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Epidemiological studies of *Entameba histolytica* and other intestinal protozoa in Taegu city, Korea*

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=國文抄錄=

大邱市民들에서의 痢疾아메바 및 腸內原蟲類 疫學的 調査

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大邱市民들에서의 痢疾아메바 및 腸內原蟲類 感染狀을 把握하기 위하여 1987年 3月부터 同年 10月까지 大邱市內 11개洞 573家口 2,381名을 調査對象으로 選定하여 formalin-ether 集卵法으로 集卵한후 Lugol氏液으로 染色하여 原蟲類 胞囊을 調査하였다.

總被檢者 2,381名中 痢疾아메바 胞囊 檢出率은 4.2%였으며 男女間의 有義的 差를 認定할 수 없었다.

年齡群別로는 年齡이 增加함에 따라 그 率도 增加하여 30~39歲群에서 男子는 5.3%, 女子는 6.3%로 最高値를 나타내었다.

總被檢家口 573世帶中 한사람 以上이 痢疾아메바에 感染되어 있는 境遇가 76世帶, 13.3%였으며, 世帶別 平均 感染者 數는 1.3名이었다.

痢疾아메바의 感染要因으로 推定되는 項目을 設問紙로 調査하였던바 檢出者와 非檢出者 사이에 뚜렷한 差를 認定할 수 없었다. 이번 調査로 大邱市民들에 있어서 痢疾아메바 및 腸內原蟲類 感染率은 아직도 高率임을 알았다.

Introduction

Entameba histolytica has become the most important protozoan parasite of man in Korea. Originally considered to be an organism largely restricted to the tropics and the subtropics, its distribution is now recognized as ubiquitous, determined by prevailing conditions of hygiene and sanitation.

Although there were many published reports in clinical, therapeutic and epidemiological literature on *E. histolytica* and other intestinal parasites in hospitals and clinics, military groups, children in schools and institutions, limited locations or communities, and miscellaneous populations since Kessel's first report on the intestinal protozoa in Seoul, Korea in 1925, relatively few studies have been carried out in family groups and communities.

Available among these latter, are the investigations of Cho and Loh(1973) in rural and urban Korea, and Joo and Baik(1986) in Kyungpook Province, Korea.

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However, these studies devoted little or no attention to *E. histolytica* and other intestinal protozoa.

The opportunity was provided for the epidemiologic survey of intestinal parasites in family unit, in connection with the Control program for helminthiasis by the Korea Association for Parasitic Eradication under the legal basis of the Prevention Law of Parasitic diseases.

Of the 2,381 members of the 537 families in the Control program, it was planned to examine the fecal specimens from each of the persons in these family groups over a 6-month period in order to obtain an accurate assessment of the incidence of the prevalent species of parasites in each individual and family, together with epidemiological, clinical and socioeconomic implications of these parasitic infections in this city.

Because of the prevailing idea that everyone in Taegu city is infected with *E. histolytica*, and that amebic dysentery is common in persistent diarrheal patients, special attention has been focused primarily on the protozoa, and particularly on the prevalence and epidemiology of *E. histolytica*.

The purpose of this paper is to report on the prevalence of *E. histolytica* and other intestinal protozoa among residents in Taegu city and to secure information concerning certain aspects of the epidemiology of the infection.

Materials and Methods

1. Geographical conditions of surveyed areas:

Taegu city is located in the southeast part of the Korean peninsula, having an area of 455 suqare kilometers, and on the border there are many mountains, such as Mt. Hwanseong, Mt. Wyalong, Mt. Biseol and Mt. Moonam, arranged in a circle that make the city seem to be a big hollow.

The city is under the influence of a typical east-coast continental climate, being situated in the warm latitude 35°46′—36°01′ north and in longitude 128°46′—128°28′ east.

Mean annual temperature is 13°C, mean January temperature is −0.9°C and average August temperature is 26.1°C, which are generally lower than those of other cities situated at the same latitude.

Taegu city comes under the category of a humid area, with annual precipitation 1,005.3 mm and aridity index 43.3. Because of humid monsoon, the city has heavier rainfall than other foreign cites located at the same latitude, but belongs to an area of less rainfall in Korea.

Of the rainy season covering June, July, August and September, July has the heaviest precipitation 227.4mm, amounting to 23 per cent of the annual precipitation.

Contrarily, annual precipitation between December thru February, which is the arid season, is 69.4mm, amounting only to 7 per cent.

Seasonal humidity shows that it is under 60 per cent in the months of January, February and March, and over 70 percent in the months of July, August and September.

On April 1st 1980, the area of Taegu city was divided into six districts (Ku): Central, East, West, North, South and Suseong, and promoted to city status under the direct control of the government(Fig.1).

It has a population of about 2,030,000 : 1, 010,000 are males and 1,020,000 females, with total households of about 500,000.

2. Parasitological methods:

During the period from April to September in 1987, the authors carried out a parasitological survey in order to estimate the *E. histolytica* and other intestinal protozoan infections based on parasitic cysts among the residents aged from 1 to 70 years living in 11 villages of Taegu city.

Pertinent data on each person regarding sex,

age, education and occupation were obtained prior to initiation of the examination.

The heterogeneity of age, sex, locality and socioeconomics of the surveyed population appear to make the Bureau of Statistics Korean Economics Planning Board as a representative of the residents of Taegu city and is readily obtainable.

The age and sex of persons examined are adjusted for the proportion of the residents belonging to each age and sex group, as kindly provided by the Bureau of Statistics Korean Economic Planning Board, based on the 1980 census.

A total of 2,381 specimens were collected from 1,174 male and 1,207 female residents living in 537 households.

The specimens were collected in cardboard cartons and brought to the laboratory. The specimens were examined within 24 hours after collection.

Since trophozoites disintegrate within a short time, only cysts were examined in solid stools. The formalin-ether sedimentation method (Ritchie, 1948) was used to recover protozoan cysts.

One drop of the sediment was first placed on a microscopic slide and one drop of Lugol's iodine solution was mixed. The preparation was mounted with a cover slip, and the entire area was examined for cysts.

When *E. histolytica* cysts were found, the size of a sufficient number of cysts were measured with a micrometer to determine the relative prevalence of large and small races, cysts measuring smaller than 10 micron being assigned to the latter.

In order to analyze additional information regarding the vehicle of infection, questions relating to type of housing unit, room being used, water service, lavatory facilities, monthly income, education level and occupation were included in the questionnaire.

The respondents were asked to check columns indicating whether they had each item "One" "Two" "Five" and "Yes" or "No"

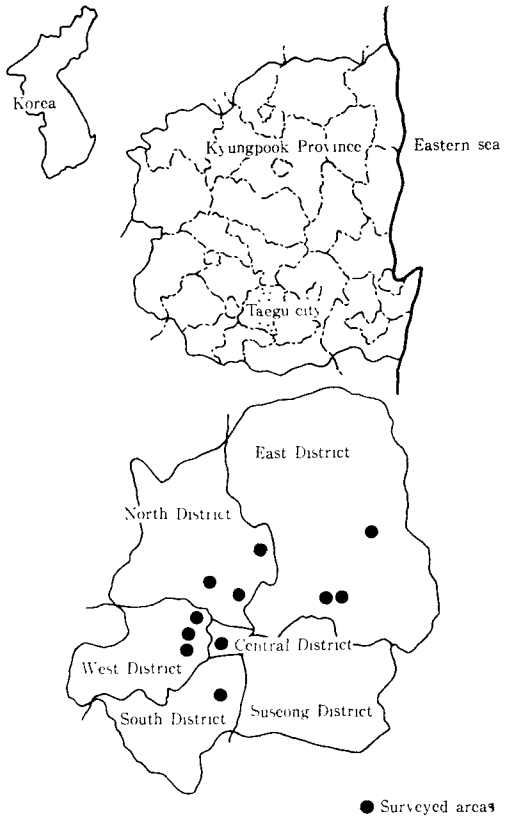

Fig. 1. Map showing the Taegu city under survey.

Results

Stool specimens from a total of 2,381 persons constituting 573 households were examined for *E. histolytica* and other intestinal protozoa.

The prevalence rate of *E. histolytica* for both the residents and the families by villages are presented in Table 1.

Ninety-nine persons were found to be infected with *E. histolytica* out of 2,381 examined, this amounting to 4.2 percent of the populations.

The highest prevalence of *E. histolytica* was found among the residents of Sankeok 1st village, being present in 7.9 per cent.

The lowest prevalence, 1.5 per cent, was observed among Bisan 6th village residents.

Chilseong 2nd and Shincheon 3rd villages residents fell into an intermediate position, with prevalence of 4.7 percent and 5.0 percent, respectively.

As might be expected familial prevalence rates were much higher.

Seventy-six or 13.3 percent of 573 families examined had one or more individuals with *E. histolytica*.

As in the case of the protozoa, the family prevalence rate of the *E. histolytica* was higher than the individual rates.

Table 2 shows the frequency of multiple infections with *E. histolytica* in positive families.

There was an average of 1.30 infected persons per family, and *E. histolytica* infections were demonstrated in more than one member of the family in 23.7 percent of the 76 families examined.

In 17.1 percent two members were infected, and in 5 families three members were found to be infected.

Multiple infections within the households were most common among the families of North district of Taegu city, being present in 34.8 percent.

The lowest incidence of multiple infections, 8.3 percent, was found among the families of West district.

The familial nature of *E. histolytica* infections is demonstrated by tabulation of the percentage prevalence of *E. histolytica* within individual families, as shown in Table 3.

In 14 of the 76 positive families examined, from 50 to 80 percent of the individual family

Table 1. Prevalence of *Entameba histolytica* among residents of Taegu city, by individuals and by families (1987)

Location of the home		Prevalence by individuals		Prevalence by families	
District	village	No. examined	Percent positive	No. examined	Percent positive
Central	Namsan 3rd	207	2.9	52	9.6
East	Dodong 1st	230	7.0	52	23.1
	Shincheon 1st	224	6.3	51	21.6
	Shincheon 3rd	222	5.0	52	17.3
West	Bisan 1st	220	1.8	55	7.3
	Bisan 6th	206	1.5	48	6.3
	Bisan 7th	215	2.8	50	10.0
South	Icheon 1st	210	2.9	51	7.8
North	Chilseong 2nd	211	4.7	49	16.3
	Chimsan 2nd	222	2.7	56	8.9
	Sankeok 1st	214	7.9	57	17.5
Total		2,381	4.2	573	13.3

Table 2. Frequency of multiple infections by *Entameba histolytica* in positive Family (1987)

Location of the home	No. of family	No. infections per family				Total infection	Average No. infection per family
		1	2	3	4		
Central district	5	4	1			6	1.20
East district	32	25	5	2		41	1.28
West district	12	11	1			13	1.08
South district	4	3		1		6	1.50
North district	23	15	6	2		33	1.43
Total	76	55	13	5		99	1.30

Table 3. Percentage prevalence of *Entameba histolytica* in positive families (1987)

Percent infected	Central	East	West	South	North	Total family
0— 9	—	—	—	—	—	—
10—19	2	9	4	3	3	21
20—29	2	12	5	—	8	27
30—39	1	4	2	—	2	9
40—49	—	2	—	1	2	5
50—59	—	3	—	—	4	7
60—69	—	2	1	—	3	6
70—79	—	—	—	—	1	1
80—	—	—	—	—	—	—
Total family	5	32	12	4	23	76
Weighted average* percent infected	23.1	23.4	23.2	21.4	32.0	25.5

*The weighted average percent infected is an average of the individual percentages weighted by the size of the family upon which the percentage is based.

members were found to be infected by *E. histolytica*.

The weighted average rate of infection per family among the 388 members of these 76 positive families was 25.5 per cent.

It will be noted from Table 3 that there are no significant differences among percentage prevalence in the families of 5 districts in Taegu city. The highest prevalence of infection was observed among the North district families.

Table 4 lists the species and prevalence of the intestinal protozoan cysts by stool examinations.

Of the protozoa, *E. histolytica* was found most frequently, in 4.2 percent of the residents, followed by *E. nana* with 1.5 percent and *Iodameba butschlii* with 0.9 percent.

E. coli and *Giardia lamblia* were the least prevalent species. Both large and small races of *E. histolytica* were observed. Thirty-five individuals had large race cysts: 52 small race cysts only: and 12 both large and small race cysts.

As to the sex-specific rate of overall protozoan infections, females were a little higher than males.

The data shown in Table 5 present the preva-

Table 4. Prevalence of intestinal protozoa by sex among residents in Taegu city (1987)

Species	Male		Female		Total	
	No. infected	Percent positive	No. infected	Percent positive	No. infected	Percent positive
Entameba histolytica						
Large race	23	2.0	12	1.0	35	1.5
Small race	20	1.7	32	2.7	52	2.2
Large & small race	4	0.3	8	0.7	12	0.5
Entameba coli	5	0.4	7	0.6	12	0.5
Endolimax nana	19	1.6	16	1.3	35	1.5
Iodamba butschlii	9	0.8	13	1.1	22	0.9
Giardia lamblia	6	0.5	6	0.5	12	0.5
Total No. examined	1,174		1,207		2,381	

Table 5. Infection rate of *Entameba histolytica* by sex and age group among residents of Taegu city (1987)

Age group (Y)	Male		Female		Total	
	No. examined	Percent positive	No. examined	Percent positive	No. examined	Percent positive
0— 9	189	0.5	178	1.7	367	1.1
10—19	287	4.2	274	4.4	561	4.3
20—29	222	5.0	240	5.8	462	5.8
30—39	187	5.3	191	6.3	378	5.8
40—94	150	4.0	156	5.1	306	4.6
50—59	86	4.7	87	2.3	173	3.5
60—	53	5.7	81	1.2	134	3.0
Total	1,174	4.0	1,207	4.3	2,381	4.2

Table 6. Summary of additional informations of *Entameba histolytica* infections (1987)

Item	76 positive family		497 negative family	
	No.	%	No.	%
Type of husing units				
Dwelling house	58	76.3	351	70.6
Tenement house	2	2.6	7	1.4
Apartment house	16	21.1	79	15.9
other	—	—	60	12.1
Room to be using				
One	22	28.9	174	35.0
Two	30	39.5	170	34.2
Three	20	26.3	139	28.0
Four	4	5.3	10	2.0
Five and over	—	—	4	0.8
Water service				
Central water supply	66	86.8	470	94.6
Simple piped water supply	8	10.5	22	4.4
Pump well	2	2.6	4	0.8
Spring well	—	—	1	0.2
Lavatorial facilities				
Flush toilet	28	36.8	133	26.8
Improved privy	22	28.9	190	38.2
Old-fashioned privy	26	34.2	174	35.0
Monthly income				
100,000 and less	5	6.6	31	6.2
200,000 and less	15	19.7	86	17.3
300,000 and less	29	38.2	165	33.2
400,000 and less	16	21.1	116	23.3
500,000 and less	3	3.9	42	8.5
500,000 and over	8	10.5	57	11.5

Table 7. Additional informations of *Entameba histolytica* infections among residents in Taegu city (1987)

Item	Male		Female		Total	
	No. examined	percent infected	No. examined	Precent infected	No. examined	Percet infected
Education level						
Primary school	265	3.8	347	3.7	612	3.8
Middle school	262	3.4	284	4.6	546	4.0
High school	327	4.9	259	5.0	586	4.9
College	171	5.3	109	6.4	280	5.7
Illiteracy/no school	30	3.0	98	3.1	128	3.1
Preschool	119	1.7	110	2.7	229	2.2
Occupation						
Professional, technical & related	33	6.1	19	—	52	3.8
Administrative, managerical & related	20	5.0	—	—	20	5.0
Clerical workers & related	64	3.1	34	—	98	2.0
Sales workers & related	126	4.8	44	—	170	3.5
Service, recreation & related	24	—	24	8.3	48	4.2
Farmers, fisherman, lumberman & related	17	5.9	6	16.7	23	8.7
Productive process workers & related	220	5.9	63	6.3	283	6.0
Other*	670	3.3	1,017	4.4	1,687	4.2

*Other includes the housewives, attending school and something else.

lence of *E. histolytica* by sex and age groups.

The prevalence of *E. histolytica* was relatively high in 0—9 year age group: 0.5 percent in males and 1.7 percent in females.

The rates subsequently increased and reached a maximum of 5.8 percent in the 30—39 year age group in both sexes, followed by a gradual decreasing rate.

The data shown in Table 6 and Table 7 summarizes the answers to the questions. Two thousand three hundred and eighty-one (constituting 573 households) questionnaires were returned and calculated in the Department of Parasitology.

In all cases, the rate among the positive family or individuals did not differ significantly from that among those uninfected.

Thus, the distribution of type of housing units, rooms used, water service, lavatory facilities, monthly income, education level and occupation among the positive family or individuals did not differ from that among negative family or individuals.

Discussion

This survey of the prevalence for *E. histolytica* and other intestinal protozoan infections among residents in Taegu city, Korea was based on a sample of 2,381 constituting 573 households selected to give competent distribution by age, sex, location of home, and socioeconomics.

It differs from the earlier surveys, for instance those reported by Nishimura (1943) in Taegu and Yeongcheon areas, by Lee (1969) in Seonsan and Wiseong counties, by Kim et al. (1971) in Kyungsan county, by Im et al. (1972) in Taegu city, by Choi et al. (1971), Lee (1979), Kwon and Choi (1983), and Choi(1983), and Choi and Lee (1986) in Kyungpook University hospital located in Taegu city, by Choi and Hwang (1980) in urban and rural Kyungpook Province, and by Ha and Joo (1987) in Ulchin county in that those surveys dealt mostly with individuals who were in institu-

tions, hospitals, or artificial groups such as military organizations, local or highly restricted populations: whereas the present survey deals with persons living in their homes.

The individuals or families for this survey are adjusted for the proportion of the residents belonging to each age, sex, location, and socioeconomics, as kindly provided by the Bureau of Statistics Korean Economic Planning Board, based on the 1980 census.

The findings in this survey are based on discovery of protozoan cysts by formalin-ether sedimentation technique and Lugol's iodine stain on 2,381 subjects.

In practice, this is no indication of the prevalence among the residents in Taegu city, because one-time fecal examinations are not sufficient to determine the true infection rate of all protozoan diseases.

However, the results are quite comparable with earlier reports based on one-time examination of feces by means of similar laboratory procedure.

From the data in Table 8, it is noted that, although higher prevalence are expected if examinations are repeated, the present results are not high if compared with prevalences of other surveys for amebic infections in residents of Taegu city and Kyungpook Province.

The general prevalence of *E. histolytica*, including all age and sex groups, was 4.2 percent. According to the reports made by Kim and cowokers (1971) it was indicated that 9.9 percent of residents in Kyungsan county were found to be positive for amebiasis, and Choi and Hwang (1980) in a demonstration of *E. histolytica* cyst from urban and rural school children in Kyungpook Province found 26.9 per cent in children to harbor *E. histolytica*.

Our figures, however, show some indication of diminution in amebic infections among residents during the period of the past 20 years.

There is good reason to believe that the diminution in amebic infections in Taegu city is due to improvement of sanitation and dwellings by New Community movements, public health education, and specific chemotherapeutic administrations.

Table 8. The reported prevalence of intestinal protozoa among residents in Taegu city and Kyungpook Province

Source	Location	No. tested	Prevalence (%)					Group tested
			E. histolytica	*E. coli*	*E. nana*	*G. lamblia*	*I. butschlii*	
Nishimura (1943)	Yeongcheon & Taegu city	303	9.9	24.1	—	6.6	4.0	Residents
Lee (1969)	Seonsan & Wiseong	549	3.6	24.0	5.6	1.5	—	Residents
Kim et al. (1969)	Kyungsan	203	9.9	28.1	11.8	6.4	1.0	Residents
Choi et al. (1972)	Taegu	2,414	11.9	15.3	7.3	0.4	0.5	Hospital patients
Im et al. (1972)	Taegu	541	4.2	6.1	5.3	2.8	0.6	Military personnels
Lee et al. (1979)	Taegu	860	45.5	7.3	2.4	—	1.5	Hospital patients
Choi & Hwang (1980)	Taegu & Yeongduk	731	26.9	4.8	1.4	—	1.4	School children
Kwon & Choi (1983)	Taegu	2,083	54.6	8.4	1.2	—	0.8	Hospital patients
Ha and Joo (1987)	Ulchin	818	5.4	2.2	2.3	1.0	0.4	Residents
Present survey (1987)	Taegu	2,381	4.2	0.5	1.5	0.5	0.9	Residents

The sex-specific rate of *E. histolytica, E. coli,* and *Iodameba butchlii* in this survey was a little higher in females than in males, while, in the cases of *Endolimax nana,* the infection rate in males was higher than in females. It is in agreement with previous findings reported by many investigators studying in other districts of Kyungpook Province (Nishimura, 1943 ; Kim et al., 1971 ; Choi et al., 1972 ; Choi and Hwang, 1980, Ha and Joo, 1987).

The exact cause of the higher female prevalence is not known, but it can be explained rationally on the following basis. In the first place, the similar prevalence rats in the children and adolescent periods are probably due to the fact that there is little between the sexes as regards sanitary habits. Both groups tend to be untidy and it is only as maturity is approached that their habits become different.

As adulthood is reached the female groups become involved with household duties which must expose them to greater risk of infection whether transmission be by direct contact or by an indirect method.

The females tend to remain in the home, and they handle children, wash clothes, make pickled vegetables, and perform other tasks which may involve risk of contamination.

Hall(1938) suggested that *E. histolytica* can surmount sanitation barriers because it is commonly transmitted by cyst, from the perianal folds rather than in feces.

He found that the incidence of amebiasis among laundry women was higher than the general population and attributed it to the handling of underwear, wash cloths, towels and sheets which has been in contact with the perineums of infected persons.

A study of Eyles et al. (1953) mentioned that the finding of greater prevalence in the female population would seem to be in best accord with transmission by direct contact with infected persons or by contact with contaminated articles, while, transmission by contamination of food by handlers of flies would result in similar sex prevalences, as would transmission by the contamination of the water supply.

The age prevalence pattern in this survey is dissimilar to that reported by Kim et al. (1971) from a nationwide survey as a whole, and also differ from the pattern in Chejudo(Kim, 1967).

In the case of these studies the prevalence rate was higher in the 50 years of age and above group. In present study the rate tended to be higher with the increase of age and reached a maximum of 5.8 percent in the 30—39 year age group. A similar pattern was described by Ha and Joo (1987) in Ulchin county located in the northern portion of Kyungpook Province.

In this survey the weighted average rate of infection per family among the 388 members of these 76 positive families was 25.5 per cent.

The findings indicated that if one member of a family was found infected by *E. histolytica,* there was a probability that one fourth of all members of his family would be shown to be infected.

That such familial prevalence occurs has been asserted by many investigators, but a few believe the findings of a number of infected individuals in one family is due to chance.

In order to obtain the additional information of the amebic infections, the answers to the questions were derived by a questionnaire to the residents.

No apparent difference in the results obtained between positive family or infected individuals and negative family or uninfected individuals was noted. It is thought to be different, if the infections were determined on the basis of repeated fecal examinations.

Compared with the earlier reports available, *E. histolytica* and other intestinal protozoa are now much less prevalent, due to improvement of sanitation and dwellings by New Community Movement, in combination with extensive public health education.

Summary

In order to determine the epidemiological pattern of the *Entameba histolytica* and other intestinal protozoa among the residents of Taegu city, Korea, this studies were made from April to September, 1987.

The method employed was formalin-ether sedimentation technique and one slide was stained with Lugol's iodine solution and examination was made for protozoan cysts.

In a total of 2,381 individuals examined, 99 cases or 4.2 percent were revealed positive of *E. histolytica*. Of them, 35 cases had large race cysts: 52 small race cysts only: and 12 both large and small race cysts.

The sex-specific rate of *E. histolytica* infections was a little higher in females than in males.

In the age prevalence pattern, the rate tended to be higher with the increase of age and reached a maximum of 5.8 percent in the 30—39 year age group of both sexes.

In the familial prevalence, 76 or 13.3 percent of 573 famlies examined had one or more individuals with *E. histolytica*.

In 76 families of infected individuals comprising 388 members, 99 infections by *E. histolytica* were found, an average of 1.30 cases of amebiasis per family, a prevalence of infection of 25.5 percent.

The questionnaire studied failed to analyze any information attributed to *E. histolytica* infection between positive families or individuals and negative families or individuals.

The results of this survey generally indicate clear evidence that the prevalence rates of *E. histolytica* and other intestinal protozoa are now much less prevalent, due to improvement of sanitation by New Community Movement, in combination with extensive public health education.

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