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THE ROLE OF ENVIRONMENTAL SANITATION IN THE EPIDEMIOLOGY OF TRACHOMA AND ASSOCIATED OCULAR INFECTIONS

by

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I INTRODUCTION

Before discussing the specific aspect of the role of environmental sanitation in the spread of communicable eye diseases and trachoma, first of all it may be useful to review some basic concept related with this problem and to describe their content and their implication.

Epidemiology in its broad sense means "that field of medical science which is concerned with the relationship of the various factors and conditions which determine the frequencies and distributions of an infectious process, a disease or a physiological state in human community" (Maxcy). Disease is not a simple battle between man and the causative agent in which environment plays no role. On the contrary, environment plays an active part in this battle. There are important factors which derive from the environment of man, the interaction between man and his environment affects, adversely or not, or even promotes, his continuous struggle towards better health.

The two ways to control the adverse effects of the environment are:

a) to adapt man to his environment, or

b) to adapt the environment to man.

The second route is the field of environmental sanitation which does not stop at the simple control of adverse effects, but goes further in the positive action of promoting health.

In the First Report of the WHO Exp rt Committee on Environmental Sanitation, the term "environmental sanitation" has been defined as

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"the control of all those factors in man's physical environment which exercise or may exercise a deleterious effect on his physical development, health and survival". In particular, it refers to the control of:

1. Methods for the disposal of excreta sewage and community wastes to ensure they are adequate and safe;

2. Water supplies, to ensure that they are pure and wholesome;

3. Housing, to ensure that it is of a character likely to

a) provide as few opportunities as possible for the direct transmission of disease, especially respiratory infections, and

b) encourage healthy habits in the occupants;

4. Milk and other food supplies, to ensure that they are safe (the question of their nutritive quality being excluded from consideration);

5. Personal habits of cleanliness, especially in relation to disease;

6. Arthropod, rodent, mollusc, or other alternative hosts of human disease;

7. Atmospheric conditions, to ensure that the external atmosphere is free from deleterious elements and that the internal conditions of workshops, houses, etc., are suitable for the occupations undertaken in them;

8. Factories, workshops, dwellings, streets, and the general environment, to ensure freedom from risk to health, whether mechanical, chemical or biological and to provide the best working and living conditions.

Further, in the same report, the Committee discussed the different diseases which are primarily due to lack of these provisions. In the infections commonly acquired by surface contamination, special mention is made of trachoma and ophthalmia, among others, which are particularly associated with certain housing conditions, overcrowding and lack of public appreciation of sanitation.

II ENVIRONMENTAL SANITATION VERSUS TRACHOMA AND OTHER COMMUNICABLE EYE DISEASES

That the background of environmental sanitation has an important effect on trachoma has been recognized and this disease reaches a high

epidemicity where conditions in environmental sanitation are extremely poor and widespread. This was vividly shown by its spread in different places of Europe with the return of the Napoleonic troops from the Middle East. At that time there was no special treatment to fight the invasion of the disease, and it was the gradual improvement of standards of living that was mainly responsible for the near disappearance of trachoma in that part of the world during the beginning of this century.

A similar experience has been pointed out by Maxwell-Lyons. Before the Second World War, trachoma in Yugoslavia was rare; it was encountered only in limited areas. But different conditions experienced during the war and immediately after it were the cause of a rapid increase of cases. What were these new conditions which caused this outburst? The movement of the people from one place to another brought healthy people into contact with infected ones and the effect of this contact was increased by overcrowding due to the destruction of houses, and by unsanitary conditions resulting from the emergency situation.

The Yugoslav Government undertook a series of measures to control the disease, directed towards systematic case finding, the supervision of infected persons, the segregation of trachomatous people in special classes, health education and treatment of cases in specific anti-trachoma institutions as much as possible. But, as Maxwell-Lyons stressed:

> "Probably the most significant factor in the long-term control of the disease will be the gradual return to previous standards of living and hygiene".

The same findings regarding the importance of the environment have been found repeatedly in the different countries of the world where trachoma is a public health problem. The picture becomes more complicated when trachoma is superimposed by bacterial infections, producing epidemics of conjunctivitis. There, an additional environmental factor is present which apparently substantially affects the epidemiology of these diseases, i.e. an overwhelming fly population. The typical example of this last condition is found in all countries of the North Africal littoral.

Between the above two extremes, that is, the pure form of trachoma without association of bacterial infections and trachoma associated with recurring seasonal epidemics of acute conjunctivitis, there are intermediate forms which seem to be encountered in different parts of the world. But the common factor which exists everywhere is the lack of basic hygiene and sanitation, overcrowding and uninhibited fly breeding in the areas where conjunctivitis is prevalent.

It may be interesting to study a little more thoroughly this association of trachoma and communicable eye diseases with environmental sanitation. For this purpose, environmental sanitation conditions can be considered under three main headings:

1. Those where vectors of the infections are abundant;
2. Those where transmission by contact is facilitated; and
3. Those where the natural resistance to the infections is lessened.

1. <u>Environmental sanitation conditions where insect vectors of the infections are abundant</u>

The principal, if not the only, insect vector involved in the spread of communicable eye diseases is the fly.

Flies were recognized as a nuisance and a danger to health from ancient times, as is apparent from the following:

> "and there came a grievous swarm of flies into the house of Pharaoh and into his servants' houses, and into all the land of Egypt, and the land was corrupted by this kind of flies" (Exodus 8:24).

During the medieval period and before the etiology of specific diseases had been learnt, the relationship between the presence of many flies and the prevalence of human disease came to be more and more fully understood.

With the development of science, it became known that filth-feeding and filth-breeding flies may carry quite a large number of different pathogenic organisms from man to man, or from infected material to man. But this infection is carried mechanically, and the fly does not act as an intermediate host where the pathogenic organisms undergo a cyclical change. Nevertheless, this mechanical transmission is quite complicated; it can take place in the following three different ways:

a) from the hair of the leg or body of the fly;

b) from the vomit; and

c) from the faeces.

From the studies and investigations made on the implication of flies as important health hazards, it has been learnt that they are mainly involved in two general categories of diseases:

a) those related to enteric infections; and

b) those ophthalmic diseases which include different kinds of conjunctivitis and trachoma.

From the very beginning, the diseases of the first group have been attracting the interest of workers and investigators to a much greater extent than those of the second. One of the earlier observers, L.O. Howard, strongly advocated the designation of "typhoid fly" as the most appropriate name for the fly involved in this type of infection. That so much attention was given to this was probably due to the need to solve the problems encountered by military authorities during the different wars, which consisted to a great extent of intestinal infections closely related to the abundance of flies. Interest continued, and there have been numerous laboratory and field investigations from which different data on the mechanism of contamination, the carrying capacity of different pathogenic organisms, the recovering of these organisms, the rate of infected flies, etc. have been collected. The culmination of this work was in the demonstration of the fact that fly control actually reduces the incidence of diarrhoeal diseases (Watt and Lindsay (1948) and Lindsay et al. (1953)).

On the second group of diseases, i.e. the ophthalmic diseases, work has been much more limited. Among the earlier references, Pattan in 1919 reported that musca domestica determinator Walker transmitted a form of ophthalmia in Mesopotamia. In the same year, trachoma began to receive attention. Nicolle, Guenod and Blanc asserted that flies transmit the infection after contact with infected eyes or with bandages. This infection, in the last instance, can be transmitted during at least the first twelve hours after the infection and six hours in the case of bandages. This question related to ophthalmia was also discussed by

Ferriers in 1920.

Coming to more modern times, and with special reference to this Region, different workers long pointed out the possible relation of flies to communicable eye diseases.

Among the first significant investigations made on the importance of the fly as a factor in the spread of communicable eye diseases was the work carried out in Egypt. Wilson has shown that epidemics of conjunctivitis are the result of fly dissemination from ophthalmic carriers of the responsible organisms. His work was followed and further developed by Maxwell-Lyons and others. As has been stated by Maxwell-Lyons, these studies show that the regular seasonal rise in incidence of acute conjunctivitis to epidemic proportions is dependent upon three main factors:

a) the number of "carriers" of pathogenic organisms;

b) the enormous increase of the number of flies tied up with epidemics; and

c) the existence of climatic conditions which favour both fly-breeding and viability of pathogenic organisms.

Maxwell-Lyons studied the method of vector control as a control measure for communicable eye diseases. According to him: (1) in areas where acute conjunctivitis occurs as regular seasonal epidemics, the common fly is the principal agent in spreading the infections; (2) there is very strong circumstantial evidence that the virus of trachoma is transmitted along with the infective secretions of the conjunctivitis.

The importance of the role of flies is enhanced even more if it is taken into consideration that the contagiousness of trachoma, normally low, is increased in the presence of bacterial infections.

Further studies by different workers in Egypt indicated that the prevalence of the acute conjunctivitis was associated with the species of musca sorbens. These flies are found abundantly on the faces of children and concentrate especially around the eyes, the nostrils and the lips.

In the Qalyub Demonstration and Training Centre, also in Egypt, studies regarding flies and communicable eye diseases showed the importance not only of musca sorbens, but also to some extent of musca domestica.

Similar work, but on a smaller scale, was carried out in Morocco. In an experiment in a village in the South of Morocco, a fly control campaign using BHC in the form of a 10% concentration powder was put into operation from April to September, during which period two epidemics of acute conjunctivitis usually occur. From the examinations carried out in that village and in a second one selected as a control village, it appeared that the control of the flies brought about a large reduction of conjunctivitis among children. According to the investigations, the incidence of the disease dropped from 88% to 36%; whereas in the control village it remained at about 85% - 88%. Nevertheless, these results do not give a strictly statistically significant picture because all necessary requirements could not be met, due to local difficulties.

The need for ensuring a statistically and indisputably sound basis for measuring the important role flies play in epidemics of communicable eye diseases, brought together Morocco, WHO and UNICEF, in 1953, to plan, organize and carry out a pilot project to try to get some of the necessary answers. This project did, in fact, give rise to some tangible data.

From the finding and statistical analysis of the results it emerged that the fly is an important, possibly the most important, single factor in the transmission of seasonal acute conjunctivitis in Morocco. Not only M.sorbens seems to be involved, but also musca domestica was found on the eyes of children. But musca domestica was comparatively less attracted to ocular discharge than musca sorbens. This difference in attractability and the relative proportion of each species in the fly population seem to be the principal factors which determine the relative importance of the two species in the transmission of the infection. From the fly control effected in the experimental area, the prevalence of conjunctivitis was reduced by approximately 24% in children of less than two years of age and by about 35% in the 2-8 age group. This

last age group in Morocco is the most exposed to flies which alight on their faces almost undisturbed.

Fly control also gave a significant reduction of carriers of Koch Weeks towards the end of the experiment.

An additional interesting finding during the above experiment was that only female M.domestica and M.sorbens were collected from the face and eyes of children.

From the above mentioned investigations and similar to ones carried out in other parts of the world, it appears that it is not always the same fly which is involved in this transmission of the contamination. In Morocco, musca sorbens and musca domestica are involved; in Egypt, musca sorbens seems to play the prominent role; in other regions, it appears that other species are implicated. This is of special interest for the application of adequate and efficient control measures in each place aiming to decrease the incidence of related communicable eye diseases.

2. Environmental sanitation conditions where transmission by contact is facilitated

In this category all conditions of environmental sanitation which are likely to facilitate transmission by contact except through an insect vector are included.

Among the most important, adequate water supply and overcrowding might be mentioned. Lack of a safe and abundant water supply probably represents the single most important factor in this group. Without sufficient water any attempt towards the improvement of personal hygiene and hygienic habits cannot be successful.

The importance of sanitary conditions facilitating transmission by contact has been recognized and mentioned as an indispensable factor in order for trachoma to reach high endemicity.

As also Professor Tulsi Das put it, it seems that "the severity of trachoma is determined by hygienic conditions".

In all places where communicable eye diseases represent a scourge the above mentioned conditions are almost invariably experienced. In

the North African Littoral and in the Middle East, besides the multitude of flies bad sanitary conditions are parallel to communicable eye diseases prevalence. In India and other places of South East Asia from recent preliminary investigations it was found steadily that communicable eye diseases problems were accompanied by poor sanitation.

Dr. Y. Mitsui, discussing the question of sanitary conditions in relation to trachoma went so far as to say that in a sense "distribution of soap" is superior to antibiotics in trachoma campaign.

In a review of activities in the field of trachoma and related communicable eye diseases (JC11/UNICEF-WHO/2, 1958) it is mentioned "It is now recognized that trachoma, throughout the greater part of its course, is of relatively low contagiousness, and that it becomes endemic only where there exist widespread environmental factors favouring transmission of infection".

Although the importance of overall environmental conditions as a factor in the prevalence of the infection leaves no way for argument, still no specific data are available assessing the value of the part played by each individual condition or by a group of them. Therefore, no clear and definite information exists on the results that might be expected from the control of the environmental conditions discussed above.

But the issue of an answer on the significance of the environmental sanitation conditions under discussion is further complicated by the co-existence of socio-economic factors. Both have mostly been confused and have been considered together in their influence on communicable eye diseases.

Since Professor Guenod said about sixty years ago that "trachoma retreats where civilization advances", not much has been added nowadays in the knowledge of the influence of specific aspects in environmental conditions. We are still referring to the unspecified and wide term "better living conditions" as a control measure.

3. Environmental sanitation conditions lessening natural resistance to the infections

In this group are included the environmental conditions which, by causing minor injuries to the eye, may increase the possibilities of

entrance by pathogenic organisms, or by irritation may decrease the natural resistance of the human organism. Here again, reference to these conditions as a factor in the spread of communicable eye diseases has been made by many different workers in different countries.

Wright in 1929 reported that trachoma was more frequent in women than in men. Among the probable reasons for this difference could be the constant irritation of the women's eyes by smoke from working stoves during the performance of the housewives' duties.

Dust also seems to play a role. In Bombay State it is known that the climate in the north is relatively warmer; the soil is sandy, and sand-storms affect the area. This can explain the higher rate of trachoma in the northern part of the State. Moreover, it seems that the incidence of trachoma in the whole country is influenced by the south-west winds during June, which, on account of the transported sand of the desert, must play an important role. From the geological analysis of the dust in different parts of India, it seems that quartz is predominant in the form of free silica and angular shape.

In recent studies made in some part of India, the presence of slight cicatrix on the tarsal conjunctiva which probably comes from the effect of the dust has been reported.

But, as in the case of the environmental sanitation conditions which facilitate transmission by contact, no specific study has been undertaken to assess the relative degree of importance of factors belonging to the above-mentioned category. Their effects are here also complicated by a multitude of other socio-economic factors and any specific evaluation should differentiate them and recognize their importance.

III CONTROL OF COMMUNICABLE EYE DISEASES THROUGH ENVIRONMENTAL SANITATION

Having discussed the effect of environmental sanitation on communicable eye diseases, let us now examine the possibilities and prospects of applying it as a control measure for communicable eye diseases and the need for further studies and research.

1. Fly Control

The probable importance of the fly as a vector in a number of diseases and the demonstrated reduction in diarrhoeal diseases and

epidemic seasonal conjunctivitis brought about by fly control have increased interest in the development of suitable methods for decreasing their population. Moreover, this interest is stimulated by other benefits, brought about by fly control, related to economical factors and the general well-being of the interested population. In fact, it has been proved that the reduction of the fly nuisance even increases the milk production in dairies.

After the Second World War, with the development of chlorinated hydrocarbon insecticides, it was at first believed that the long sought for solution was on hand. However, the proven ability of the fly to build up resistance to these insecticides to the extent that they fail as a control measure under field conditions soon turned out to be a big handicap to chemical control. This resistance of the fly to chlorinated hydrocarbon led to a shift to the use of organophosphorus compounds. The results of these compounds were encouraging for several years although their residual effect is for a comparatively short period, but now laboratory and field data show that susceptibility to this new insecticide can also be lost. Even without taking into consideration the above shortcomings, chemical control of the fly cannot be the principal technique to be used in operational programmes; there is no sense in keeping up and multiplying breeding places and on the other hand continuing to kill the flies which are multiplied by our activities; environmental sanitation remains the basic necessity. Moreover, chemical control alone by the means at present available may give disappointing results.

Fly control by the use of imagocides has also been tried. In rural and under-developed areas, the use of larvicides may provide an easier and more adaptable method for chemical control as a supplementary to basic sanitation. The main breeding points there, are generally manure heaps and human excreta. Due consideration should be given that such control may cause or augment the development of resistance in the fly population; also the larvicide should not be detrimental to the manure as fertilizer. There is no satisfactory answer to these problems, and there is plenty of room for further studies and research.

As already mentioned, the fly involved in the spread of conjunctivitis is not always of the same species or family. Sometimes more than

one fly is involved. Moreover, their ecology is closely related to local and climatic conditions. In order to devise better and more efficient control measures, all these factors must be further studied and identified. This is the only way to develop the best and least expensive method of control, attacking specifically the fly involved and reducing its population to a level that will make it inoffensive.

The need for further research work has also been recognized by the Expert Committee on Trachoma and in its second report it is mentioned "the Committee therefore recommends that studies be continued and coordinated on the different species of flies and other arthropods suspected of playing the part of vectors of seasonal epidemic conjunctivitis and trachoma in different regions, as well as on the development of effective and economically feasible methods of fly control applicable to different local conditions".

In summary adequate environmental sanitation measures are the basic requirement in controlling flies. Additional and useful help might be provided by the use of insecticides judiciously applied. Further research on the role of flies, their ecology and the development of better methods for their control are advisable and necessary.

2. Control of basic aspects of environmental sanitation related to Communicable Eye Diseases

Raising of the standard of living is definitely contributing in the control of communicable eye diseases. But standard of living is a component of many variables which do not necessarily affect communicable eye diseases. Neither these variables are so rigidly tied up together not allowing to apply or to give priority to one without the other. It is obvious that from the point of control of communicable eye diseases, it is interesting and necessary to recognize and evaluate the variables which are of some importance and to tackle them accordingly.

As has been said earlier, there is no clear-cut study of the relative importance of a single factor in environmental sanitation or of a limited number of them which shows the part it plays in the incidence of communicable eye diseases. It is advisable to differentiate the environmental sanitation factors from the socio-economic variables and to carry out the necessary research which will support and clarify

the already recognized importance of environmental sanitation. Such separation of socio-economic variables is already applied in the studies of different treatment for the control of trachoma and the same should be applied for environmental sanitation conditions.

From a recent study on similar lines which have been carried out on the relationship of environmental factors to enteric disease it strongly derives that incidence of acute infectious diarrhoeal disease may be reduced significantly through selective modification of specific environmental factors without regard to etiological or sociologic differences. This is indicative of what might be the case also for communicable eye diseases since sanitary facilities tend to improve personal hygiene.

Considering the above points, a basic research which warrants special attention seems to be the influence that safe ample and readily available water might have on communicable eye diseases.

On the other hand, the important sanitary improvements which probably affect communicable eye diseases,that is (a) an adequate water supply (b) a safe disposal of waste material mainly human and animal faecal matter, this taking into consideration their influence on the fly population, and (c) healthy housing, are also the basic sanitary facilities which form the first step for the improvement and promotion of environmental sanitation conditions.

Moreover in the present concept of community development more and more the influence of environmental sanitation is recognized and basic sanitation is becoming an indispensable part of programmes aiming at improvements in the standard of living. In this respect the control of communicable eye diseases will come as a part of the general improvement aimed at, when environmental sanitation is properly planned and incorporated in the community development programmes.

The fact that where communicable diseases exist, community development action is also required brings up the need for some correlated action for the benefit of both.

But to get the expected results, merely introducing the above improvements in environmental sanitation will not be enough. The change

has to be accepted and recognized by the people in order for them to make adequate use of the facilities provided and to maintain them properly. Moreover the people's full cooperation is indispensable and must be obtained. With this, we come to the field of health education.

3. Health education

Health education plays an essential part in the improvement of environmental sanitation. People must understand and realize the nature of the infection which they are risking, how they are preventing it by making proper use of the amenities provided; otherwise they will not use them. Water is the primordial agent of cleanliness and personal hygiene, but its use must be explained and demonstrated. In the same way, it is pointless to provide a healthy house if it is soon to deteriorate through lack of knowledge as to the value of maintenance. Ignorance is one of the links in the chain of poverty-ignorance-disease. Any programme of environmental sanitation must be tied up with health education activities.

IV PLACE OF ENVIRONMENTAL SANITATION IN AN OVERALL MASS CAMPAIGN AGAINST COMMUNICABLE EYE DISEASES

The recognition given to the importance of environmental sanitation constitutes at present only a lip service. It is expected that a detailed evaluation through the research described above (there is no detailed estimate of the specific importance of the role played by its various aspects) would stimulate some definite and concrete work in that direction. But on the other hand environmental sanitation is on the road called "higher standard of living" which leads to the accepted end-point of communicable eye disease. Postponement of measures tending to improve environmental sanitation and reliance on mass treatment only after a number of years might bring us back to where start has been made; this in addition to the continuous financial load which is being carried.

The application of a mass treatment campaign without changing the epidemiological factors of the disease will probably be only a palliative and not a solution. As pointed out by J. E. Gordon, in a paper on epidemiology, no disease has been conquered by attempts to treat every individual affected.

An attempt to extinguish a disease biologically is condemned to failure. A practical solution is to diminish the severity of the disease and to bring about an equilibrium by adjusting the environment to man or vice-versa. Here the first seems to be applicable. It is apparent that the long-range solution to this public health problem is the improvement of the environment, in which improved environmental sanitation plays a primary and substantial role.

In planning such a programme, the general effect of environmental sanitation over and above its role in the control of communicable eye diseases must not be overlooked. Already the influence of flies on diseases other than communicable eye diseases and mainly on diarrhoeas has been mentioned. When also the other improvements in environmental sanitation described above are effected the circle of influence will be enlarged and will embrace most of the other predominant diseases prevalent in the same areas where communicable eye diseases are endemic. This makes it all the more necessary to combine a mass treatment campaign against communicable eye diseases with a programme for developing environmental sanitation. It is the sure way toward the eradication of these diseases and the "sine qua non" condition within the activities for the general improvement of the standard of living, the ultimate goal of all our efforts and work.

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