Diet and Sleep

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Background

This study seeks to assess the bi-directional association between the quality of one's sleep and different components of one's diet.

Data

Data from CM and DQ were combined for the purpose of this study. Two sets of data were collected, one for each direction of the analysis. In order to establish a temporal order, the event associated with the outcome variable was ensured to have occurred after the event associated with the predictor variable – for example, to assess the influence a subject's diet may have had on their sleep, the investigators recorded what they ate before they went to sleep.

For the purpose of this analysis, both datasets will be subsetted to just records that indicate the "Aligned" condition.

Variables

In investigating the influence that one's diet may have on their sleep, we are interested in the following predictors: energy, food weight (no beverages), energy density, protein, fat, corbohydrate, plant protein, animal protein, fiber, calcium, magnesium, sodium, zinc, vitamin B6, vitamin B12, saturated fat, unsaturated fat, vitamin D, fruits, vegetables, fruits and vegetables, eggs, nuts, dairy, and added sugar. We are interested in the following outcome variables that measure sleep: sleep efficiency, total sleep time, wake after sleep onset, and sleep fragmentation index.

In investigating the influence that one's sleep may have on their diet, we are interested in the following predictors: sleep efficiency, total sleep time, wake after sleep onset, and sleep fragmentation index. The following variables will serve as predictors: energy, food weight (no beverages), energy density, protein, fat, corbohydrate, plant protein, animal protein, fiber, calcium, magnesium, sodium, saturated fat, unsaturated fat, fruits, vegetables, fruits and vegetables, eggs, dairy, and added sugar.

In both analysis directions, we will also assess the significance of age, sex, and BMI as covariates

Methods

We will construct linear mixed effect models to conduct a preliminary assessment of the relationships between all variables of interest. First, we will regress the outcome variable of interest on one predictor and the three covariates, adding a random intercept for subject ID. We will then evaluate the significance of the coefficients associated with each of the three covariates. If the coefficient is determined to not be significant (i.e., $p > 0.05$), it will be removed from the model. The truncated model will then be run again and its result saved.

Diet and Sleep

The following table presents the results of regressing sleep outcome variables on diet predictors:

Outcome	Predictor	Model
SE	ADDED_SUGAR	SE = 79.2821 + 0.3374(AGE) + 0.0368(ADDED_SUGAR)
SE	CA	SE = 78.7415 + 0.338(AGE) + 9e-04(CA)
SE	CHO	SE = 78.8497 + 0.3364(AGE) + 0.0033(CHO)
SE	DAIRY	SE = 79.3834 + 0.3445(AGE) + 0.0024(DAIRY)
SE	ED	SE = 79.3072 + 0.3449(AGE) + 0.0408(ED)
SE	EGG	SE = 79.4855 + 0.3351(AGE) + 0.2721(EGG)
SE	EN	SE = 78.4283 + 0.337(AGE) + 6e-04(EN)
SE	F_V	SE = 79.0809 + 0.3371(AGE) + 0.1732(F_V)
SE	FAT	SE = 78.6725 + 0.3408(AGE) + 0.01(FAT)
SE	FIBER	SE = 78.8933 + 0.3416(AGE) + 0.0281(FIBER)
SE	FOOD_WT_F	SE = 78.4128 + 0.3359(AGE) + 0.001(FOOD_WT_F)
SE	FRUIT	SE = 79.3893 + 0.3496(AGE) - 0.1188(FRUIT)
SE	MG	SE = 78.9172 + 0.3429(AGE) + 0.0016(MG)
SE	NA	SE = 78.2697 + 0.3358(AGE) + 4e-04(NA)
SE	NUTS	SE = 79.4534 + 0.3434(AGE) - 0.0414(NUTS)
SE	PROT	SE = 79.1502 + 0.3427(AGE) + 0.003(PROT)
SE	PROT_ANI	SE = 79.1016 + 0.3378(AGE) + 0.0773(PROT_ANI)
SE	PROT_PLANT	SE = 79.3311 + 0.3449(AGE) + 0.0266(PROT_PLANT)
SE	SFA	SE = 79.1623 + 0.3429(AGE) + 0.0106(SFA)
SE	UFA	SE = 78.4733 + 0.3406(AGE) + 0.0209(UFA)
SE	VEG	SE = 78.6162 + 0.3445(AGE) + 0.4413(VEG)
SE	VIT_B12	SE = 78.9422 + 0.35(AGE) + 0.058(VIT_B12)
SE	VIT_B6	SE = 78.7897 + 0.3438(AGE) + 0.2711(VIT_B6)
SE	VIT_D	SE = 79.1306 + 0.3466(AGE) + 0.0397(VIT_D)
SE	ZN	SE = 79.6486 + 0.3441(AGE) - 0.0214(ZN)
SFI	ADDED_SUGAR	SFI = 17.1932 + 0.0522(ADDED_SUGAR)
SFI	CA	SFI = 18.2895 - 7e-04(CA)
SFI	CHO	SFI = 19.934 - 0.0099(CHO)
SFI	DAIRY	SFI = 11.8914 + 0.2389(BMI) - 0.4511(DAIRY)
SFI	ED	SFI = 16.7208 + 0.5234(ED)
SFI	EGG	SFI = 17.3979 + 0.3764(EGG)
SFI	EN	SFI = 18.6618 - 5e-04(EN)
SFI	F_V	SFI = 18.7216 - 0.3682(F_V)
SFI	FAT	SFI = 17.8005 - 0.0021(FAT)
SFI	FIBER	SFI = 18.9168 - 0.0625(FIBER)
SFI	FOOD_WT_F	SFI = 19.1606 - 0.0013(FOOD_WT_F)
SFI	FRUIT	SFI = 17.8413 - 0.1733(FRUIT)
SFI	MG	SFI = 18.4801 - 0.0026(MG)
SFI	NA	SFI = 18.4018 - 2e-04(NA)
SFI	NUTS	SFI = 17.5738 + 0.0664(NUTS)
SFI	PROT	SFI = 17.9639 - 0.0035(PROT)
SFI	PROT_ANI	SFI = 17.4613 + 0.0274(PROT_ANI)
SFI	PROT_PLANT	SFI = 17.6176 + 0.0071(PROT_PLANT)
SFI	SFA	SFI = 17.5883 + 0.0016(SFA)
SFI	UFA	SFI = 17.9593 - 0.0067(UFA)
SFI	VEG	SFI = 18.7252 - 0.6282(VEG)
SFI	VIT_B12	SFI = 12.3161 + 0.2206(BMI) - 0.1405(VIT_B12)
SFI	VIT_B6	SFI = 18.0094 - 0.167(VIT_B6)
SFI	VIT_D	SFI = 17.8103 - 0.0363(VIT_D)
SFI	ZN	SFI = 16.9419 + 0.0591(ZN)
TST	ADDED_SUGAR	TST = 407.9344 + 1.7064(ADDED_SUGAR)
TST	CA	TST = 406.4134 + 0.0166(CA)

Outcome	Predictor	Model
TST	CHO	TST = 404.2199 + 0.0773(CHO)
TST	DAIRY	TST = 413.9838 + 5.2428(DAIRY)
TST	ED	TST = 406.8272 + 8.885(ED)
TST	EGG	TST = 423.1419 - 1.4822(EGG)
TST	EN	TST = 400.4625 + 0.0105(EN)
TST	F_V	TST = 421.1741 + 0.3521(F_V)
TST	FAT	TST = 399.0921 + 0.2807(FAT)
TST	FIBER	TST = 416.6607 + 0.2692(FIBER)
TST	FOOD_WT_F	TST = 412.4507 + 0.0082(FOOD_WT_F)
TST	FRUIT	TST = 419.7079 + 2.0589(FRUIT)
TST	MG	TST = 415.0863 + 0.0216(MG)
TST	NA	TST = 403.9238 + 0.0049(NA)
TST	NUTS	TST = 420.3497 + 2.2528(NUTS)
TST	PROT	TST = 409.8319 + 0.1296(PROT)
TST	PROT_ANI	TST = 412.8371 + 1.5138(PROT_ANI)
TST	PROT_PLANT	TST = 419.8634 + 1.4161(PROT_PLANT)
TST	SFA	TST = 401.3029 + 0.8086(SFA)
TST	UFA	TST = 403.0031 + 0.3918(UFA)
TST	VEG	TST = 423.512 - 0.7295(VEG)
TST	VIT_B12	TST = 418.601 + 0.7213(VIT_B12)
TST	VIT_B6	TST = 418.5736 + 1.5911(VIT_B6)
TST	VIT_D	TST = 422.5331 - 0.061(VIT_D)
TST	ZN	TST = 412.0455 + 0.8703(ZN)
WASO	ADDED_SUGAR	WASO = 57.1209 - 0.8707(AGE) + 0.2502(ADDED_SUGAR)
WASO	CA	WASO = 58.2637 - 0.8181(AGE) - 6e-04(CA)
WASO	CHO	WASO = 58.5346 - 0.812(AGE) - 0.0042(CHO)
WASO	DAIRY	WASO = 57.9866 - 0.8213(AGE) - 0.1032(DAIRY)
WASO	ED	WASO = 51.3111 - 0.7969(AGE) + 3.3597(ED)
WASO	EGG	WASO = 57.9608 - 0.833(AGE) + 0.3128(EGG)
WASO	EN	WASO = 57.5766 - 0.8243(AGE) + 2e-04(EN)
WASO	F_V	WASO = 58.6194 - 0.8039(AGE) - 0.431(F_V)
WASO	FAT	WASO = 56.1832 - 0.8307(AGE) + 0.0232(FAT)
WASO	FIBER	WASO = 58.477 - 0.8185(AGE) - 0.0353(FIBER)
WASO	FOOD_WT_F	WASO = 59.7262 - 0.806(AGE) - 0.002(FOOD_WT_F)
WASO	FRUIT	WASO = 57.8467 - 0.8274(AGE) + 0.1224(FRUIT)
WASO	MG	WASO = 58.773 - 0.8191(AGE) - 0.0031(MG)
WASO	NA	WASO = 59.722 - 0.8079(AGE) - 6e-04(NA)
WASO	NUTS	WASO = 57.2554 - 0.812(AGE) + 0.3699(NUTS)
WASO	PROT	WASO = 57.2403 - 0.8269(AGE) + 0.0078(PROT)
WASO	PROT_ANI	WASO = 56.9568 - 0.8429(AGE) + 0.2389(PROT_ANI)
WASO	PROT_PLANT	WASO = 57.0201 - 0.816(AGE) + 0.3919(PROT_PLANT)
WASO	SFA	WASO = 56.4365 - 0.8327(AGE) + 0.0662(SFA)
WASO	UFA	WASO = 56.4203 - 0.8283(AGE) + 0.0327(UFA)
WASO	VEG	WASO = 59.5408 - 0.8223(AGE) - 0.9615(VEG)
WASO	VIT_B12	WASO = 58.0411 - 0.8245(AGE) - 0.0249(VIT_B12)
WASO	VIT_B6	WASO = 58.7901 - 0.8211(AGE) - 0.4241(VIT_B6)
WASO	VIT_D	WASO = 57.5685 - 0.8199(AGE) + 0.0433(VIT_D)
WASO	ZN	WASO = 56.4446 - 0.8198(AGE) + 0.1147(ZN)

Sleep and Diet

The following table presents the results of regressing diet outcome variables on sleep predictors:

Outcome	Predictor	Model
ADDED_SUGAR	SE	ADDED_SUGAR = - 5.78549 + 0.68036(BMI) - 0.02774(SE)
ADDED_SUGAR	SFI	ADDED_SUGAR = - 7.83993 + 0.67591(BMI) - 0.01932(SFI)
ADDED_SUGAR	TST	ADDED_SUGAR = - 7.90786 + 0.67357(BMI) - 0.00047(TST)
ADDED_SUGAR	WASO	ADDED_SUGAR = - 8.36156 + 0.67556(BMI) + 0.0059(WASO)
CA	SE	CA = 187.97016 + 8.57242(SE)
CA	SFI	CA = 1003.9062 - 3.07794(SFI)
CA	TST	CA = 674.65545 + 0.65043(TST)
CA	WASO	CA = 910.41479 + 1.13755(WASO)
CHO	SE	CHO = 145.41266 + 0.98547(SE)
CHO	SFI	CHO = 238.07294 - 0.29155(SFI)
CHO	TST	CHO = 192.58659 + 0.0955(TST)
CHO	WASO	CHO = 234.56724 - 0.04581(WASO)
DAIRY	SE	DAIRY = - 3.39265 + 0.06675(BMI) + 0.03458(SE)
DAIRY	SFI	DAIRY = - 0.47192 + 0.07593(BMI) - 0.00214(SFI)
DAIRY	TST	DAIRY = - 1.13715 + 0.07335(BMI) + 0.00161(TST)
DAIRY	WASO	DAIRY = - 0.37879 + 0.0744(BMI) - 0.00271(WASO)
ED	SE	ED = 2.0464 - 0.00356(SE)
ED	SFI	ED = 1.76655 - 0.00209(SFI)
ED	TST	ED = 1.62211 + 0.00025(TST)
ED	WASO	ED = 1.7644 - 0.001(WASO)
EGG	SE	EGG = - 0.93213 + 0.01782(SE)
EGG	SFI	EGG = 0.81861 - 0.00947(SFI)
EGG	TST	EGG = 0.65485 - 1e-05(TST)
EGG	WASO	EGG = 0.78306 - 0.00376(WASO)
EN	SE	EN = 835.73124 + 13.77075(SE)
EN	SFI	EN = 2086.7981 - 1.56709(SFI)
EN	TST	EN = 1259.61568 + 1.89055(TST)
EN	WASO	EN = 2059.13562 + 0.00628(WASO)
F_V	SE	F_V = 2.82161 + 0.00173(SE)
F_V	SFI	F_V = 3.14876 - 0.00991(SFI)
F_V	TST	F_V = 2.22979 + 0.00176(TST)
F_V	WASO	F_V = 3.02178 - 0.00135(WASO)
FAT	SE	FAT = - 9.57724 + 1.01852(SE)
FAT	SFI	FAT = 83.07457 - 0.12039(SFI)
FAT	TST	FAT = 28.9727 + 0.12282(TST)
FAT	WASO	FAT = 83.39938 - 0.07016(WASO)
FIBER	SE	FIBER = 14.83545 + 0.06644(SE)
FIBER	SFI	FIBER = 21.01888 - 0.01593(SFI)
FIBER	TST	FIBER = 18.09269 + 0.00626(TST)
FIBER	WASO	FIBER = 21.70143 - 0.02769(WASO)
FOOD_WT_F	SE	FOOD_WT_F = 533.37014 + 7.38562(SE)
FOOD_WT_F	SFI	FOOD_WT_F = 1163.97584 + 1.46089(SFI)
FOOD_WT_F	TST	FOOD_WT_F = 897.71367 + 0.69011(TST)
FOOD_WT_F	WASO	FOOD_WT_F = 1171.44206 + 0.52109(WASO)
FRUIT	SE	FRUIT = 0.88371 + 0.00389(SE)
FRUIT	SFI	FRUIT = 1.11137 + 0.00675(SFI)
FRUIT	TST	FRUIT = 0.99253 + 0.00056(TST)
FRUIT	WASO	FRUIT = 1.15211 + 0.00223(WASO)
MG	SE	MG = 315.45705 + 0.15551(SE)
MG	SFI	MG = 349.29759 - 1.14395(SFI)
MG	TST	MG = 252.20525 + 0.18216(TST)
MG	WASO	MG = 321.20853 + 0.23237(WASO)

Outcome	Predictor	Model
NA	SE	NA = - 56.01749 + 41.54821(SE)
NA	SFI	NA = 3801.72914 - 9.49832(SFI)
NA	TST	NA = 2209.41259 + 3.37084(TST)
NA	WASO	NA = 3709.1713 - 2.11865(WASO)
PROT	SE	PROT = 41.14259 - 17.00319(SEX2) + 0.64025(SE)
PROT	SFI	PROT = 99.14729 - 14.95572(SEX2) - 0.08441(SFI)
PROT	TST	PROT = 50.56379 - 20.22029(SEX2) + 0.11357(TST)
PROT	WASO	PROT = 91.29385 - 14.36507(SEX2) + 0.18033(WASO)
PROT_ANI	SE	PROT_ANI = - 3.55184 + 0.32241(AGE) - 5.59518(SEX2) + 0.01772(SE)
PROT_ANI	SFI	PROT_ANI = - 2.26237 + 0.32654(AGE) - 5.56494(SEX2) + 0.00931(SFI)
PROT_ANI	TST	PROT_ANI = - 5.22753 + 0.31883(AGE) - 5.87299(SEX2) + 0.00804(TST)
PROT_ANI	WASO	PROT_ANI = - 3.23747 + 0.34202(AGE) - 5.73347(SEX2) + 0.02108(WASO)
PROT_PLANT	SE	PROT_PLANT = 1.14314 + 0.00551(SE)
PROT_PLANT	SFI	PROT_PLANT = 1.47001 + 0.00929(SFI)
PROT_PLANT	TST	PROT_PLANT = 0.30146 + 0.00314(TST)
PROT_PLANT	WASO	PROT_PLANT = 1.539 + 0.00271(WASO)
SFA	SE	SFA = - 11.49108 + 0.41645(SE)
SFA	SFI	SFA = 27.11189 - 0.09002(SFI)
SFA	TST	SFA = 8.97143 + 0.03912(TST)
SFA	WASO	SFA = 27.37465 - 0.05308(WASO)
UFA	SE	UFA = 0.10488 + 0.54007(SE)
UFA	SFI	UFA = 48.15816 - 0.00235(SFI)
UFA	TST	UFA = 16.99844 + 0.07349(TST)
UFA	WASO	UFA = 48.53695 - 0.0121(WASO)
VEG	SE	VEG = 1.64971 + 0.00111(SE)
VEG	SFI	VEG = 2.04787 - 0.01706(SFI)
VEG	TST	VEG = 1.14778 + 0.00142(TST)
VEG	WASO	VEG = 1.88752 - 0.00399(WASO)