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A preventive medical study on sudden death in youths

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ABSTRACT

We have surveyed sudden death in youths in the Okinawa prefecture by autopsy. We also have tried to establish an Okinawan health check system for high-school students for the past 10 years. In this continuing study, we offer some preventive medical considerations for a future school health check system in Japan through the cases which could not be predicted or prevented by the high-school health check system in Okinawa prefecture. The questionnaires will probably be one of the most important factors. More over, it may be necessary for specialists to hold seminars for school authorities, such as nurses or teachers and even for school doctors periodically. We should consider many concerns of citizens regarding sudden death among youths, as well as the concerns of government officers, industrial and public health nurses and school health managers. Above all, the vertical and horizontal communication systems for personal health check informations will be indispensable for the prediction and prevention of sudden death in youths. *Ryukyu Med. J., 17 (1)7~13, 1997*

Key words: school health, sudden death, autopsy, youths, prediction and prevention

INTRODUCTION

In Japan, since the revision of the rules on school health in 1973, the program of school medical examinations has been obligatory for school children. Although the school health-check program has been carried out country-wide for early detection and mainly for health administration of heart disease in children, in Okinawa it has been developed earlier on an original course[1-4]. However, the particular medical examinations performed and the systems created are decided at the prefectural level, hence they vary between prefectures. Because the school health-check program in each prefecture is not uniform, it is difficult to compare the results and to evaluate the effectiveness of the screening systems among local communities. Furthermore, up to this point there may not have been sufficient feedback assessments provided both clinically and from the view point of preventive medicine.

The causes of sudden death in youths, especially in students, are still not fully understood compared with those of middle-aged or elderly people, partly because they passed their daily lives apparently quite healthy, and partly because their families or school authorities often do not consent to autopsies. Sudden death among the young not only creates much grief in the family, but is an immeasurable loss for society, so it is a problem not to be overlooked.

The victims which could not be found to be high-risk subjects in our system were investigated by autopsy along with their backgrounds, with the intention of offering some help on prediction and prevention of sudden death in youths in future.

MATERIALS AND METHODS

We investigated the results of the health-check program for prefectural high school students, aged 15, who had been examined for the past 10 years (April 1, 1982 to March 31, 1992). We also investigated the causes of death for victims of sudden death in the Okinawa prefecture through analyzing autopsy studies from the period, examining personal data of the students retrospectively, parts of which were already reported[6,7]. In this context, sudden death is defined as an unexpected death within 24 h from symptom onset. The subjects were young adults aged 15 to 29 years-old, who lived in Okinawa, and were examined by autopsy in the Department of Legal Medicine of the University of the Ryukyus.

Table 1 Annual changes in the number of subjects and the rate of examined students for the past ten years

	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
the total number of students to be examined*	17,507	19,196	19.549	19,249	19,490	19,515	20,739	21,062	21,097	20,011
the rate of examined students (%)	96.7	97.4	97.3	96.7	97.8	98.4	97.7	97.4	97.1	96.8

*Government of Okinawa prefecture. A report of the basic survey of-school in 1992. 1993

Table 2 Characteristics and death conditions of the three cases

	Case 1	Case 2	Case 3
Sex	male	male	male
Age	20	20	16
Height (cm)	167	180	165
weight (kg)	79	71.5	49
Occupation	repair technician	college student	high-school student
Past history	nothing particular	coarctation of aorta	nothing particular
Conditions of death	Chasing a thief	Crashing his car into the wall of a house	Jogging around school ground
Findings by autopsy	No abnormal organic findings except mild cardiomegaly (385g)	Expansion of ascending aortic wall, rupture of aorta, cardiac tamponade and coarctation;heart weight, 350g	Myocardial abnormal growth;Within normal range weight of heart, 250g
Causes of death	acute functional heart failure	rupture of aorta, cardiac tamponade	ischemic heart failure
Findings of ECG	within normal limits	within normal limits	sinus arrhythmia
Diagnose of chest X ray	no abnormal findings	no abnormal findings	no abnormal findings
Contents of questionnaire*	nothing particular	nothing particular	nothing particular
Comments of school doctor	no abnormality	no abnomality	no abnormality

*by students themselves ECG: electrocardiogrm

RESULTS

The annual number of subjects and the rate of examined students in the high-school health check system (HHS) for the past ten years, 1982 to 1991, were shown in Table 1. The total number of students who should have been examined by the HHS was 197,460 and those actually examined were 192,189 (97.3%). Although the total number of students to be examined was gradually increased annually, the rates of examined students were not so much changed with higher level. Through this period the total number of autopsies for sudden death was 1,137. Of this, the number of young adults was 278, with potential subjects being 9 (3.2%)[7]. Of these 9 subjects, we studied only the subjects who had been examined in the HHS, which numbered 3. The characteristics and actual conditions of death for the 3 cases are shown in Table 2.

DISCUSSION

The flow chart of the screening system is shown in Fig. 1. The HHS for high school students in the Okinawa prefecture has been in existence since 1979[1]. Since then, its efficiency and its effectiveness as a medical screening tool has gradually been improved[2,3]. In 1989, the Okinawan HHS adopted the mark-sheet computer reading system, the first prefecture to do so[4].

Originally our subjects were limited to prefectural high school students, the number of prefectural high schools in Okinawa including full-time and part-time high schools was 80 in 1989, and we included all of them in our study. Incidentally, the number of private high schools was 4, whereas there were no national high schools in Okinawa then. The number of private high school students was 3,540 (5.29%), far lower than that

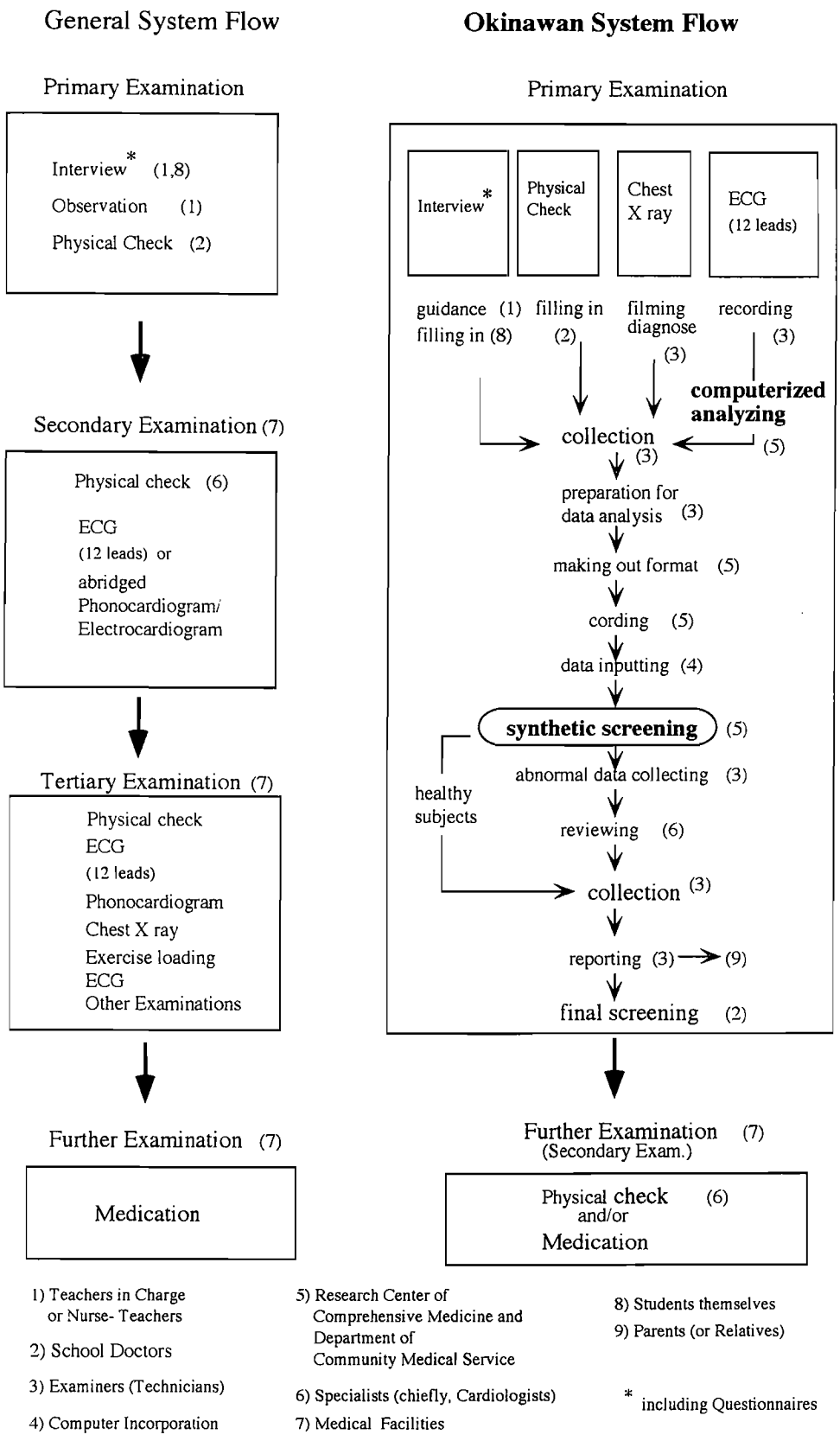

Fig. 1 The flow chart of school health-checking system in Okinawa (right). Four fundamental examinations are carried out, following computerized analysis and synthetic screening, which are all in the frame-work of primary screening system. Further examinations comprise physical check by specialist and/or medication. General health-check system in other prefectures is shown at the left side.

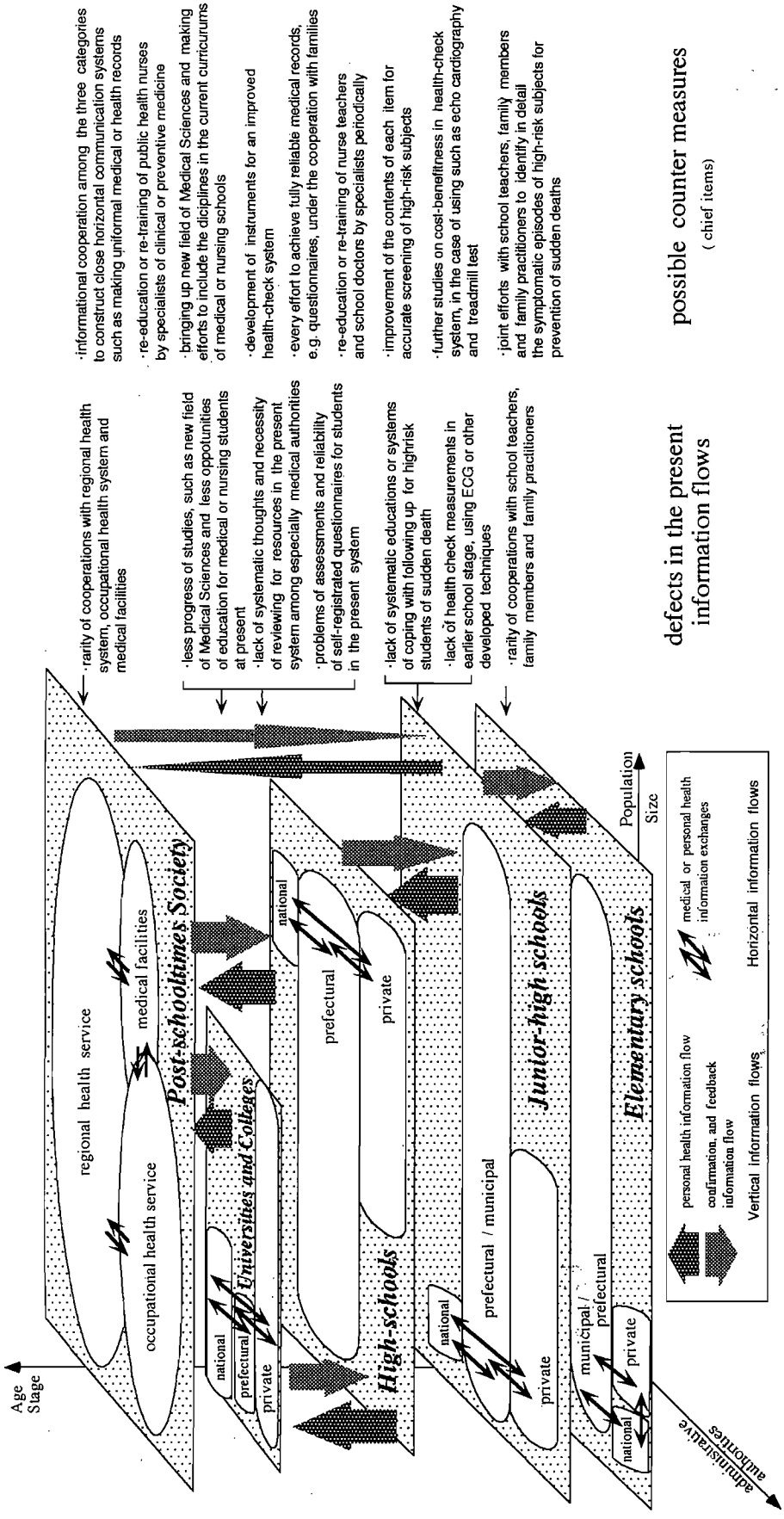

Fig. 2 A model of the vertical and horizontal health system for the prediction and prevention of sudden death in youths based on the synthetic results of our previous studies. Vertical and horizontal information flow of personal health-check data or feedback information are shown between age stages (elementary schools, junior-high schools, high-schools, universities and colleges, post-schooltimes society) (left). Chief items of possible counter measures at each stage are also shown at the right side.

of prefectural high school students 62,750 (93.8%)[8]. Other students were 596 (0.89%)[8]. The 15 year-old population in Okinawa in that year was 22, 423, more than 93% of whom were at prefectural high schools. Hence, by making the prefectural high school students the HHS subjects, we could expect a fairly efficient screening system at least from the methodological point of view.

Case 1 was one of the subjects who had entered our HHS. The findings on autopsy study revealed no organic abnormalities except mild cardiomegaly. This was to be expected for an active baseball player in adolescense.

However, after graduating from high school he did no more exercise, and became overweight (BMI 28). Then physical and emotional stress over-loaded his heart abruptly (he was chasing a thief), which might have caused his sudden death. From this case, sudden death occurring during exercise should be an important point[9].

Results of the HHS including a health check questionnaire in case 2 produced nothing outstanding. However, the direct cause of sudden death was clear because the autopsy study revealed coarctation, cardiac tamponade, and rupture of the aorta. We followed up the case in several ways. First of all, we took a detailed illness history from his family directly.

It was proved that he had not been followed up by the family doctor (cardiologist) since his elementary school time. However, commonly speaking, coarctation progresses its abnormal findings and reveal symptoms clearly year by year. So, if he had not abandoned medical follow up by a specialist, he might have taken valuable advice from him after several years. Secondly, why was his 'abnormal' health check data judged 'normal' in the course of the HHS? However we could not get his original health check data in the HHS because of expiration of term for custody, comments on the findings of chest X ray at the time of his matriculation in which was mentioned 'slight cardiomegaly' and checked on the item, 'be necessary for medical observation'. It is probable that the state of his coarctation rapidly progressed during his high school years and there might have been few findings of chest X ray and ECG at the time of the HHS which was held in the early tenth grade. Therefore, it is most important for such cases to be followed medically. Also, people around such a 'candidate for sudden death' should not fail to observe them and to help them to continue following up medically.

The health administration systems in colleges or universities should also be investigated. For example, this case entered a private college from a prefectural high school and at the time of entrance, no detailed health check data was exchanged between the schools. This is a communication problem between the health administrative systems for personal health check information in schools and communities (Fig. 2). To address this problem, in 1991 we tried a secondary heart disease investigation and follow up for our students at the University of the Ryukyus. The students who are judged as needing further cardiovascular investigations are examined, mainly by us, then we continue to follow the students who need medical treatment. So far, there have been no sudden deaths in this group[10].

The last case of sudden death was a 16 year-old high school student. Concerning the anatomic findings in the heart, peripheral parts of the right coronary artery were not identified. It was found that peripheral parts of the right coronary artery were buried and running through the relatively thick right ventricular muscle. More over this case presented important findings concerning sudden death under school administration. The results of several examinations, including ECG, chest X ray, and the questionnaire showed no abnormal findings. Also, the comment of the school doctor's health check was just 'unremarkable' or 'no abnormality'.

Ohkuni *et al.*[11] reported 36 cases (77%) of sudden cardiac death in an autopsy study of 47 school chil dren.

The greatest number of cases occurred among high school boys. Ohkuni suggests that the quality of the HHS, the level of administration for heart diseased children and the number with family histories of hypertrophic cardiomyopathy are the most important factors influencing the incidence of sudden death in school-aged children.

This is similar to our results. For the period 1979 to 1989, the prefecture with the least sudden deaths was Okinawa, with a death rate of 0.13 per hundred thousand students, whereas Japan as a whole averaged 0.40[12].

This report also indicates that the incidence of sudden death depends more upon physical characteristics or sex than locality. In the Okinawa prefecture, a more stringent HHS has been tried for the past 10 years. This might have contributed to the low death rate. Nevertheless, several cases of sudden death have actually occurred in school-aged youths in Okinawa prefecture. It is a problem. In one case, a school-boy aged 16 died during cooling-down jogging after hard soccer training. The question occurs as to why it might have happened at all.

There must have been severe loading for his heart. Moreover, because this heart anomaly had been present since he was born, why did it happen now? On this point, the author has speculated on facts of the conditions and the causes and discussed some possibilities of sudden death for children in such conditions[13]. In these cases, they had taken the questionnaire lightly and had written that their conditions were no longer present and that they had felt no cardiac symptoms. An unremarkable questionnaire and an

asymptomatic clinical course before sudden death has also occurred with other 2 cases. Regretably, for these 3 cases, we could not predict and prevent sudden death in advance even by the Okinawan HHS. So, generally speaking, could the HHS be considered ineffective for its purpose? We suggest this is not the case. For we could have recognized that not only might the present HHS has some difficulties detecting high-risk students, especially for sudden death, but also has problems predicting sudden deaths. Furthermore, we have done autopsy studies for the sudden death subjects, which revealed the causes of sudden death in the young. The results indicate that some problems exist in the HHS. The preventive study for sudden death in youths has just started.

One of these problems is that from the pathological point of view, it would have been difficult to recognize the 3 cases as high-risk subjects for sudden death with the present HHS. That means we need to add another higher examination level so as to change the contents of each component in the present system. If we persist with the present system we should also improve some points in the system flow from the efficiency or management points of view[14]. This may include detection or prediction of high-risk subjects who require further study.

In this context, the questionnaires will probably be one of the most important factors. Questions should be answered by recording any symptomatic episodes carefully and precisely, however trivial they may seem. We should make students understand the importance of answering carefully and accurately. It is crucial to make every effort to obtain fully reliable medical records. If possible, it would be most helpful to take histories from their parents. In comparison with teachers' observations or by any high-level instru-ments, nothing can replace the parents' eyes, for only the parents or family members know the detailed symptomatic episodes from their earlier days. It may not to be necessary to add new items to the questionnaire, but rather aim at obtaining very reliable answers. It would be of no use to have contents of collected questionnaires showing 'nothing paticular' or 'no abnormality' in whole items. And if obtaining fully reliable answers is the problem, it would not matter how the assessment of cost-benefit is, because it will require no more costs to improve the present HHS.

On the other hand, school authorities may also be very important. For example, it may be necessary for specialists to hold seminars for nurses or teachers and even for school doctors periodically, on some theme, such as physical conditions leading to sudden death. Finally, we should consider many concerns of citizens regarding sudden death among youths, as well as concerns of government officers, industrial and public health nurses and school health managers. Especially, the vertical and horizontal communication systems of personal health check informations will be indispensable for the prediction and prevention of sudden death in youths (Fig. 2). Ungrudging efforts to construct a preventive medical system for the younger generation can make the primary data more reliable, and more valuable, which consequently would influence the ability to predict and prevent sudden death in youths.

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