one hand, the county where this study was implemented had been included in the national surveillance for clonorchiasis (Qian et al., 2018). During the faecal sample collection, leaflets, which could increase the knowledge of some students, had been distributed (Qian et al., 2019a). Additionally, some pupils in the control school might have actively searched for the knowledge after the baseline survey. The increase of knowledge does not inevitably lead to the change of behaviour. For example, in areas endemic for clonorchiasis, adults indulge in ingestion of raw freshwater fish, even though they usually also have some knowledge (Qian et al., 2013). Indeed, although the knowledge increased in the control group, the practice of raw freshwater fish consumption did not change significantly. However, the practice decreased significantly in the school where interventions had been carried out, which demonstrates the effectiveness of comprehensive educational activities. Especially, the special educational cartoon film had been produced. Cartoons could draw the attentions of students, who do not concentrate easily (Qian et al., 2019b). The effectiveness of the cartoon approach has already been demonstrated in the control of other helminthiases (Bieri et al., 2013a, 2013b; Esse et al., 2017; Yuan et al., 2000). The cartoon in this study demonstrates the *C. sinensis* life cycle vividly and the control of clonorchiasis through a story, in which some real pictures are integrated to increase the impression. To further strengthen the impression, educational brochure was distributed to each student and then drawing and essay writing competitions on prevention of clonorchiasis were also implemented. These diverse educational activities promoted a change of pupils' practice with respect to raw freshwater fish consumption. The improvement of belief in the school that was subjected to interventions further showed the effectiveness of education. Obviously, the findings here demonstrate that education can increase the knowledge, change the behaviour and strengthen the belief, which could only be achieved through appropriate products and strategy. In the school, where the interventions had been carried out, knowledge and belief were kept at high level after another six months, which demonstrates the sustainability of the education strategy. However, some parts of knowledge in interventional school decreased from mid-term to long-term survey. Thus, there exists knowledge oblivion, which is rational. This demonstrates the importance of continuous education.

Our study has one important limitation. The comparability was not high between the two schools in term of the differences in knowledge, practice and belief at the baseline. Thus, self-comparison before and after intervention was employed for both groups. The higher improvement in knowledge in interventional school compared to control one, as well as the decrease in practice and strengthening of belief in interventional group other than control one could still demonstrate the effectiveness of comprehensive education strategy in control of clonorchiasis. However, further cluster-randomized controlled trials are expected in future, in which more schools including students in higher grades should be included. Longer observation than 12 months is also expected.

5. Conclusions

Health education in primary school children could effectively increase the knowledge on prevention of clonorchiasis, decrease the ingestion of raw freshwater fish, and strengthen the belief not to eat in future. Although the knowledge decreases in some degree following the cessation of interventions, the belief still keeps at high level. Larger cluster-randomized controlled trials are expected to verify the effectiveness.

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CRediT authorship contribution statement

Men-Bao Qian: Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing - original draft, Writing - review & editing, Visualization, Supervision, Project administration. **Xiao-Qin Gan:** Investigation, Resources, Supervision. **Jia-Guang Zhao:** Investigation, Resources, Supervision. **Wei-Jie Zheng:** Investigation, Resources, Supervision. **Wei Li:** Investigation, Resources, Supervision. **Zhi-Hua Jiang:** Conceptualization, Investigation, Supervision. **Ting-Jun Zhu:** Conceptualization, Methodology, Investigation, Supervision. **Xiao-Nong Zhou:** Conceptualization, Methodology, Writing - original draft, Writing - review & editing, Supervision, Project administration, Funding acquisition.

Declaration of Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.actatropica.2020.105436.

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