

The Effect of Physical Activity on Sleep

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12/12/2017

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The Data

Step 0: Specify the Scientific Question

Background

50-70 million Americans have chronic sleep problems and 35.5% of adults report getting less than 7 hours of sleep a day (Disease Control and Prevention 2014). Everyone knows the implications of not getting enough sleep. It has been linked to many health problems such as obesity, mood disorders, and heart disease (“Consequences of Insufficient Sleep,” n.d.). Getting a good night’s sleep gives the body the necessary time to recover and is shown to improve memory (“Sleep, Learning, and Memory,” n.d.). People across the country test herbal supplements, meditation and prescription drugs to fight insomnia. However, some studies have shown that exercise alone can help improve the quality of sleep (Foundation, n.d.). We set out to examine this relationship and see if exercise does indeed cause better sleep quality.

Scientific Question and Target Population

Among American adults aged 20 years or older, how does participating in moderate or vigorous-intensity sports, fitness or recreational activities affect quality of sleep?

Step 1: Specify the Causal Model

Option 1

Our endogenous variables are $X = \{W, A, Y\}$ which are defined as:

$W = \{W_d, W_h, W_l\}$

$W_d = \{\text{Gender, Age, Race1, Education, MaritalStatus, HHIncomeMid, HomeOwn}\}$

$W_h = \{\text{HealthGen, DaysPhysHlthBad, DaysMentHlthBad, LittleInterest, Depressed}\}$

$W_l = \{\text{TVHrsDay, CompHrsDay, AlcoholDay, SmokeNow, RegularMarij, HardDrugs}\}$

$A = \{\text{PhysActive}\}$

$Y = \{\text{SleepTrouble}\}$

Our exogenous variables are $U = U_{W_d}, U_{W_h}, U_{W_l}, U_A, U_Y, P_U$. These are the unmeasured factors which influence what values our endogenous variables, X can take.

Our structural causal model is defined as:

$W_d = f_{W_d}(U_{W_d})$

$W_h = f_{W_h}(W_d, U_{W_h})$

$W_l = f_{W_l}(W_d, W_h, U_{W_l})$

$A = f_A(W_d, W_h, W_l, U_A)$

$Y = f_Y(W_d, W_h, W_l, A, U_Y)$

A directed acyclic graph displays this SCM below.

Option 2

Our endogenous variables $X = \{W, A, Z, Y\}$ which are defined as:

$W = \{W_d, W_h, W_l\}$

$W_d = \{\text{Gender, Age, Race1, Education, MaritalStatus, HHIncomeMid, HomeOwn}\}$

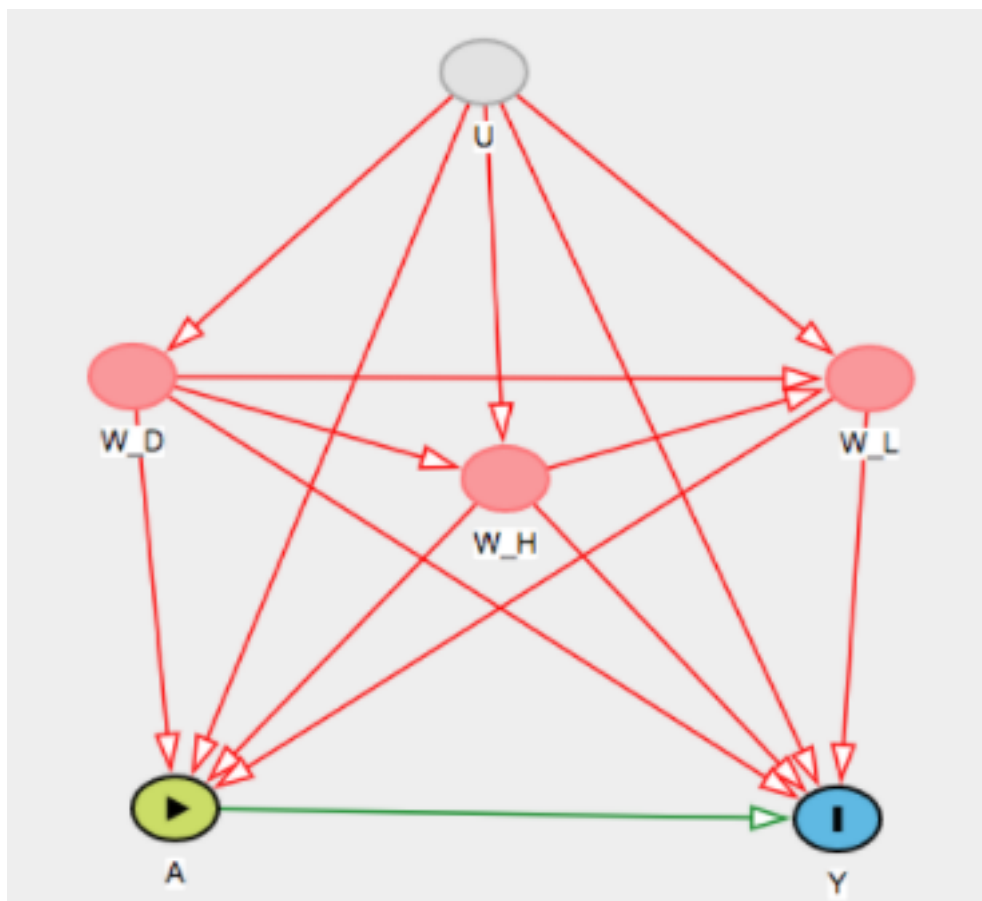


Figure 1: Structural Causal Model Option 1.

$W_h = \{\text{HealthGen}, \text{DaysPhysHlthBad}, \text{DaysMentHlthBad}, \text{LittleInterest}\}$
 $W_l = \{\text{TVHrsDay}, \text{CompHrsDay}, \text{AlcoholDay}, \text{SmokeNow}, \text{RegularMarij}, \text{HardDrugs}\}$
 $A = \{\text{PhysActive}\}$
 $Z = \{\text{Depressed}\}$
 $Y = \{\text{SleepTrouble}\}$

Our exogenous variables are $U = \{U_{W_d}, U_{W_h}, U_{W_l}, U_A, U_Z, U_Y\} \sim P_U$. These are the unmeasured factors which influence what values our endogenous variables, X can take.

Our structural causal model is defined as:

$W_d = f_{W_d}(U_{W_d})$
 $W_h = f_{W_h}(W_d, U_{W_h})$
 $W_l = f_{W_l}(W_d, W_h, U_{W_l})$
 $A = f_A(W_d, W_h, W_l, U_A)$
 $Z = f_Z(W_d, W_h, W_l, A, U_Z)$
 $Y = f_Y(W_d, W_h, W_l, A, Z, U_Y)$

A directed acyclic graph displays this SCM below.

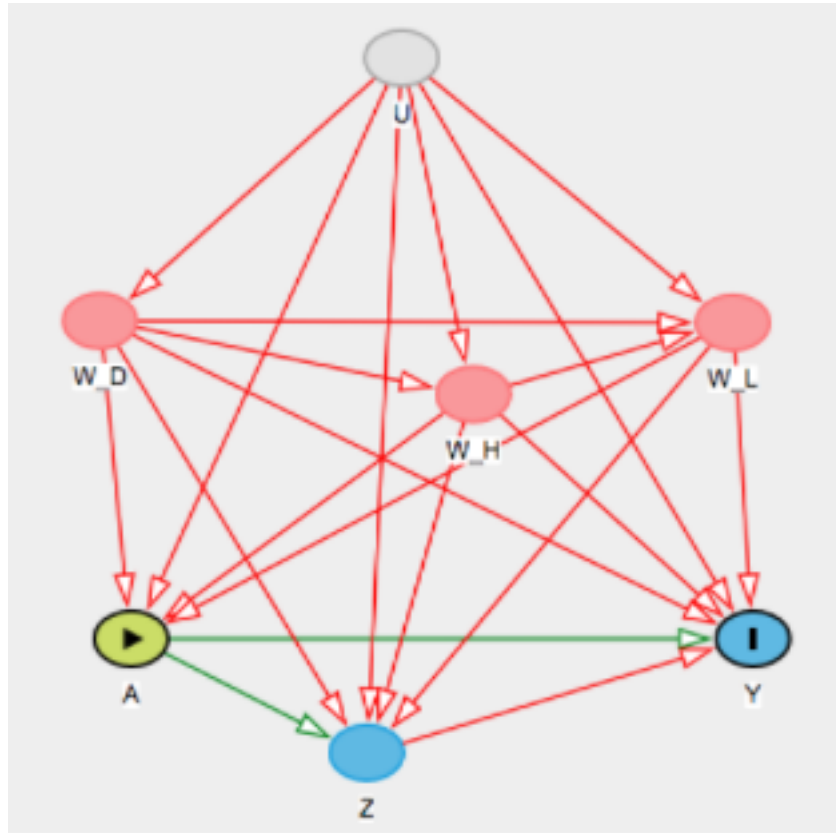


Figure 2: Structural Causal Model Option 2.

This alternative model defines Depressed as an intermediary between the exposure and outcome. Both models are valid, however we will proceed with the first model in the following analyses.

Step 2: Translation in the Target Causal Parameter Using Counterfactuals

Step 3: Specify the Observed Data and its Link

Step 4: Identifiability

Step 5: The Statistical Model and Estimand

Step 6: Estimation

Step 7: Interpretation

References

“Consequences of Insufficient Sleep.” n.d. *WGBH Educational Foundation Division of Sleep Medicine at Harvard Medical School*. doi:<http://healthysleep.med.harvard.edu/healthy/matters/benefits-of-sleep/sleep-and-disease-risk>.

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