Hospital-based Analysis of the Effects of Mental Health Disorders on Asthma and Nutrition Disorder Admissions and the Cost Saving by Investing in Mental Health in Bhutan

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Abstract

Purposes: Aims to explicate the relationship between mental health and disease morbidity in Bhutan and the association between mental health and these two major public health concerns. Furthermore, we evaluated the added economic cost-savings benefit.

Methodology: Univariate linear regression was initially utilized and calculated and ran a Shapiro-Wilk W test and a Lagrange multiplier test.

Findings: It was indicated that for every one-unit increase in the number of admittances categorized as a mental health disorder within Bhutan, there is a significant average increase in health center admissions for asthma by 0.3601 and for nutritional disorders. It was estimated that the increase in the reduction of mental health disorders would increase the number of averted cases and the cost-saving to the Bhutanese healthcare systems to a significant level.

Research limitation: We were unable to infer whether there was an increase in health center admissions due to new disease development or to higher occurrences of existing symptoms caused by these diseases.

Practical implications: In order to decrease the burden of comorbidities associated with mental health disorders, proper dispersal of accessible resources in addition to investment in mental healthcare is necessary.

Social implications: Findings reinforce the need to properly invest in mental health services not only for its own sake but also for the significant morbidities associated with other diseases.

Originality: All data presented in this manuscript are true and valid and no data from the study has been or will be published separately.

Key Words: *mental health, asthma, nutritional disorders, Bhutan, cost-savings*

Introduction

The relationship between mental health disorders and disease morbidity and mortality has been well documented in a variety of settings[1-3]. Research has demonstrated that individuals with severe mental disorders have a life-expectancy 10 to 20 years lower than the general population[4]. In 2010, the Global Burden of Disease study revealed that 10.4% of total global disability-adjusted life years (DALYs), 2.3% of global years of life lost (YLLs), and 28.5% of global years lost

due to disability (YLD), were related to mental health disorders[5]. Despite mounting evidence, low-and-middle income countries spend less than $1 per capita on mental health services[6]. These figures highlight not only a need for greater attention and investment into mental health resources but also the multifaceted interplay between mental health disorders and physical health. While the effects of disease morbidity on mental health, such as on diabetes or heart disease, may be facile to understand, the effects that mental health disorders have on the development of physiological disorders are more obscure. A growing body of evidence has shown that mental health disorders can lead to the development of a variety of diseases[7-9]. Mechanistically, individuals who suffer from mental health issues may be less likely to consume a balanced diet or engage in other health promoting activities[10,11]. The cause of such actions can lead to higher disease morbidities within populations which experience increased rates of mental health disorders. However, within a larger macro context it is often difficult to assess the effect mental health disorders have on disease incidence and prevalence. As such, our team chose to investigate health center admission rates within the Kingdom of Bhutan as a proxy for disease morbidity at the population level. We examined the effect that mental health disorders have on health center admissions for two disease categories – asthma and nutritional disorders. This study offers the first assessment of the effect mental health disorders have on health center admissions onto an entire healthcare system for our disease categories.

Materials and Methods

Our data set was provided by the Bhutan Ministry of Health and was analyzed at the health center level for every major hospital and health center within the Kingdom of Bhutan. It included over 1,600,000 health center admissions from 2018. We specifically examined the effect that mental health disorders (classified as: depression, anxiety, and other mental health disorders) had on the health center admission rates for asthma and nutritional disorders (nutritional anemia, malnourishment, vitamin deficiencies). The classification of these diseases was diagnosed by a Bhutanese healthcare provider and the data were subsequently aggregated by the Ministry of Health. More specifically, an asthma health admission was classified as such if a health worker recorded that either the primary cause of admission was due to asthma-related reasons or if the patient presented with asthma-like symptoms, likewise for nutritional disorders and mental health disorders. A univariate linear regression was initially utilized to identify which variables were necessary to control for, these variables were subsequently used within our multiple linear regression models. Since the nation of Bhutan affords its citizens free access to universal health coverage, the usage of health center admission rates is a powerful tool for investigating disease morbidity, as there are comparatively few barriers to accessing care within health centers. Within all our models we controlled for the age of the patients (0-15,15-49, 49+), health center admission rates, population per hospital catchment, differences in disease morbidity among hospital catchment (using monthly reported sickness as a proxy for variances in health), hospital differences in mortality, and mental health discrepancies among regions (using health center admissions for mental health disorders across hospitals).

Using the 2011 "A Costing of Healthcare Services in Bhutan," report released by the Bhutanese Policy and Planning Division[12], and our results from our multiple linear regression model, our team calculated the economic savings related to a reduction in mental health disorders on admissions related to asthma and nutritional disorders. We used the average unit cost of admission in each healthcare facility type to find the average estimated cost-savings associated with a decrease in mental health disorders. In order to ensure accurate economic values, we stratified the total number of admissions for the two-specific illnesses we modeled by the three types of Bhutanese healthcare facilities (Primary Health Centers, District Hospitals, and Referral Hospitals) – which each have vastly different costs for admission.

In order to properly model our dependent variable, we ensured that each variable analyzed in our investigation was significantly correlated with the variable "Mental Health Disorders." Additionally, we ran a Shapiro-Wilk

W test to ensure that the variables were all normally distributed. We also checked for the requirement of homoscedasticity within our examined variables by running a Lagrange multiplier test. Lastly, we checked for the effects of multicollinearity within each of our models by ensuring that the variance inflation factor was below the accepted threshold of five. To assess the fit of our models, we report adjusted R^2 values as well as Pearson's R^2 values. SAS version 9.4 was utilized in conducting all of the statistical analysis for this study.

Results

Table 1: The results from our multiple linear regression model indicate that for every one-unit increase in the number of admittances categorized as a mental health disorder within Bhutan, there is a significant average increase in health center admissions for asthma by 0.3601 (95%CI: 0.2052, 0.5167) and for nutritional disorders by 2.049 (95%CI: 1.385, 2.714) the adjusted R^2 and Pearson's R^2 are displayed for each disease model as indicated in the table 1.

Disease Model Mental Health Disorder)	Parameter Estimates	95%CI	P-Value	Adj-R Value	Pearson's R2
Asthma	0.3601	(0.2052, 0.5167)	<0.001	0.6195	0.6871
Nutritional Disorders	2.049	(1.385, 2.714)	<0.001	0.8535	0.8765

Table 2: Estimated number of averted cases along with their associated savings onto the Bhutanese healthcare system with the respective percentage reduction in mental health disorders.

5% Decrease in Mental Health Disorders	Number of Averted Cases	Cost Saved in USD
Nutritional Disorders	2,697	$ 13,400
Asthma	947	$ 4,819
Mental Health Disorders	160	$ 3,412
Totals	3,804	$ 21,631
10% Decrease in Mental Health Disorders	Number of Averted Cases	Cost Saved in USD
Nutritional Disorders	5,394	$ 26,800
Asthma	1,894	$ 9,639
Mental Health Disorders	321	$ 6,824
Totals	7,609	$ 43,263
15% Decrease in Mental Health Disorders	Number of Averted Cases	Cost Saved in USD
Nutritional Disorders	8,091	$ 40,200
Asthma	2,840	$ 14,459
Mental Health Disorders	481	$ 10,236
Totals	11,412	$ 64,895

It was estimated that with the increase in the reduction of mental health disorders would increase the number of averted cases and the cost saving to the Bhutanese healthcare systems to a significant level as shown in the table 2.

Discussion

Our investigations within the Kingdom of Bhutan reveal the impact that mental health disorders have on increasing health center admissions for asthma and nutritional disorders. Additionally, our analysis shows that a decrease in rates of mental health disorders would result in a cost-savings onto the Bhutanese healthcare system. A 15% reduction in mental health disorders can lead to an annual savings close to $65,000 and 11,000 fewer health center admission rates. While these savings may not seem notable, it is important to realize that Bhutan has a particularly low cost of health center admittance; as low as $2.32 per health center admittance. Neighboring nations would likely experience similar if not greater cost-savings. Countries like Nepal and India have significantly higher average cost of health center admittance, with costs of $6.58 and $18.90, respectively[13,14].

The relationship between asthma and mental health, although not well understood, has been studied extensively. Asthma remains a major public health concern, particularly in low-and middle-income countries, and has often been associated with mental health disorders[15]. Although the direction of causality remains unclear, evidence from one group found that depression more often leads to incident asthma than vice versa[16,17]. It does remain clear, however, that there have been no studies fully recognizing the extent to which each contributes independently[18]. Our own research demonstrates a significant linkage between mental health cases and asthma hospital admissions in Bhutan. More specifically, on average, for an increase in 100 mental health disorder admissions, 36 more people were found to be admitted to a health center due to asthma related concerns. In past literature, asthma and mental health disorders have been shown to co-occur at higher rates than expected, supporting a link between the two disorders[16,19]. Whether the coexistence of these co-morbidities has underlying pathophysiological mechanisms or is due to socio-environmental influences has yet to be further studied. However, the impact of psychological factors on asthma has been well described, specifically in the domains of affect, behavior, and cognition[20]. One systematic review of existing literature found that psychological factors play a role in as many as 80-90% of asthma deaths[20]. It is conceivable that negative thoughts or life experiences could play a role in poor breathing functions, such as dyspnea, and other disease activity. In fact, stress-induced or emotionally triggered asthma attacks are no rare occurrence. In an 18-month prospective study of children with asthma, those who had experienced a negative life event had an increased risk of an asthma attack by nearly 2-fold[21]. Additionally, a Patient Health Questionnaire (PHQ-9) developed to examine the impact of depression and anxiety on reduced bronchodilator response (BDR) found that major depression was more prevalent in participants with asthma (8.9%) than those without (2.5%)[17]. While much research is left to be investigated, current literature highlights the association that mental health disorders have on increasing rates of asthma related symptoms as well as new disease cases.

Despite myriad pharmacologic treatments and asthma education worldwide, asthma control can be not only difficult to implement but also hard to maintain. Triggers can be inescapable, whether they be genetic or environmental, and psychological stresses can impede proper medication adherence. In a 2013 review of psychological dysfunction in asthma, it was found that maladaptive breathing behaviors and dysfunctional beliefs about the disease were associated with poor disease control and asthma deaths[20]. Much like mental health, asthma does not have a one size fits all treatment, and varying social determinants can result in profound effects on people's health status. Social pressures, poor housing environments, exposure to pollution, urbanization, and a multitude of other factors are precursors to this multifactorial disease. Unsurprisingly these social determinants have also shown to increase incidence of mental health disorders. These factors increase differential exposure to asthma pathogens, contributing to the experience of psychological stress, which is increasingly linked to asthma expression[22].

Similar to the illness of asthma, nutritional disorders are a significant public health issue in developed and developing countries[23]. The connection between mental

illness and nutrition is one which is multifaceted and has been well reported in literature. The bulk of research done has been conducted on the influence of poor diet and nutritional deficiencies resulting in mental health issues. However, the converse has also been considered in a variety of settings. A 2015 cross-sectional study of 378 patients found that the prevalence of anemia among chronic psychiatry patients was more frequent than the general population[23]. Correspondingly, our results indicated that on average for an increase in 100 mental health disorder admissions, 201 more Bhutanese were admitted to health centers for nutritional related disorders. Understandably, mental health illnesses can have adverse effects on individuals' physical well-being in a variety of manners. Increasingly there is evidence showing that depression has a significant effect on the diet of those suffering from a mental health disorder[24]. A study conducted in 2019, found that depressive symptoms among foreign-born Latinas were associated with lower Healthy Eating Index scores, an increased intake of nutrient poor foods, and decreased fruit and vegetable consumption[24]. From both a scientific and an intuitive perspective, there are many ways poor mental health can negatively affect nutrition consumption and lead to increased rates of nutritional disorders and anemia.

It is also important to note that domestic violence can lead to an increase in depression, anxiety, substance abuse, post-traumatic stress disorder, and other mental health conditions [25]. This is worth mentioning in the context of Bhutan, as acceptance of domestic violence is particularly high in this nation, with about 70 percent of women accepting violence from their husbands[26]. According to an analysis conducted by the World Bank on Bhutan, when results of domestic violence were compared with district levels of anemia, the association was significantly high[26]. Lastly, poor diet is used as a coping mechanism for various mental health illnesses. For example, binge eating disorder (BED) and anorexia nervosa (AN) have been linked to psychological triggers including low self-esteem, traumatic events, and sexual abuse[27,28]. Patients will often find themselves coping with social pressures or past traumas through eating dysregulation, creating a vicious cycle that can lead to a slew of nutritional insufficiencies and disorders[27]. These findings provide a clear mechanism to understanding how high prevalence of mental health disorders can lead to increases in a variety of nutritional disorders.

Like many resources limited countries, Bhutan struggles to properly invest in mental health services – investing only 1% of their health budget in this category[26]. Due to the few mental health resources available, many individuals could find themselves unable to receive the proper help they require. As inhabitants are predominantly widespread throughout rural regions and have diverse cultural practices, organizing mental health services has resulted to be challenging[18]. Lack of funding, mental healthcare resources, and psychiatrists, in addition to the absence of mental health legislation, remain key issues in adequately addressing mental health and its apparent linkages at hand.

Limitations

While our analysis specifically controlled for discrepancies in mental health disorders across regions, we were unable to infer whether there was an increase in health center admissions due to new disease development or to higher occurrences of existing symptoms caused by these diseases. In other words, we could not delineate whether there was an increase in asthma and nutritional disorders due to new disease cases arising or due to increased symptoms of existing cases. However, research has indicated that both avenues have been linked to mental health disorders – an increase in both symptoms of existing diseases and the creation of new disease cases due to mental health disorders. Additionally, the majority of cost figures were derived from the averages of each specific health center category. Due to this, it is possible that the average cost of admittance at a specific health center is not reflective of the actual cost of admittance for the specific disease modeled.

Conclusion

Our study outlines the specific impact that mental health disorders have on asthma and nutritional disorder admissions in Bhutan. In order to decrease the burden of

comorbidities associated with mental health disorders, proper dispersal of accessible resources in addition to investment in mental healthcare is necessary. This research also reveals the added economic benefit which may be incurred when resource limited nations invest in mental health resources for their citizens. Our findings reinforce the need to properly invest in mental health services not only for its own sake but also for the significant morbidities associated with other diseases. In this regard, to decrease the burden of comorbidities associated with mental health disorders, proper dispersal of accessible resources in addition to investment in mental healthcare is essential.

Declarations:

Ethical approval and consent to participate: Data usage agreement has been drawn with the Health Information and Management System, Ministry of Health.

Consent for publication: All authors unanimously agreed and consented to send the manuscript to Journal of Health Research for publication.

Availability of data and materials: All data generated or analyzed during this review were as prescribed in the data usage agreement

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