CHARLES UNIVERSITY
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Disaster, war, conflict, complex emergencies and international public health risks

PhD Dissertation – Autoreferat

Preventive Medicine

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Résumé of the project

Introduction

In the 21st century, the prevention of illness, disease and risks to health ushered in public health and medical practice with mixed results. War, hybrid warfare, conflict, complex emergencies and disasters remain significant public health risks and areas of strategic concern; focused epidemiological study in health policy remains elusive. The paradigm shift from major world powers leading global affairs and affecting global health to multiple state and non-state actors vying for power and influence regionally has possibly led to an increase in small scale and low intensity conflict with high morbidity and mortality, including both noncommunicable (NCD) and communicable diseases.

This global shift has led to an increase in human suffering and is indirectly proportional to the quantifiable decrease of health and food security, as well as a higher mortality rate. This thesis describes and elucidates these seemingly disparate streams of public health, applying epidemiological methods and evidence-based practice and concluding that the prevention of disease needs a global reset.

Background

The basic research carried out for this PhD project includes: 1) mental health surveys and trauma associated with war; 2) the migration of, and the need for, advanced medical personnel and their services in war and hybrid warfare, including how the negative movement or adverse flow through 'brain drain' of doctors affects disaster; 3) a quantitative study of infectious diseases, health and human security associated with state stability and the mitigation of state failure; 4) a qualitative food security review, the origins of food security and its impact; and 5) the general concepts of health security and the need for institutions that promote the prevention of disease (Quinn et al., 2011; Quinn et al., 2013; Quinn et al., 2014). Methodologies for each are discussed separately.

This research project is independent, apolitical and not tied to any national process or platform. The basic conclusions of this qualitative and quantitative research are that state stability is directly linked to health security and that there are identifiable health metrics and indicators for both 'health' and for 'state stability' that can be measured directly and in aggregate with valid results and novel conclusions. The end results are that war and violence are bad, and there are multiple support structures that need to be bolstered in support of health security for communities. Additional studies based on this research have also concluded that doctor and healthcare worker migrations share similar trends of economic incentives at economies of scale, among others.

Most importantly, we conclude that war, hybrid warfare, conflict, disasters and complex emergencies and their negative and debilitating effects on health and human security can be prevented. 1The deleterious effects of state failure can be averted through an evidence-based prevention policy, risk assessment models and by quantifying the disease risk of communities in fragile and failed states. Furthermore, I conclude that, unlike state fragility and state failure, state stability and health security can be predicted. Further research is needed to describe these features more clearly with respect to disease and the state.

The direct and indirect impact of disasters, wars and complex emergencies on the health and well-being of populations is qualitatively clear; however, implementing epidemiological data analyses and basic hygiene study methods have not yet been comprehensively carried out to quantify the human, health and food security risks that negatively affect health across nations. Essentially, epidemiological, hygiene and public health principles are applicable to the growth, stability and development of fragile and failed states. We portray this in a positive feedback loop of health security engendering more state stability and in the negative feedback loop of a lack of health security engendering state failure. Some basic conclusions based on this research are that both communicable diseases and NCDs play roles in health security and that the growing incidence or prevalence of preventable illnesses leads to state fragility and failure.

This interdisciplinary research project was initiated in 2007 and has been further pursued since the beginning of the PhD in 2009. The preliminary phase included a review of human security challenges in the 21st century by examining multiple perspectives. This paper integrates several perspectives and disciplines – epidemiology, hygiene, medicine, public health and global affairs. This evidence-based research reveals that the delineation between a natural and human-induced disaster has become blurred over time. It shows that, despite the many health indicators not influenced by human action, many truly are and the underlying factors that contribute to the short-term, medium-term and long-term impacts of such complex emergency events on populations and their public health are quantifiable, in some stages predictable, and (we propose) preventable.

Core Project: introduction

In clinical medicine, risk refers to the possible peril related to a particular condition or treatment. For example, risk may be derived directly from an illness or indirectly from the process or method involved in the diagnosis and/or treatment of that illness. Epidemiology is a bit more specific about risk, offering: *attributable risk* or the amount or proportion of incidence of disease or death (or risk of disease or death) in individuals exposed to a specific risk factor that can be attributed to exposure to that factor (the difference in the risk for unexposed or exposed individuals); *empiric risk*, which is the probability that a trait will occur or recur in a family based solely on experience rather than knowledge of the causative mechanism; *genetic risk*, which is the probability that a trait will occur or recur in a family based on knowledge of its genetic pattern of transmission; and, finally, *relative risk*, which is the ratio of the incidence rate among individuals with a given risk factor to the incidence rate among those without the disease or other outcomes.

When evaluating environmental risk and its perception, psychosocial and psychosomatic factors may be of fundamental importance for public health programming and the promotion of quality of life. This applies not only in the case of indoor environment related complaints but also to non-ionizing electromagnetic radiation and electro-ionic microclimate, among many others (Quinn and Bencko, 2010).

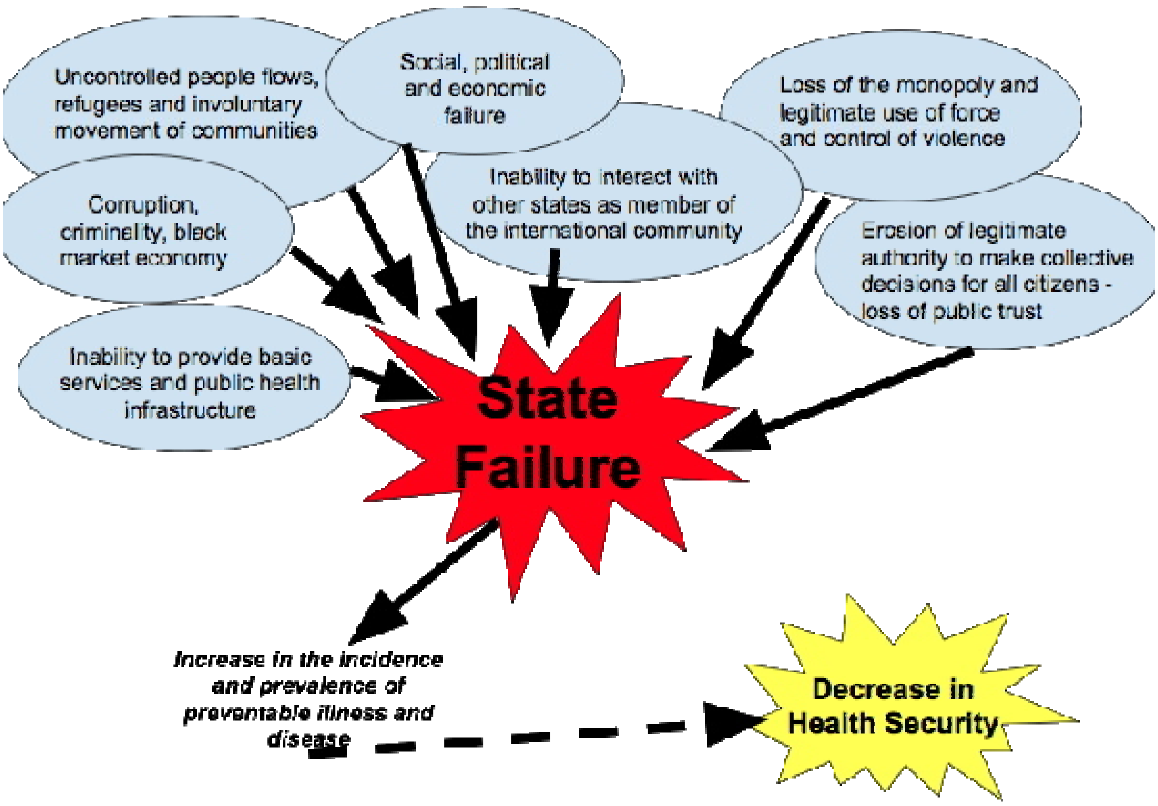
Public health crisis in war and conflict: Failed states and health security

The public health status of populations is multifactorial and linked to war and conflict. Public health crisis can erupt when states go to war and health security is reduced. This study design reviews (in aggregate) multiple indices of human security, human development and the legitimacy of the state in order to describe the predicted global health portrait. We find that the paradigm shift of large global powers to non-state actors and proxies impact regional influence through scaled conflict and present major global health challenges for policy makers. Small-scale conflict with large-scale violence threatens health security. The paper concludes that health security is directly proportional to state security.

Introduction

Health security is directly proportional to state sovereignty, legitimacy and the mandate to provide health services (Quinn et al., 2013; Quinn, Zeleny and Bencko, 2014). Health security is negatively impacted across fragile and failed states, while regional conflicts intensify and manifest globally (Williams, 2008). The connection between violence and health is difficult to study, and many considerations regarding approach have been applied. This aggregate research through the core measures of country status and multiple development indices in public health and health indicators provides rigorous information regarding how much the general indices relate to tangible health security. By proxy, health security is implemented by incidence of preventable disease.

Figure 1.



Aggregate research describes combined data from several measurements, such as those related to health security and multifaceted concepts of conflict and health. Based on this aggregate research model and at the individual level of health, it is observed that health behaviors and outcomes have multilevel determinants and can be predictable (Marshall, 2008; Von Korff, 2008). The perspective of multilevel analysis acknowledges the importance of both individual and environmental variables in determining health behaviors and outcomes at the level of the indivisible unit and in conceptualizing multiple levels of organization relevant to a particular research question and the individual (Diez-Roux, 2009).

Objectives and methods

We used aggregate analysis with spread data, constructing a model by merging diseases (cholera, tuberculosis (TB), malaria and measles) into a single variable: 'agreg', which is a simple sum of cumulative incidence. Incidence can be described as a rather rough variable to implement in such an analysis, as attributes of diseases used in the aggregate analysis (measles, cholera, TB and malaria) are extremely diverse. These ailments affect different populations globally and are generally widely dissimilar; nonetheless, they are preventable.

Statistically, however, generality is not lost, as disease burden, public health infrastructure and prevention programs aimed at disease mitigation when following best practices for these diseases are similar in nature. For example, measles, cholera and TB are preventable through vaccination (albeit with varying seroconversion and efficacy rates) and malaria is preventable through primary prevention measures (chemoprophylaxis, mosquito bed nets and sprays, prompt diagnosis, and initiation of effective therapy). Diagnosis of these diseases can be performed clinically or through diagnostic procedures. However, these diseases can be difficult and expensive for poorly resourced public health infrastructures to prevent and treat.

Finally, measles, cholera, TB and malaria are endemic in most of the resource-poor and developing world; these regions are where fragile and failed states originate. Thus, the argument that populations are or would be indifferent about getting these diseases is rejected. This variable is the proxy for health security, as a high risk of exposure to deadly infectious diseases is a prime example of inadequate health security and the variable itself is not interdependent with other variables (indices implemented with this research do not have incidence of infectious diseases included), which allows for clear statistical analysis.

The multiple indices used in this analysis involve high-level data composed of a multitude and combination of individual data. By combining multiple indices with data sets for economic, health, social and behavioral, political, security and overall health status, this aggregate research concludes regarding human health trends in the data – i.e. the health security environment or portrait. The indices used are listed in Table 1.

Table 1. Summary of indices implemented
Failed States Index (FSI)
State Fragility Index (SFi)
Public Integrity Index (PII)
Political Stability Index (PSI)
Human Security Index (HSI)
Economic Fabric Index (EFI)
Environmental Fabric Index (EnFI)
Social Fabric Index (SFI)
Literacy rate (LR)
Life expectancy at birth
Specific diseases in the population: *measles, cholera, TB and malaria*

Failed States Index (FSI)

The US Fund for Peace publishes the annual FSI listing those countries that are failed states or at great risk of becoming so. There are multiple metrics that rely on key social, political and economic indicators that compose this index. The reason for including this index in the aggregate analysis is that the included diseases are preventable through vaccination programs promoted by state health ministries and departments, as well as through basic public health and hygiene measures (clean water, access to night-time mosquito nets or repellents, immunization and educational programs, etc.) based on health security infrastructure promoted by organized and properly funded state governmental health institutions.

Humanitarian aid programs are great but can be very inconsistent, have difficult-to-achieve successes that are not reproducible and are under donor strain given global social, political and environmental complex emergencies; often, strong state institutions would have been a better alternative when possible (Hughes, 2009; Moyo, 2011). The assumption and expectation of using the FSI for this aggregate analysis is that states without, or with decreased exposure to, conflict and war will be stronger states, will not be fragile or failing states and will promote the health security of the population (correlated with an assumed lower incidence of measles, cholera, TB and malaria).

State Fragility Index (SFi)

The SFi combines scores measuring two essential qualities of state performance: effectiveness and legitimacy. These two quality indices combine scores on distinct measures of the key performance dimensions of security, governance, economics and social development. The SFi utilizes a set of eight indicators to measure state fragility in previous years and examines changes in each indicator over time (Marshall and Coll, 2011). The SFi helps look at overall state fragility.

Human Security Index (HSI)

The HSI covers 232 countries and societies. It is not intended to become an annual index for publication but is rather a result of over 25 years of indicator development. Steady advances in characterizing different aspects of the human condition have resulted in indicators – covering an increasing number of countries – on a wide variety of subjects; the HSI is an attempt to create an index on people-centric human security (HSI, 2012). Components of the HSI include data from the EFI, EnFI and the SFI. In sum, the HSI can be considered as an index of 30+ leading economic, environmental and social indicators related to health and state stability (HSI, 2012).

Economic Fabric Index (EFI)

The EFI uses the gross domestic product (GDP) per capita, adjusted for pricing, purchasing power parity (PPP), equality of income distribution (income and finance distribution) and financial and economic governance (which is described as the risk of hardship through unsustainable trade or debt or from a catastrophic healthcare governance disaster). The EFI is implemented in this aggregate analysis for the economic status of the population and is the reason why the GDP per capita is not included alone, as it is of much bigger interest when combined with other main economic factors (especially income distribution) than as a standalone variable. Economic security is directly linked to health security.

Environmental Fabric Index (EnFI)

The EnFI examines environmental vulnerability, environmental protection (access to clean water, etc.), policies and deliverables and overall environmental sustainability in a population. The EnFI is the main variable containing environmental information for the HSI.

Social Fabric Index (SFI)

The SFI lists health education, information empowerment and protection of (and benefits from) diversity and peacefulness governance, including protection from official or illegal corrupt practices and food security (HSI, 2012). This is very powerful, as the information in this combined index is much more valuable because it captures a descriptive side of society.

Literacy Rate (LR)

LR is the percentage of people who are literate in a given country. The importance of this factor is indirect – it is expected that a more literate population would be able to inform itself better about the prevention of disease (especially measles, cholera, TB and malaria), as well as educate itself about health promotion in general for the family unit, and would be able to demand health security promotion and measures in the form of policy from state institutions. An illiterate population increases public health risk and may be linked to poor health security status and state fragility.

Life expectancy at birth

This variable serves as the comparison of the results in terms of the extent to which the indexes explain the incidence of preventable lethal diseases and the extent to which they explain actual life expectancy. In global health, policy and resources are devoted to reducing the incidence, duration and severity of major diseases that cause morbidity (but not always their rate of mortality) and to reducing their negative impact on human life (WHO, 2014).

Infant mortality and political crisis are not proposed to be linked; however, infant mortality is a better indicator for democracies prone to failure than it is for less democratic states. It is also an indication of maternal health security (Quinn, Zeleny and Bencko, 2014; Rotberg, 2004). It is important to capture both fatal and non-fatal health outcomes in a summary measure of average levels of population health. Healthy life expectancy (HALE) at birth adds up the expectation of life for different health states, adjusting for severity distribution; this makes it sensitive to changes over time or differences between countries in the severity distribution of healthy states (Alesina et al., 1996).

Preventable illness and infectious diseases

Conflict and war are inextricably linked to human disease and deterioration in health security (Quinn et al., 2014; Quinn, Zeleny and Bencko, 2013; Helman, 1993; Lymon, 1993; Ottaway and Mair, 2004). Many infectious diseases are preventable through vaccination, simple prevention measures and basic access to standardized primary healthcare. Measles, cholera and TB have been selected as the leading infectious diseases in order to find linkages to health security reduction in conflict areas.

Routine measles vaccinations for children, combined with mass immunization campaigns in countries with low routine coverage, is a key public health strategy to reduce global measles deaths (CDC, 2014; Peltola, 1994). More than 20 million people are affected by measles each year (CDC, 2014). The cholera disease burden is estimated to be 3 to 5 million cases and 100,000 to 120,000 deaths due to cholera every year. Approximately 80% of cases can be successfully treated with oral rehydration salts and even prevented via vaccine (WHO, 2014). Areas with low sanitation and no potable water due to war and conflict are at increased risk of cholera. It is estimated that approximately one third of the world's population is infected with TB, that there are 8 to 9 million new cases of TB and nearly 2 million deaths each year from TB (Peltola, 1994). Globally, malaria is the most important parasitic disease that threatens health security annually.

Results

The analysis of the data is done through a two-stage least squares (2SLS) method (Quinn, Zeleny and Bencko, 2013), where it is instrumented with the FSI and by the SFI. The reason is that the FSI is a general observation index and, thus, it is expected to be correlated by any variable that is not put into the equation, making it residual. The SFI, however, is very highly correlated with the FSI and is a restricted index; thus, to assume that its correlation with non-included variables is non-existent or at least very small would be indirect. For most variables, observations for different years are not identified; the only data available is in a cross-sectional format. In order to counter heteroscedasticity, White robust residuals are implemented.

For the 2SLS estimation, the FSI is first estimated using the SFI. The results are in Table 2.

Table 2. Linear regression with White robust residuals				
Dependent variable = FSI				
Number of observations	83	R-squared	0.9018	
F(1,81)	743.79	Root MSE	7.4413	
Prob>F	0.000			
Variable	Coefficient	Standard error	t-statistic	P>|t|
Constant	**164.6428**	3.784455	43.51	0.000
SFI	-159.9359	5.864374	43.51	0.000

To answer the initial question, the most natural testing method is a simple linear regression in the form of:

$$agreg = \alpha + \beta * IVFSI + \varepsilon \quad \text{(equation 1)}$$

This trivial method offers FSI as a significant (p-value < 0.001) variable for explaining the incidence of preventable infectious diseases. However, the overall explanatory power seems rather limited, as the coefficient of determination is only 0.10. In order to get a more practical answer, an extended model is implemented. The model takes the following form:

$$agreg = \beta_0 + \beta_1 * IVFSI + \beta_2 * PI + \beta_3 * GI + \beta_4 * EFI + \beta_5 * EnFI + \varepsilon$$ (equation 2)

Instead of the HSI, the main three parts are used: the EFI, EnFI and SFI. The SFI is, however, already being used for FSI instrumenting, so it is not used in the estimation by itself. The model estimation results are in Table 3.

Table 3. Linear regression with White robust residuals

Dependent variable = agreg

Number of observations	141	R-squared	0.2522	
F(4,136)	8.72	Root MSE	5161.9	
Prob>F	0.000			
Variable	Coefficient	Standard error	t-statistic	P>|t|
Constant	16509.01	5476.253	3.01	0.003
IVFSI	2.689046	25.52681	0.11	0.916
PI	-167.6503	64.6096	-2.59	0.011
GI	-36.25174	73.51627	-0.49	0.623
EFI	-10629.49	7259.811	-1.46	0.147
EnFI	-10941.05	7046.882	-1.55	0.125

The explanatory power of the model has improved significantly to 0.2253. While that is still not high, given the size and variance of the examined sample, it is not insignificant. What is more intriguing is the specific results themselves – FSI and Government

Instability (GI) turn out to be completely insignificant with respect to the dependent variable, while Policy Institutions (PI) takes over as the main explanatory variable.

The EFI and the EnFI are also fairly significant, but surprisingly at a rather lower level. Yet their coefficients have a higher-level coefficient compared to other variables, suggesting that their potential impact may be much higher. This means that the FSI on a global scale is unable to explain incidence of infectious diseases, which may be against conventional expectations. The model also provides a prompt explanation: the FSI mostly contains government stability-themed components.

With GI by itself being irrelevant, the FSI takes over the insignificance as well. The problem is much more technical than social, as the results suggest that what truly matters is the ability to take action through strong institutions and policy implementation; as long as the institutions necessary for such a move exist and are operational, the status of the remainder of the state's public sector is irrelevant.

Higher magnitude factors are population income and environmental conditions. The former is the obvious indicator of whether people can prevent contamination by infectious diseases by themselves, while the latter is a good indicator of the likelihood of contracting the disease given environmental conditions. Thus, while external conflict or general government instability may have an adverse effect on the creation of necessary policy institutions, it is the institutions themselves and fundamental factors (economic and environmental conditions) that play a major role in infectious disease prevention and possibly in ensuring health security for populations.

The main issue of the previous model is that health security is not only the incidence of preventable infectious diseases, but includes many other factors. Thus, these results reflect only a part of the portrait. So, in order to solidify these results, the same model is created but with a wider dependent variable, one that includes health security and (unfortunately) many more variables. The average result of the smaller and larger models should then be a more accurate result than that of any one model. For the dependent variable, life expectancy (LE) is used. The model calculation is seen below:

$$le = \beta_0 + \beta_1 * IVFSI + \beta_2 * PI + \beta_3 * GI + \beta_4 * EFI + \beta_5 * EnFI + \beta_6 * agreg + \varepsilon$$

(equation 3)

The results of its estimation are given in Table 4.

Table 4. Linear regression with White robust residuals				
Dependent variable = LE				
Number of observations	83	R-squared	0.6907	
F(6, 76)	35.65	Root MSE	5.4144	
Prob>F	0.0000			
Variable	Coefficient	Standard error	t-statistic	P>|t|
Constant	35.60688	6.432873	5.54	0.000
IVFSI	-.1775256	.0430917	-4.12	0.000
PI	.210276	.1081607	1.94	0.056
GI	.0656733	.1495496	0.44	0.662
EFI	23.60701	10.20632	2.31	0.000
EnFI	3.911065	6.798452	0.58	0.567
Agreg	-.0004447	.0001607	-2.77	0.007

The results are quite different from the previous case. The FSI is very significant in this model, with life expectancy decreasing in increasing values of FSI (as would be predicted). PI remains at approximately the top of the explanatory variables, as it is still highly significant. The EnFI and EFI no longer share the same importance – the EFI has almost six times as much of an impact in scale than the EnFI, which has lost importance in this model and has become barely significant.

As for scale, since the FSI is approximately 100 times larger in units than the EFI and the EnFI, it has about the same effect on life expectancy as the level of income, only in the opposite direction. The economic situation of a country or population has then about twice as much impact as these other variables. Finally, the coefficient of determination is up to 0.6907, which is more than double that of the previous model. This suggests that there is much less unexplained variance than in the previous case, which is both expected and important, as it should be the case that aggregate variables (in our case, the indices) are better at explaining other aggregate variables than concrete ones.

Comparing the results of both models, they fit perfectly. For the EFI and the EnFI, we made a case for health security to be well instrumented by incidence of preventable infectious diseases. Their switching roles when it comes to diseases and life expectancy is perfectly logical, because life expectancy requires significantly more factors (influenced by an individual's income) than the prevention of infectious diseases. Furthermore, life expectancy has more factors involved that are more important than the environment alone. Avoiding mosquitoes and other infectious but preventable illnesses from birth in sub-Saharan Africa is extremely difficult, but an individual can extend their life through a healthy lifestyle, including access to nutritious and abundant food and access to quality primary healthcare and disease prevention in general. This is the environment that engenders health security.

Conclusion

This aggregate research has reviewed indices and variables related to the public health of populations in countries that are in crisis, are fragile and many that are failed states. The FSI, used to measure the quality of national-level institutions, does not capture all variables related to state fragility and health. An explanation is provided by the EFI and the EnFI. They both have a very large impact on the incidence of preventable infectious diseases and give a new context to the issues faced by states in providing environments for health security.

The matter is divided into two levels: the primary cause and the resolution of effects. The primary cause seems to be the quality of the environment, which greatly reduces the incidence of preventable infectious diseases. In parallel, there is the nationwide issue of improving the quality of the environment, which is impossible at only the individual or citizen level. Environmental policy is difficult in each state, as all states share the same global environment and poor health effects from a bad environment are transborder. On the other hand, personal wealth is capable of mitigating the problems caused by a poor environment (personal wealth is captured by the EFI, as its main component is income per capita). Indeed, economic security can dictate health security.

To summarize, the data suggests that, to improve health security in fragile and failed states, policy focus should seek to resuscitate fragile states, mitigate the loss of failed states, provide health security in the form of prevention, prevent environmental degradation, engender economic security, improve environmental conditions that affect health and, finally, empower the population to counter the impact of poor environmental conditions.

Limitations

The FSI is contested as a good aggregate to review the listed variables. Some opponent researchers describe the index as deficient, stating that it is counterproductive to states as diverse as Colombia, Malawi, Somalia, Iraq, Haiti and Tajikistan with data in aggregate. The main points of contention with the FSI relate to its inability to distinguish capacity gaps, security gaps and legitimacy gaps that the states experience, that these gaps often do not coincide in a given country, and that the logical responses to each of the three gaps diverge in significant ways (Corbett et al., 2003). Lastly, the status of HIV/AIDS and associated data were not directly used in this analysis as health indicators due to the disproportionate geographical representation and regional disease burden.

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