Examining Multiple Health Behaviors

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Abstract

Health behaviors have been extensively studied as predictors of disease; however, these behaviors may interact and intersect to amplify or ameliorate risks of predicted disease outcomes. Breadth of study is needed to examine how single antecedents may act to influence multiple health behaviors, and how multiple health behaviors may predict other behaviors and/or interact to influence the occurrence of disease outcomes. Better understanding of how behaviors interact and impact health is necessary to identify the appropriate leverage points for the evolution of health behavior theory, and the promotion of multiple health behavior change.

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Risky health behaviors frequently co-occur and culminate in disease and disability. In the United States, these risk behaviors include poor diet, inadequate water consumption, smoking, a lack of physical activity, poor sleep, heavy alcohol consumption, and illicit drug use. According to Fine et al. (2004), a majority of adults living in the United States meet criteria for two or more risk behaviors. Multiple risk behaviors may interact to form a lifestyle driven by environmental and cultural antecedents which culminate in interactive forces that influence disease and disability.

Health behavior theory and research are frequently isolated from practice, and this isolation hinders the mission of public health professionals. As research has grown to indicate sophisticated relationships in behaviors and environment, there is a humanitarian need to focus on the interaction and intersection of multiple health behaviors in order to improve health outcomes. If a single behavior can be clearly linked to disease, such as smoking and cancer, then imagine the improved interventions possible with the development of models and understanding of multiple health behavior relationships. Such might include direct effects of smoking on cancer risk, but also the effect of smoking on sleep and nutrition as factors which act upon the development of cancer and cancer-related mortality. This approach, then, expands a variety of harm reduction approaches across multiple behaviors of interest.

New paradigms of research methodology and theory may be necessary to address multiple health behavior change, and thereby to improve public health. It is necessary to address the complexity of behaviors, and their interactions. This manuscript will not address the need for multiple health behavior change, as that has been addressed elsewhere (e.g., Prochaska, Spring, & Nigg, 2008). Rather, this manuscript serves as an overview of the current state of the sciences for multiple health behavior change in theory and practice.

Intersection of Multiple Health Behaviors

The United States has a lower life expectancy than other industrialized nations around the world (The Organisation for Economic Co-operation and Development, 2016). In the past 5

years, the decline in life expectancy for American men and women (0-65 years of age) is directly related to the large-scale drug overdose epidemic fueled by the misuse of opioids (Ho & Hendi, 2018). The use of opioids to treat pain is an example of the intersection of multiple behaviors. Pain is caused by multiple factors as inflammation is a common underlying factor. Additionally, behaviors related to diet, physical activity, and sleep all play a vital role in the promotion or reduction of inflammation. In this example, inflammation, pain, and opioid use are interrelated with certain underlying health behaviors. Therefore, addressing the multiple intersecting health behaviors may improve life expectancy.

Targeting change in multiple health behaviors has a wide variety of benefits including the potential to maximize the health of populations and reduce health care costs (Prochaska & Prochaska, 2011). As such, there are interrelationships among health behaviors: interventions designed to promote change in one behavior may mutually benefit other health behaviors, improving overall health for individuals and communities. In addition to improving overall health, interventions successful in changing one or more lifestyle behaviors may lead to an increased self-efficacy or confidence to improve other risk behaviors (Prochaska & Prochaska, 2011). For example, a dietary and physical activity program for weight loss or maintenance may also improve sleep outcomes. Improved sleep outcomes may act independently on heart health, reducing the incidence of coronary heart disease. It is likely that one behavior serves as a stimulus for another behavior, therefore there is evidence for the clustering of behaviors.

Behaviors cluster because of the impact culture and environment have on the risks associated with acute and chronic disease among individuals. Common multi-behavioral interventions may focus on diet and physical activity, poly-substance use (e.g., alcohol use disorder and cigarette use), or behaviors directly related to disease outcomes, like cancer or cardiovascular disease. In order to maximize change, interventions focused on positively affecting multiple health behaviors relevant to an individual's health profile would increase efficiency (Prochaska & Prochaska, 2011). Therefore, it is important to focus on multi-behavioral interventions that have the potential to create a greater impact, rather than focusing our interventions on single behaviors, ignoring the interaction of health behaviors.

A Multilevel Depiction

Stokols' ecological model references potential leverage points for behavioral intervention: aspects of the environmental context that have the capability to influence behavior. Influential aspects of the environmental context may include physical, social, and cultural dimensions (Stokols, 1996). In some contexts, for example when one behavior is linked to another behavior, these leverage points may act as behavioral antecedents, rather than risk factors. In other cases, they may be risk factors which influence multiple health behaviors.

Consider screen time as a potential leverage point. Screen time is known to be negatively correlated with physical activity. Generally speaking, these are competing behaviors as an individual does not watch television and engage in physical activity at the same time. However, as screens proliferate gyms (home and public), this may not be a perfect picture of the influence. But, behaviorism suggests that these are likely to be competing behaviors.

Dietary habits and patterns are negatively affected by screen time. This occurs when people eat while watching television and do a poor job of monitoring their consumption. It is also influenced by the advertisement of health risk behaviors modeled on television, which are known to affect dietary patterns and alcohol use (Pechmann & Catlin, 2016). Moreover,

disrupted sleep patterns negatively affect dietary behaviors as sleep deprivation is associated with choosing foods high in fat, sugar, and salt content.

Lastly, screen time, particularly in the evening hours, negatively impacts sleep quality and quantity. Both sleep quality and quantity are critical factors regarding an individual's readiness to engage in physical activity and dietary choices (Al Khatib et al., 2018). This creates a negative feedback loop and re-emphasizes a negative connection between screen time and physical activity with sleep as the moderator.

From this example, screen time is a potential leverage point for multiple health behaviors. Screen time has measurable and demonstrated direct effects on physical activity, diet, and sleep. As previously mentioned, multiple health behaviors cluster within individuals and certain combinations of health behaviors may indicate an increased risk for adverse health outcomes.

Theoretical Constructs

Targeting multiple health behavior change offers an opportunity to improve both individual and population health. This is done by directly acting upon risks associated with premature morbidity and mortality. Theoretical constructs used to address multiple health behaviors can be grouped into several categories. Co-occurring behavioral models (Figure 1a) of multiple health behaviors occur when a combination of two behaviors results in a disease outcome. In this case, Behavior A in addition to Behavior B can cause disease. For example, the combination of a poor diet and a lack of physical activity may cause obesity.

Spillover effect models seek to change one behavior as a leverage point to change other behaviors. However, spillover effects can affect behaviors in either a positive or negative direction. In the case of Figure 1b, Behavior A acts as the antecedent of Behavior B, but the combination of the two may cause disease. An example of Figure 1b is the relationship between combustible cigarette smoking and serum folate (vitamin B9) status: folate, combined with vitamins B6 & B12 regulate homocysteine, which is an independent risk factor for the development of coronary heart disease (Vardavas, 2008). Smoking causes direct injury to the coronary system as well. Therefore, we must consider the combination of dietary behaviors and smoking as we consider interventions, harm reduction or otherwise, to reduce the overall burden of morbidity from coronary artery disease.

Antecedents are of great importance when assessing negative behaviors because eliminating an antecedent may eliminate a certain behavior, therefore minimizing the cause of disease. As Figure 1c depicts, Behavior A acts as the antecedent of Behavior B, but this relationship of behaviors may mediate disease. For example, the use of alcohol may disturb an individual's sleeping patterns and sleep disturbance may lead to an increased risk for certain disease outcomes such as hypertension, diabetes, obesity, and depression (Institute of Medicine (US) Committee on Sleep Medicine and Research, 2006). Alcohol use has a direct behavioral interaction with sleep as it is culturally appropriate to drink at night. Moreover, alcohol use physiologically impedes sleep: individuals with alcohol use disorders are more likely to suffer from altered sleep patterns (Brower, 2001).
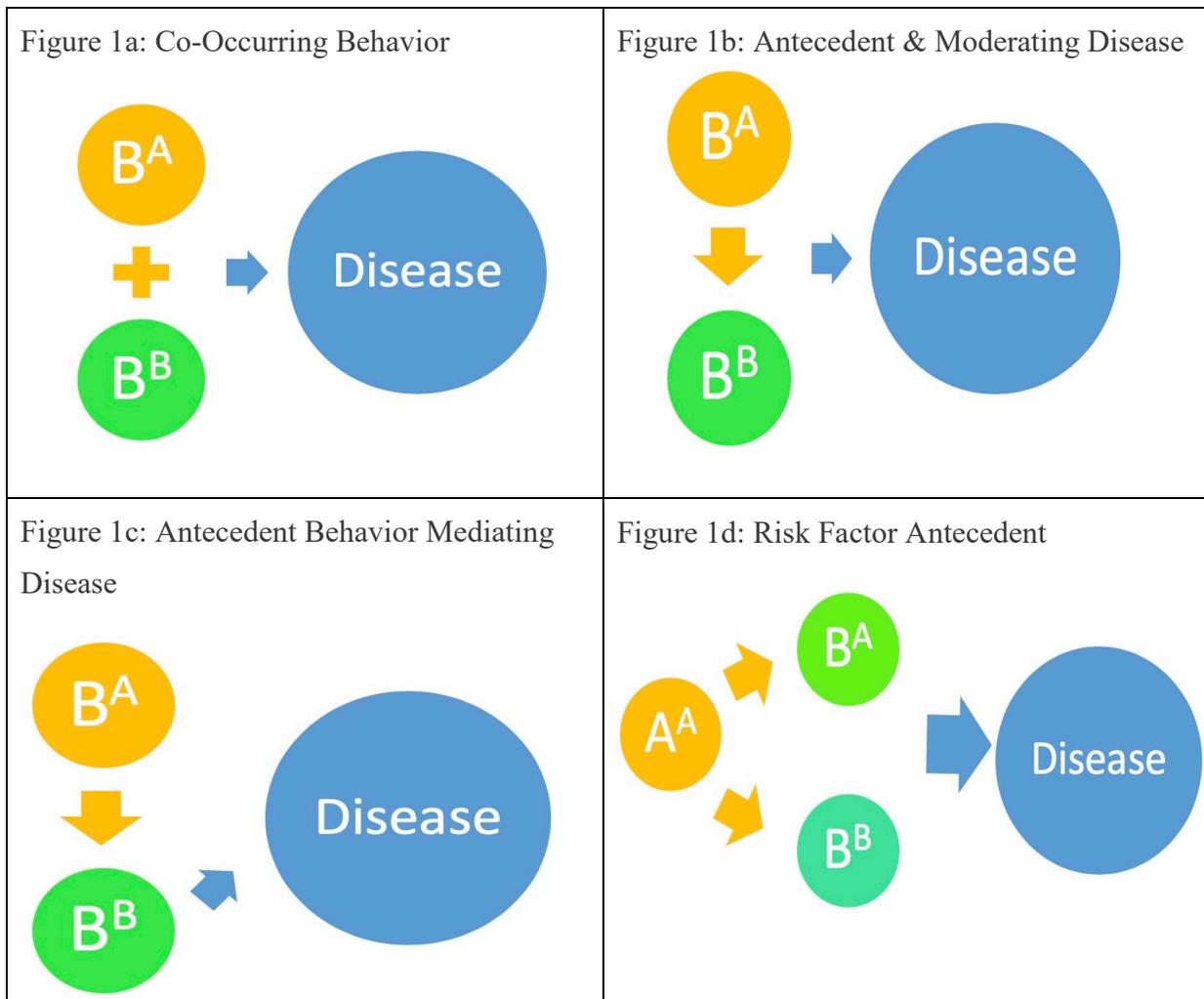
Figure 1. Theoretical constructs used to address multiple health behaviors.

Finally, a particular antecedent may trigger certain behaviors which result in the onset of disease. As seen in Figure 1d, Antecedent A is presented as a risk factor for Behaviors A and B, which may lead to an increased risk for disease. In this case, exposure to Adverse Childhood Experiences (ACEs) such as abuse, neglect, or other traumatic experiences that occur during the first 18 years of life may serve as the antecedent. For example, the more negative events a child experienced, such as sexual abuse, the higher the likelihood he or she will suffer from certain health and/or behavioral problems as an adult (Leitch, 2017). Behavioral problems such as poor diet, smoking, alcohol abuse, and illicit drug use may be used as coping mechanisms for past traumatic experiences. However, these behaviors increase the risk for disease outcomes such as liver disease, cancer, stroke, depressive disorders, and high blood pressure (Leitch, 2017).

Emerging health behavior theories acknowledge the interaction and mutual influence of behavior and biology on health and disease outcomes. Research has demonstrated that changes in one behavior can mutually benefit other behaviors, improving overall health for individuals and communities. Additionally, some research has examined multiple health behavior change interventions and found them to be successful. A study conducted by Spring et al. (2018) revealed that adults with multiple diet and physical activity risk behaviors could sustainably

improve diet and activity through a multicomponent intervention including the use of a smartphone application to track targeted behaviors, remote professional coaching, and modest incentives. The success of multiple health behavior interventions remains an important area of research to address population level rises in the prevalence of poor health behaviors and associated morbidity, disability, mortality, and health care costs.

Conclusion

Many individuals engage in multiple health behaviors that directly influence their health and well-being. Certain health behaviors have the capability to intersect and increase the likelihood of morbidity and premature mortality amongst individuals and communities. Success in changing an individual's behavior is limited when targeting only one health behavior of interest. Therefore, in order to improve the overall health of the public, new research methodology must be continually developed to improve multiple health behavior interventions that can readily be incorporated into practice.

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References

Al Khatib, H. K., Hall, W. L., Creedon, A., Ooi, E., Masri, T., McGowan, L., … & Pot, G. K. (2018). Sleep extension is a feasible lifestyle intervention in free-living adults who are habitually short sleepers: A potential strategy for decreasing intake of free sugars? A randomized controlled pilot study. *American Journal of Clinical Nutrition,* 107, 43-53. https://doi.org/10.1093/ajcn/nqx030

Brower, K. J. (2001). Alcohol's effects on sleep in alcoholics. *Alcohol Research and Health, 25*(2), 110-125.

Fine, L. J., Philogene, G. S., Gramling, R., Coups, E. J., & Sinha, S. (2004). Prevalence of multiple chronic disease risk factors: 2001 National Health Interview Survey. *American Journal of Preventive Medicine, 27*(2Suppl), 18-24. https://doi.org/10.1016/j.amepre.2004.04.017

Ho, J. Y., & Hendi, A. S. (2018). Recent trends in life expectancy across high income countries: Retrospective observational study. *BMJ, 362*, k2562. https://doi.org/10.1136/bmj.k2562

Institute of Medicine (US) Committee on Sleep Medicine and Research. (2006). Extent and health consequences of chronic sleep loss and sleep disorders (Chapter 3). In H. R. Colten & B. M. Altevogt (Eds.), *Sleep disorders and sleep deprivation: An unmet public health problem.* Washington (DC): National Academies Press (US). https://www.ncbi.nlm.nih.gov/books/NBK19961/

Leitch, L. (2017). Action steps using ACEs and trauma-informed care: A resilience model. *Health & Justice*, *5*(1), 1-10. https://doi.org/10.1186/s40352-017-0050-5

Organisation for Economic Co-operation and Development (OECD). (2016). OECD.stat. http://stats.oecd.org/index.aspx?DataSetCode=HEALTH_STAT#

Pechmann, C., & Catlin, J. R. (2016). The effects of advertising and other marketing communications on health-related consumer behaviors. *Current Opinion in Psychology,* 10, 44-49. https://doi.org/10.1016/j.copsyc.2015.12.008

Prochaska, J. J., & Prochaska, J. O. (2011). A review of multiple health behavior change interventions for primary prevention. *American Journal of Lifestyle Medicine*, *5*(3), 208–221. https://doi.org/10.1177/1559827610391883

Prochaska, J. J., Spring, B., & Nigg, C. R. (2008). Multiple health behavior change research: An introduction and overview. *Preventive Medicine, 46*(3), 181-188. https://doi.org/10.1016/j.ypmed.2008.02.001

Spring, B., Pellegrini, C., McFadden, H. G., Pfammatter, A. F., Stump, T. K., Siddique, J., . . . Hedeker, D. (2018). Multicomponent mHealth intervention for large, sustained change in multiple diet and activity risk behaviors: The Make Better Choices 2 randomized controlled trial. *Journal of Medical Internet Research*, *20*(6), e10528. https://doi.org/10.2196/10528

Stokols, D. (1996). Translating social ecological theory into guidelines for community health promotion. *American Journal of Health Promotion, 10*(4), 282–298. https://doi.org/10.4278/0890-1171-10.4.282

Vardavas, C. I., Linardakis, M. K., Hatzis, C. M., Malliaraki, N., Saris, W. H. M., & Kafatos, A. G. (2008). Smoking status in relation to serum folate and dietary vitamin intake. *Tobacco Induced Diseases 4*(1), 8. https://doi.org/10.1186/1617-9625-4-8