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Review

Demystifying concepts of epidemic and causal association for public health students - A pedagogical approach to promote critical and analytical thinking

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Epidemiology is a difficult but an important subject in public health curriculum. As teachers, we need to be very innovative in teaching the core concepts in epidemiology since it is basically a research oriented subject that calls for enormous application of logic and mathematical skills. Very often, complex epidemiological concepts need to be communicated in simple language with the help of analogies and examples. Here is a case study on how a complicated concepts of "Epidemic" which is very often (mis)understood only in the context of infectious diseases and the concept of causal associations were communicated to Public Health students in a novel way to facilitate better learning. This method of pedagogical approach promotes critical and analytical thinking which is crucial in internalizing and applying concepts in epidemiology.

Key words: Epidemiology, teaching, pedagogy, anology, case study.

CASE STUDY

All of us are familiar with the word `Epidemic' but the understanding of this term is primarily restricted to the context of infectious diseases only, that is, epidemics of measles, malaria, cholera, typhoid etc. As Public Health students one should be aware that epidemics occur even outside the realm of infectious disease, that is, non communicable diseases or health behavior, example, smoking or accidents or depression etc. Let us have a re-look at the definition of epidemic.

Definition

The unusual occurrence in a community or region of a disease (example, malaria, tuberculosis), specific health-related behavior (example, smoking) or other health-related events (example, traffic accidents) clearly in excess of expected occurrence (Park, 2002). Let us desconstruct the components in the definition of epidemic:

Event occurrence + Excess + Expected frequency previous occurrence

Event occurrence= Any health related occurrence. It could be accidents (chopping of hands/fingers in factory, deafness) etc; behaviour (habits like alcoholism, smoking, absenteeism from work); psychological (Irritability, memory loss, depressions); sickness (cancer, TB, skin problems etc); reproductive (sterility, infertility, defective births).

What constitutes an epidemic?

For example, occurrence of unusually large number of chronic bronchitis or skin cancers occurring in the communities living in the vicinity of polluting factories can be considered as epidemic. It can be demonstrated that the rates of these diseases in these communities are higher than in areas where polluting factories do not exist. Occurrence of unusually large number of diseases in any community will invariably draw attention as it could be due to ongoing epidemic. It is important to remember that epidemiological conclusion rely heavily on the frequency (count) of occurrence of event (disease, disability etc).

Please note, while one may confirm the occurrence of epidemic by counting number of cases and establishing that the excess number of cases are significantly higher than the expected frequency one cannot say with conviction that polluting factories have `caused' chronic bronchitis or skin cancer in the community.

One of the important endeavour in any epidemic investigation is to find the cause of the given epidemic. In fact, finding the causal association or an etiology is one of the important functions in epidemiology (Gordis, 2009). Let us examine what constitutes a causal association?

Before we understand what constitutes a causal association, we need to understand what an association actually means in epidemiology. Occurrence of two events more often than that would be expected by chance are said to be associated (Park, 2002). Here it is important to appreciate that all associations need not necessarily be causal association instead they could be spurious association which means we are falsely attributing one event to be cause for the occurrence of other event.

Conceptually it is easy to understand causal association from our day to day life examples, exposure to fire causes burn injury, taking paracetomol causes a relief of fever or exposure to hot sun causes tanning of skin. Whereas it takes a little effort in understanding or communicating spurious association.

Analogy to help differentiate causal and spurious association

As an epidemiology teacher I have always found use of analogy with simple examples from our day to day life, a very useful method in teaching different concepts in epidemiology.

Let us forget about epidemiology and epidemic for a moment and let us enlighten ourselves with a story which describes a situation in which any one of us could find ourselves. The scenario is like this "suppose that you are planning to buy a flat in a particular apartment. A well-meaning neighbor in that apartment cautions you not to buy that particular flat. According to him the flat has a bad omen attached to it. He further declares that none of the earlier occupants could occupy it for more than one year. Now you will get curious about it and almost instinctively ask for the reason. Your good prospective neighbor will share several experiences of previous owners, who had bought the flat in question. He would recount his observations vividly narrating that the first owner met with an accident, the second one incurred heavy losses in business, the third one had marital problem which lead to divorce, fourth person had fracture and the fifth one never returned from office one day and is untraceable till date. , what more, all these happened within one year of their buying the flat and hardly lived in peace.

Having heard the narration, it would not be surprising if some of us would decide not to buy that flat But let us explore what factors influenced your decision to not to buy the flat?

The strongest factor would be that there is dreadful history linked to a flat, where none of the previous occupants stayed more than one year because of unfortunate incidents taking place in their lives. The result is speculation by neighborhood that the flat is cursed and has a bad omen attached to it.

Let us analyze the entire situation epidemiologically. A flat (place) is put up for sale and there is unpleasant experiences of previous occupants (person) in preceding years (time), had experienced unfortunate incidents like accident, business loss etc (occurrence events) in their lives, which had happened to five earlier buyers at a stretch (unexpected frequency). Keeping these in the background, the neighbour who has been a witness to such mishaps is now convinced that the flat has some unusual characteristic which they call "bad omen" (Hypothesis formation).

It now seems, we have found a pattern in this story .... emergence of "sequence of events", that is, "occupying a particular flat" in an apartment and experiencing unfortunate incidents within one year of buying the flat is a common factor in all the previous 5 owners. Also there is a second common factor, that is, there is time sequence which is called "temporal association" in epidemiology, that is, buying flat, residing in it followed by mishap occurring all happening one after other sequentially.

If the unfortunate incidents had occurred with one or two persons after buying the flat (usual frequency that could have been seen as mere coincidence), the prospective buyer would have certainly dismissed the hypothesis as freak (or chance occurrence, epidemiologically) and would have probably gone ahead and bought the flat. Since the incidents have occurred five times to the persons occupying the flat (unusual occurrence, even in our experiences) hence forcing the prospective buyer to take the hypothesis of "bad omen" seriously, that was put forward by the neighborhood.

Is it not astonishing that all of us actually apply epidemiological logic in our day to day life, a subject which we thought was a complicated and exclusive domain restricted to qualified professionals?

To those curious ones from among us inquisitive to know the actual ending of the story here is how it turned out to be.

Fortunately, there are few of us who are rational, who would not rest until we unearth the truth and put an end to the bluff. Probably a dare devil from among us may take it up as a challenge and decide to buy and reside in the flat, while being alert all the time. It paid well, one day all the residents of apartment see a familiar person being rounded by the police. It turns out that the guy happened to be brother of the person to whom the flat

originally belonged, and was unhappy that he was selling it off without giving his due share.. He therefore conspired criminally and was responsible directly or indirectly in the occurrence of those unfortunate events that had happened to five occupants. The intention was to bring disrepute to the flat so that nobody dared to buy the flat. So, while buying the flat and occurrence of unfortunate incidents were associated (because the events were occurring together) but what is important to note that the flat was not the `cause' for the mishaps in buyer's life within one year.

In the above analogy, we were wrongly attributing flat to be the causal factor for all the mishaps occurring, when it was not. This is called "spurious association" in epidemiology. The real cause was the third factor (the brother of the original owner) who conspired criminally to make those mishaps happen or in other words was responsible (causally associated) for the occurrence of all the five mishaps. Hence the occurrence of number of unfortunate incidents to the flat occupants could be considered 'epidemic' in conceptual term because the mishaps have occurred to five new buyers of the flat consecutively, the occurrence of five mishaps is clearly in excess of what could be expected by coincidence or chance.

CONCLUSION

Concurrence of two events (occupying of flat and mishap occurring) (phenomenon) more often (five times) than would be expected by chance, in other words, set of events occurring more frequently together than one would be expect by chance need not necessarily be causal association.

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