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Misuse of Malaria Bednets in Fishing Villages: Causes, Consequences, and Public Health Policy Solutions

Rohan Garg
Department of Global Health and Diseases, Case Western Reserve University, United States of America

Abstract*: The improper usage of malaria bednets, especially in fishing villages, is a growing concern for malaria control programs. By means of a thorough literature review, this paper explores the causes and effects of malaria bednet misuse in fishing villages and accordingly offers health policy solutions. Caused primarily by poverty and a lack of health education, bednet misuse deprives people of antimalarial protection and imperils marine ecosystems. In light of these causes and consequences, it is recommended that health policy leaders strengthen health education programs at the community level, incorporate follow-up programs into bednet distribution campaigns, and promote research on novel antimalarial insecticides that are more environmentally friendly. These strategies will enable malaria control programs to maximize proper bednet usage and minimize the deleterious consequences of bednet misuse.*

1. Introduction

Malaria is an infectious disease that is responsible for more than 200 million infections and 400,000 deaths each year [1]. Nearly half of the world's population is at risk of malaria, making malaria one of the toughest global health challenges for scientists and health policymakers. In order to reduce the burden of malaria on vulnerable populations, numerous antimalarial interventions have been implemented in endemic areas. Common interventions include indoor residual spraying and the distribution of antimalarial drugs and insecticide-treated bednets, among others [2].

Of these antimalarial interventions, the distribution of bednets is the most common—and arguably, the most important—malaria control strategy [3]. Insecticide-treated bednets serve two important antimalarial purposes: they serve as a physical barrier to prevent from mosquitoes from reaching humans, and as a biological barrier that kills mosquitoes by means of the insecticide. As a result, bednets have been effective in controlling and reducing malaria transmission. One study, for example, found that the introduction of bednets in southern Kenya reduced the entomological inoculation rate by more than 75% [4]. Another recent study found that malaria bednets successfully protected against malaria infections in Madagascar [5].

Although bednets tend to control and reduce malaria effectively, they are not as effective as they could be. This is largely due to the unanticipated misuse of bednets and in some cases, the lack of bednet usage. Several studies have examined the prevalence of barriers that lead to bednet nonuse. In particular, two meta-analyses revealed that cost, cultural beliefs, and lack of education are the main factors that lead to the avoidance of bednets in malarious communities [6,7].

While the avoidance of bednets is an issue that certainly needs to be addressed, the misuse of bednets is a growing concern that also demands attention from researchers and policymakers [8]. A number of recent studies have discussed the manners in which bednets are used for purposes other than protection against malaria. One study, for example, discovered that in coastal Kenya, bednets were frequently misused as window screenings, construction materials, and fishing nets [9]. Since bednet misuse is a growing concern for malaria control programs, this paper seeks to examine the causes and consequences of the unforeseen misuse of malaria bednets. Specifically, this paper focuses on bednet misuse in coastal and fishing villages because of the unique challenges that are found in these communities.

2. Causes of Bednet Misuse

In order to understand bednet misuse in fishing villages, it is important to first establish the factors that lead to bednet misuse. In malarious fishing communities, poverty is the primary cause of bednet misuse. In January 2015, a *New York Times* article exposed the harsh reality of bednet misuse by documenting how Tanzanians employ bednets as fishing nets [10]. When asked why his family uses bednets to fish rather than to protect against malaria, the leading cause of death in the region, fisherman

Mwewa Ndefi replied by saying, "I know it's not right, but without these nets, we wouldn't eat." Ndefi's reply highlights the struggle of many who must make the choice between starvation and disease on a daily basis. For these people whose subsistence depends on fishing, the fear of hunger and starvation eclipses the fear of illness and disease. Ideally, there should not have to be a choice between sustenance and protection from disease. However, as Ndefi's statement illustrates, poverty forces many to make the choice. Poverty is thus the main factor that leads people to use bednets for purposes other than protection against malaria.

In addition to poverty, the lack of education further contributes to bednet misuse. In the same *New York Times* article previously discussed, Ernest Shauri, a medical assistant at the Kirando Health Center in Tanzania, explained this lack of education when he said, "Some of them, they think that, you know, these European countries introduced some poison through mosquito nets and that they don't want us to have a child" [10]. Shauri's statement reveals the lack of education among residents in malarious communities and highlights the need to couple bednet distribution with health education. In the absence of health education programs, misconceptions and misunderstandings can lead people to use bednets for purposes other than antimalarial protection, or to avoid using bednets altogether.

Thus, poverty and lack of education are the two main factors that lead to bednet misuse in fishing villages. Generally speaking, these two factors lead many to view bednets as an easy way to subsist and to avoid starvation because for them, the importance of sustenance often transcends the fear of illness.

3. Consequences of Bednet Misuse

Unintended consequences have ensued from the widespread misuse of bednets. In order to better understand the significance of these consequences, however, it is important to first establish the prevalence of bednet misuse. Since the prevalence bednet misuse has not and cannot been completed documented, public health experts are not fully aware of the extent to which bednets are misused in fishing villages. However, in order to gain a better understanding of the prevalence of bednet misuse, a number of recent studies have investigated bednet usage in fishing villages. One such study reported that in seven lakeside villages in Tanzania, 87% of households admitted to using their bednets for fishing, and 97% of residents had observed other residents fishing with bednets [11]. Another study found that in villages along the coast of Lake Victoria, more than 50% of the nets used for fishing were antimalarial bednets [12]. The findings of these two studies suggest that bednet misuse is widespread in fishing villages and that the consequences of misuse are therefore likely to impact a sizeable fraction of people who live in malarious communities along bodies of water.

The most expected and obvious effect of bednet misuse has been the loss of antimalarial protection for the many who misuse bednets. Logically, when people choose to misuse bednets as fishing nets, they lose protection against malaria. If bednet misuse is indeed as widespread as the two previously mentioned studies indicated, then millions of people are compromising protection against the leading cause of death in order to avoid starvation.

While the loss of antimalarial protection may not be a surprising consequence, bednet misuse has had unforeseen effects, the most important of which is environmental degradation. Compared to ordinary fishing nets, malaria bednets have a mesh with much smaller holes that are designed to stop even the smallest of mosquitoes from passing through. As a result, when bednets are used for fishing, the fine mesh collects much more marine life than traditional fishing nets. According to Dan Strickman, a senior program officer for the Bill and Melinda Gates Foundation, "If you're using freshly treated [bed]nets in a smallish stream or in a bay in the lake, it's quite likely you're going to kill fish you don't intend to kill. That's definitely an environmental hazard" [10]. Environmental experts have expanded upon Strickman's observation, arguing that bednet fishing inadvertently leads to overfishing, disrupts the ecosystems of lakes and other bodies of water, and therefore endangers a vital source of food for millions of people who live in poverty. In this fashion, bednet misuse poses environmental threats that may ultimately imperil the survival of those who are misusing bednets in the first place.

Moreover, due to the insecticide that is sprayed on bednets, bednet misuse can endanger marine life and human health. Malaria bednets are sprayed with permethrin, an insecticide that the Environmental Protection Agency has classified as "likely to be carcinogenic to humans" and toxic for marine life [13]. For this reason—in order to minimize the deleterious effects of permethrin on marine life—leading bednets manufacturers typically add labels to their bednets that read, "Do not wash in a lake or a river." When asked about the environmental effects of bednet fishing, Egon Weinmueller, a public health executive for BASF, a major bednet manufacturer, explained, "We want to avoid any form of contamination" [10]. Weinmueller suggests that as a result of bednet fishing marine invertebrates are exposed to toxic permethrin, which can result in the death of fish that do not even come into contact with a bednet. The effects of permethrin, however, are not limited to marine life. Environmental experts warn that when people consume fish that have been trapped with a bednet, they can ingest unsafe

amounts of permethrin, which could increase their risk of contracting cancerous diseases down the line.

Therefore, the consequences of bednet misuse in fishing villages are manifold. In addition to depriving people of antimalarial protection, bednet misuse threatens vital fish populations and ecosystems and results in the consumption of toxins by humans. Public health leaders will need to implement a variety of policies and strategies to address these deleterious consequences.

4. Public Health Policy Solutions

In order to solve the issue of bednet misuse in fishing villages, three health policies and strategies are recommended: strengthen health education programs, incorporate follow-up programs, and promote research on environmentally friendly insecticides.

4.1. Strengthen Health Education Programs

This paper finds that one major cause of bednet misuse in fishing villages is the lack of health education that exists among many residents. Ernest Shauri, a medical assistant at the Kirando Health Center in Tanzania, revealed this lack of education when he told the *New York Times* about common public misconceptions about bednets [10]. Misconceptions and misunderstandings, such as the ones discussed by Shauri, are likely to lead people to either misuse bednets or avoid bednet usage altogether. Therefore, one might expect robust health education systems to promote proper bednet usage. To this end, several studies have investigated the relationship between health education level and bednet usage and have reported that indeed, higher health education levels correlate with higher levels of bednet usage [14-17]. Accordingly, in order to maximize proper bednet usage, malaria control programs should couple bednet distribution with health education programs for bednet users.

4.2 Incorporate Follow-Up Programs

Merely distributing bednets and educating residents, however, may not be sufficient to ensure that bednets are being used for their intended purposes. According to Mark Grabowsky, Malaria Program Manager at the Global Fund to Fight AIDS, Tuberculosis, and Malaria, "The biggest flaw in current malaria control efforts is that we need to invest in more disease surveillance systems to know the true story of what is really happening in Africa" [18]. Grabowsky's statement underscores the importance of surveillance programs that track the rates of bednet usage. Indeed, the only way to ensure proper bednet usage is to incorporate follow-up programs that periodically monitor bednet usage rates after bednets are distributed. Without such follow-up programs, people are more likely to either misuse bednets or avoid using bednets altogether. For this reason, the most successful malaria bednet campaigns—the Imagine No Malaria campaign and the Against Malaria Foundation—conduct regular check-ups after distribution to ensure proper use and care of the bednets [19]. Although it may be logistically impossible to coordinate follow-up programs for every bednet distribution in the world, follow-up programs should nonetheless be implemented to the extent possible.

4.3. Promote Research on Environmentally Friendly Insecticides

This paper finds that bednet misuse in fishing villages has had unforeseen environmental consequences. These environmental consequences are due, in large part, to permethrin, the insecticide that is sprayed on bednets. Permethrin has been classified by the Environmental Protection Agency as toxic to humans and marine life, and therefore imperils both human health and ecosystems when bednets are misused as fishing nets [13]. Accordingly, environmental experts recommend that funding be increased for research aimed at discovering novel bednet insecticides that are less toxic to humans and marine life [20]. Although this research will not necessarily promote proper bednet usage, it will minimize the deleterious environmental consequences of bednet fishing.

5. Conclusion

This paper has examined the primary causes and consequences of malaria bednet misuse in fishing villages. Bednet misuse can most commonly be attributed to poverty and a lack of health education. The misuse of bednets in fishing villages not only deprives people of antimalarial protection but also imperils fish populations and marine ecosystems. In light of these causes and consequences, this paper offers three main health policy solutions. Health education programs must be strengthened at the community level, follow-up programs ought to be incorporated into bednet distribution campaigns, and research on less toxic insecticides should be promoted. These three health policies and strategies will enable malaria control programs to maximize proper bednet usage and minimize the effects of bednet misuse. It is important to note, however, that poverty is an underlying factor that engenders bednet misuse. Therefore, while the three aforementioned policies will reduce bednet misuse, they will not completely eliminate all forms of bednet misuse. Infrastructure development in the areas of electricity, transportation, education, and primary healthcare

will be critical to ensuring the success of the three previously described strategies. Furthermore, since this paper focused exclusively on the misuse of bednets as fishing nets, additional analyses of this nature should be conducted on other forms of bednet misuse in order to gain a better understanding of bednet misuse in general.

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7. References

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