A methodical review of the causal role of socioeconomic determinants of health disparities

May 23, 2018

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Intuitive model of Health Disparities

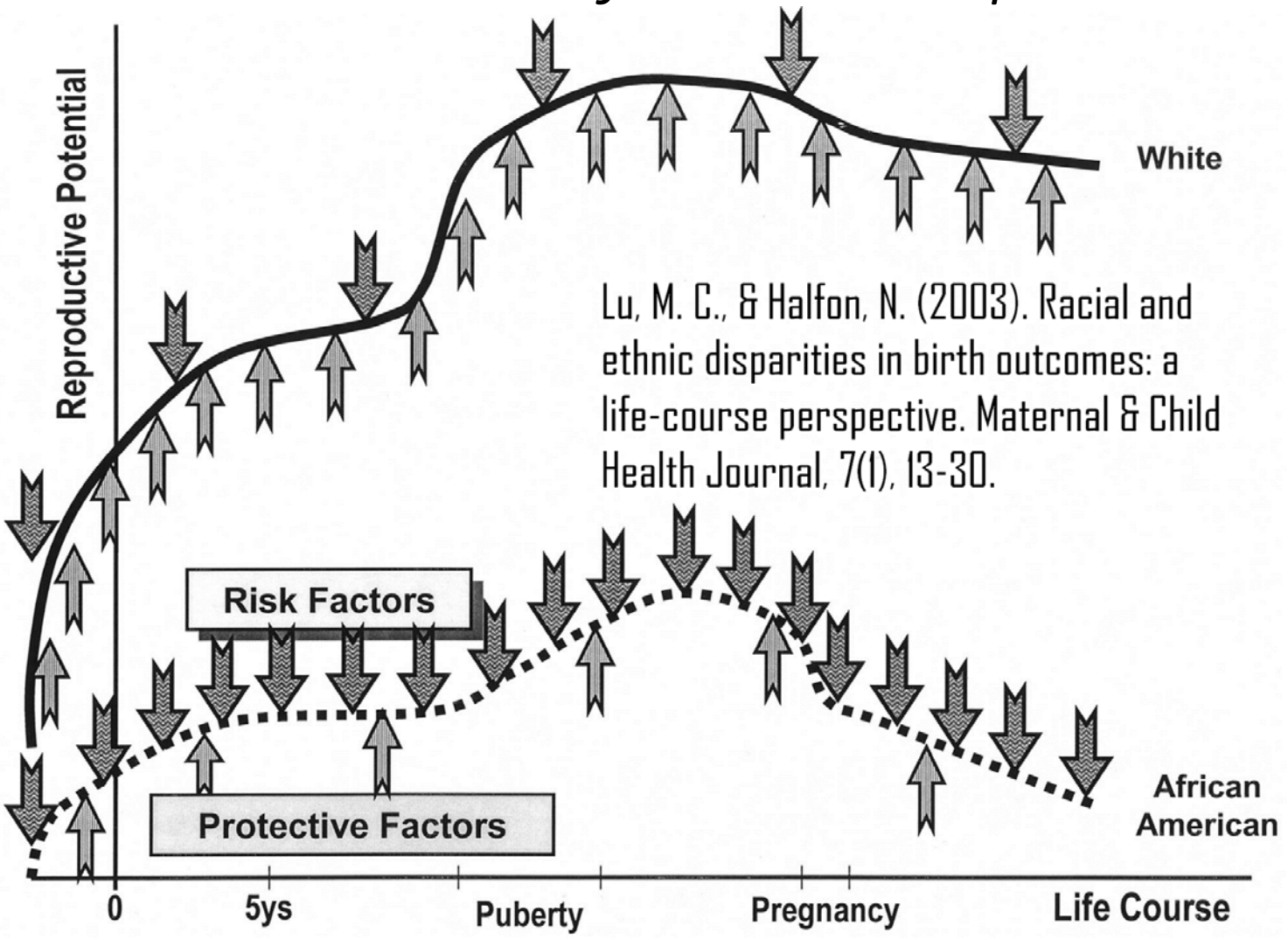


Fig. 1. How differential exposures to risk factors (downward arrows) and protective factors (upward arrows) over the life course affect developmental trajectories and contribute to disparities in birth outcomes. The lower reproductive potential of African American women, relative to White women, results from their cumulative exposure to more risk factors and less protective factors across the life span, particularly during sensitive periods of development.

Lu, M. C., & Halfon, N. (2003). Racial and ethnic disparities in birth outcomes: a life-course perspective. *Maternal & Child Health Journal, 7(1), 13-30.*

Statistics -> Modeling -> Causal modeling

	Statistical Concepts	Causal Concepts
1	Correlation	Randomization
2	Regression	Influence
3	Dependence	Effect
4	Conditional independence	Confounding
5	Likelihood	“Holding constant”
6	Collapsibility	Disturbance
7	Propensity score	Error terms
8	Risk ratio	Structural coefficients
9	Odds ratio	Spurious correlation
10	Marginalization	Faithfulness/stability
11	Conditionalization	Instrumental variables
12	“Controlling for”	Intervention
13		Explanation
14		Attribution

Pearl, J. (2010). An introduction to causal inference. *Int J Biostat, 6(2), Article 7. doi: 10.2202/1557-4679.1203*

Statistics vs. Modeling

A baby step: separate out in analytical work:

1. Modeling
2. Statistical testing

I.

A t-test can be seen as a

1. Model (2-group 1-continuous variable)
2. Test (Student's t: ideal distribution vs. real/sample)

II.

A correlation can be seen as a

1. Model (1-group 2-continuous variable)
2. Test (z or t test of ρ significance)

III.

A regression can be seen as a

1. Model (directional: 1-group 2-continuous variable)
2. Test (of β or of R^2)

Modeling vs. statistics

#R made nicely clear one can build a data-free model
install.packages("MIIVsem")
model.miiv1 <- ' DV~ IV1 + IV2‘

#Model and Data are 2 ingredients: fitting is a 3rd
fit.miiv.real <- miive(model. miiv1, datareal)

#One can simulate data off a model too
data.sim.1 <- simulateData(model = model.miiv1, sample.nobs = 1000, seed = 123)

fit.miiv.sim <- miive(model. miiv1, data.sim.1)

#dagitty can plot the model too

SES and its place in the causal scheme

- Socioeconomic position (SEP) [1]

* "The research goals of measuring SEP: monitoring aetiology and confounding.

-The most obvious purpose in measuring SEP is to describe and monitor the social distribution of a disease in order to inform health policy.

- The second purpose for measuring SEP relates to explaining the *causal mechanisms* through which SEP *generates* health differences.

- The third purpose of measuring SEP in health-related research is to statistically adjust for socioeconomic circumstances when another exposure is the main focus of interest.
In this context, it is crucial to fully account for *confounding* effects due to socioeconomic conditions." [2]:4-5.

1. Lu, M. C., & Halfon, N. (2003). Racial and ethnic disparities in birth outcomes: a life-course perspective. *Maternal & Child Health Journal, 7(1), 13-30.*
2. Galobardes, B., Lynch, J., & Smith, G. D. (2007). Measuring socioeconomic position in health research. *British medical bulletin, 81(1), 21.*

SES issues

Terminology

- Socioeconomic position (SEP) [1]

- How independent are SES indicators?
- Wealth ≠ income, e.g.
- "even at similar levels of income, non-white minorities lag behind whites in total assets and net worth (the difference between assets and liabilities)" [1]

- Should one combine them into some weighted total?
- Is there a latent SES?
- Objective vs. subjective SES.

1. Pollack, C. E., Chideya, S., Cubbin, C., Williams, B., Dekker, M., & Braveman, P. (2007). Should health studies measure wealth?: A systematic review. *American Journal of Preventive Medicine, 33(3), 250-264.*

SES & structures

"The validity of common adjustment strategies when estimating the outcome distribution under hypothetical interventions of the exposure is potentially compromised by **structured relations** between covariates, observed and unobserved."

"conditioning on covariates without regard to **structured interrelations** among the relevant quantities (measured and unmeasured) can lead to biased estimation of casual effects"[1:157-8]

1. Kaufman, J. S., & Kaufman, S. (2001). Assessment of Structured Socioeconomic Effects on Health. *Epidemiology, 12(2), 157-167. doi: 10.2307/3703617*

What is A 'structure'

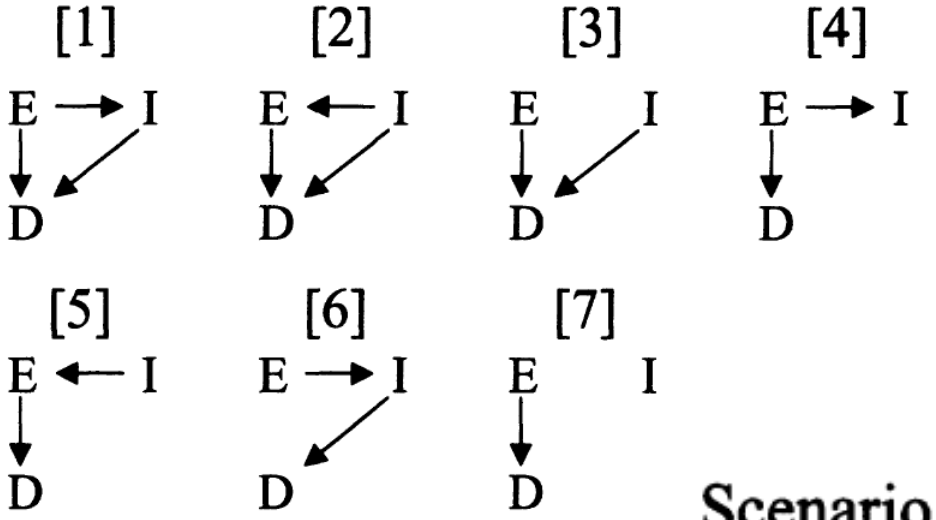


FIGURE 2.

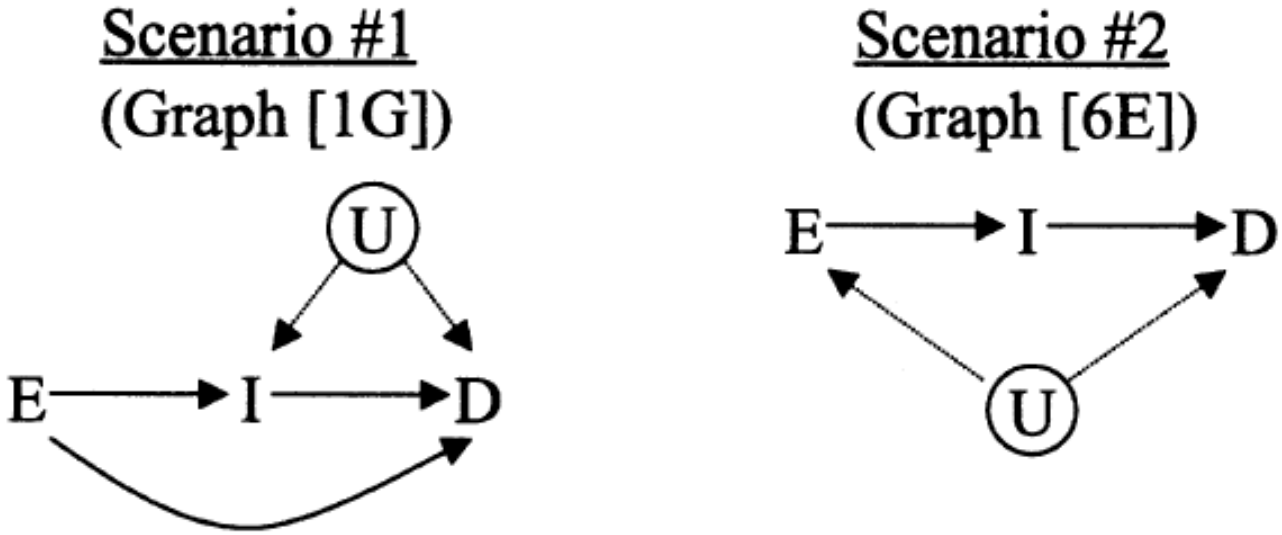


FIGURE 4.

E = Education; I = Income; D = Death (Mortality)

Kaufman, J. S., & Kaufman, S. (2001). Assessment of Structured Socioeconomic Effects on Health. *Epidemiology, 12(2), 157-167. doi:10.2307/3703617*

Kaufman – structure analyzed (1 age group)

Appendix 2

TABLE A2.1

Income	Education	Low	Education	Mid	Education	High	Education	Total
Low	ALIVE:	2350	ALIVE:	918	ALIVE:	315	ALIVE:	3583
	DEAD:	1024	DEAD:	322	DEAD:	116	DEAD:	1462
Mid	ALIVE:	2931	ALIVE:	2366	ALIVE:	1038	ALIVE:	6335
	DEAD:	790	DEAD:	524	DEAD:	260	DEAD:	1574
High	ALIVE:	2379	ALIVE:	3666	ALIVE:	4417	ALIVE:	10462
	DEAD:	445	DEAD:	634	DEAD:	594	DEAD:	1673
Total	ALIVE:	7660	ALIVE:	6950	ALIVE:	5770	ALIVE:	20380
	DEAD:	2259	DEAD:	1480	DEAD:	970	DEAD:	4709

E = Education; I = Income; D = Death (Mortality)

Kaufman, J. S., & Kaufman, S. (2001). Assessment of Structured Socioeconomic Effects on Health. *Epidemiology, 12(2), 157-167. doi:10.2307/3703617*

Kaufman – structure analyzed (1 age group)

Step 5: Standard Adjustment for Effect of E given I:

$$\sum_i (P(d|e, i)\,P(i)):$$

$$\begin{aligned} P(dead|SET[E = L]) &= (1024/(2350 + 1024)) \cdot (0.201) + \\ &\quad (790/(2931 + 790)) \cdot (0.315) + \\ &\quad (445/(2379 + 445)) \cdot (0.484) = 0.204 \end{aligned}$$

Step 7: Structured Adjustment for Scenario 2:

$$\sum_i [P(i|e) \sum_{e'} (P(d|e', i)\,P(e'))]:$$

	$I = L$		$I = M$		$I = H$	
	Step 3	Step 6	Step 3	Step 6	Step 3	Step 6
$P(dead\|SET[E = L])$	(0.340) ·	(0.280) +	(0.375) ·	(0.199) +	(0.285) ·	(0.144) = 0.211
$P(dead\|SET[E = M])$	(0.147) ·	(0.280) +	(0.343) ·	(0.199) +	(0.510) ·	(0.144) = 0.183
$P(dead\|SET[E = H])$	(0.063) ·	(0.280) +	(0.193) ·	(0.199) +	(0.743) ·	(0.144) = 0.163

Kaufman, J. S., & Kaufman, S. (2001). Assessment of Structured Socioeconomic Effects on Health. *Epidemiology, 12(2), 157-167. doi:10.2307/3703617*

SES as a latent factor

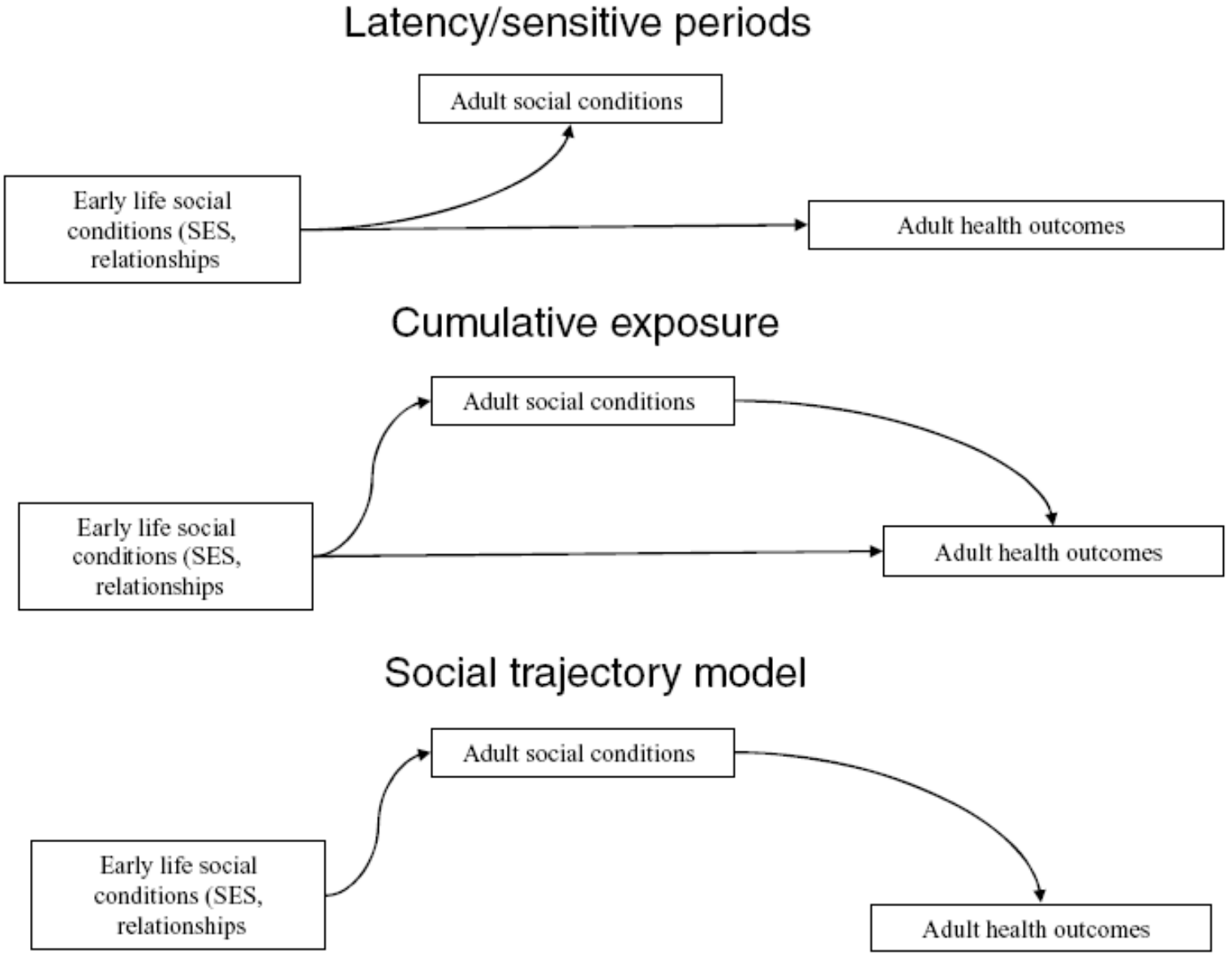
Table 1 38 young adult (Add Health Wave III; 2000–2001) SES indicator variables used to generate SES factors, listed by three domains of SES (Material, Human, and Social Capital).

MATERIAL CAPITAL	**Public assistance (no/yes)**
Income sources (no/yes)	Housing assistance
Wages, including tips/bonus	Food stamps
Interest from stocks, bonds	AFDC, welfare
Income from family/friends	Ever received assistance other than food stamps
Personal economics	**Miscellaneous**
Personal income in 2001	Number of months of health insurance in past year
Own residence (no/yes)	Currently living with parents (no/yes)
Own vehicle (no/yes)	**HUMAN CAPITAL**
Information and financial access (no/yes)	**Education**
Own/access to computer	Highest grade attained
Have email account	HS diploma (no/yes)
Have checking account	BA degree (no/yes)
Have credit card	In school part/full time (no/yes)
Have savings account	In 4-year college (no/yes)
Have shares of stock	**Labor experience**
Have student loan	Number of jobs
Have credit card debt	Job description
Economic hardship in the last year (no/yes)	**SOCIAL CAPITAL**
Without telephone service	Community activities
Unable to pay rent/mortgage	Volunteer experience
Gas/electricity/oil turned off	Organ donor (no/yes)
Unable to afford doctor	Registered to vote (no/yes)
Evicted for not paying rent	Voted in 2000 (no/yes)
	Political affiliation (no/yes)

Scharoun-Lee, M., Adair, L. S., Kaufman, J. S., & Gordon-Larsen, P. (2009). Obesity, race/ethnicity and the multiple dimensions of socioeconomic status during the transition to adulthood: A factor analysis approach. *Social Science & Medicine, 68(4), 708-716. doi:https://doi.org/10.1016/j.socscimed.2008.12.009*

Figure 3

Three life course models of disease: latency, cumulative exposures, and social trajectories.



Berkman, L. F. (2009). Social epidemiology: social determinants of health in the United States: are we losing ground? *Annual Review of Public Health, 30, 27-41.*

Subjective SES

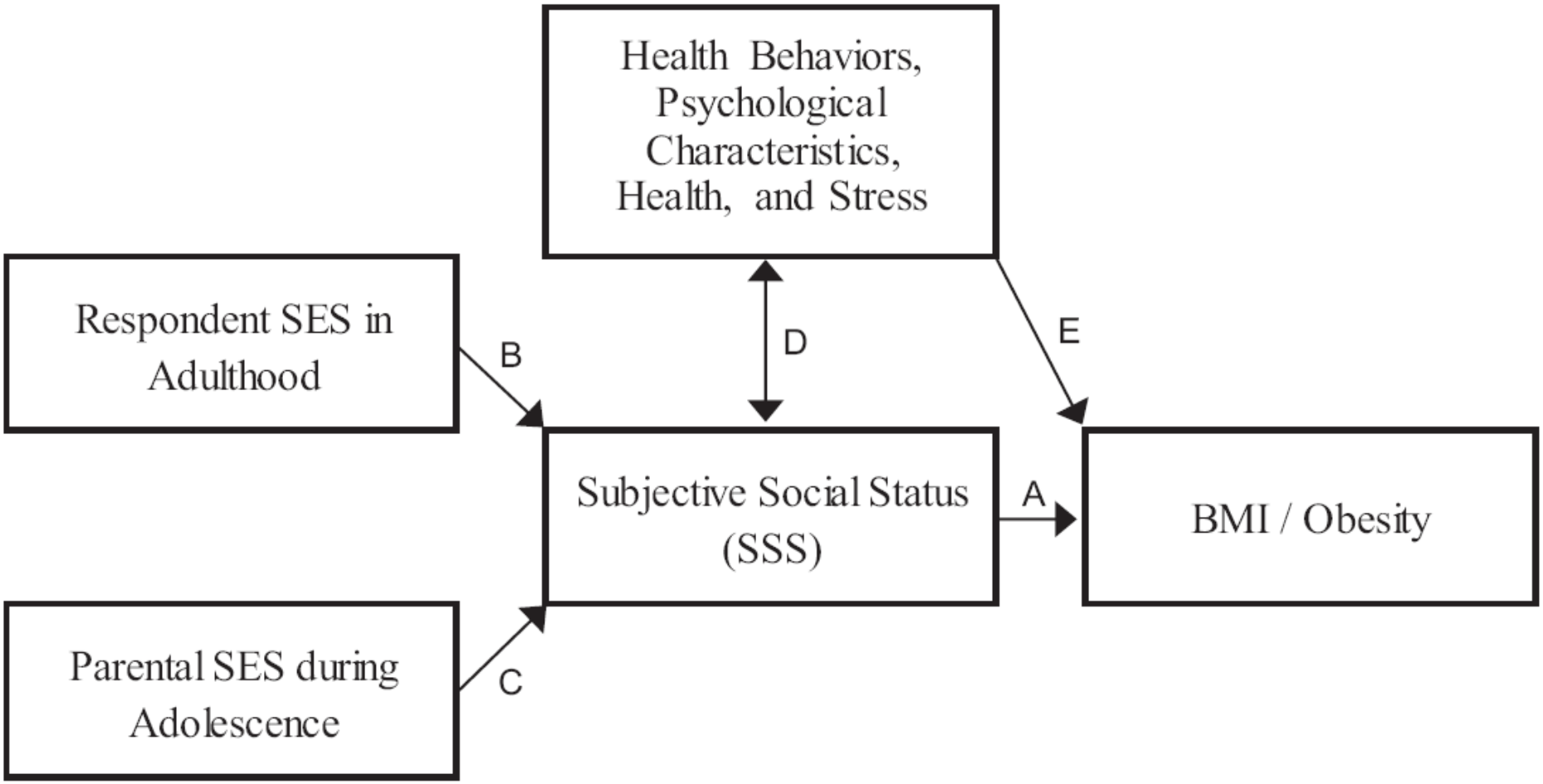
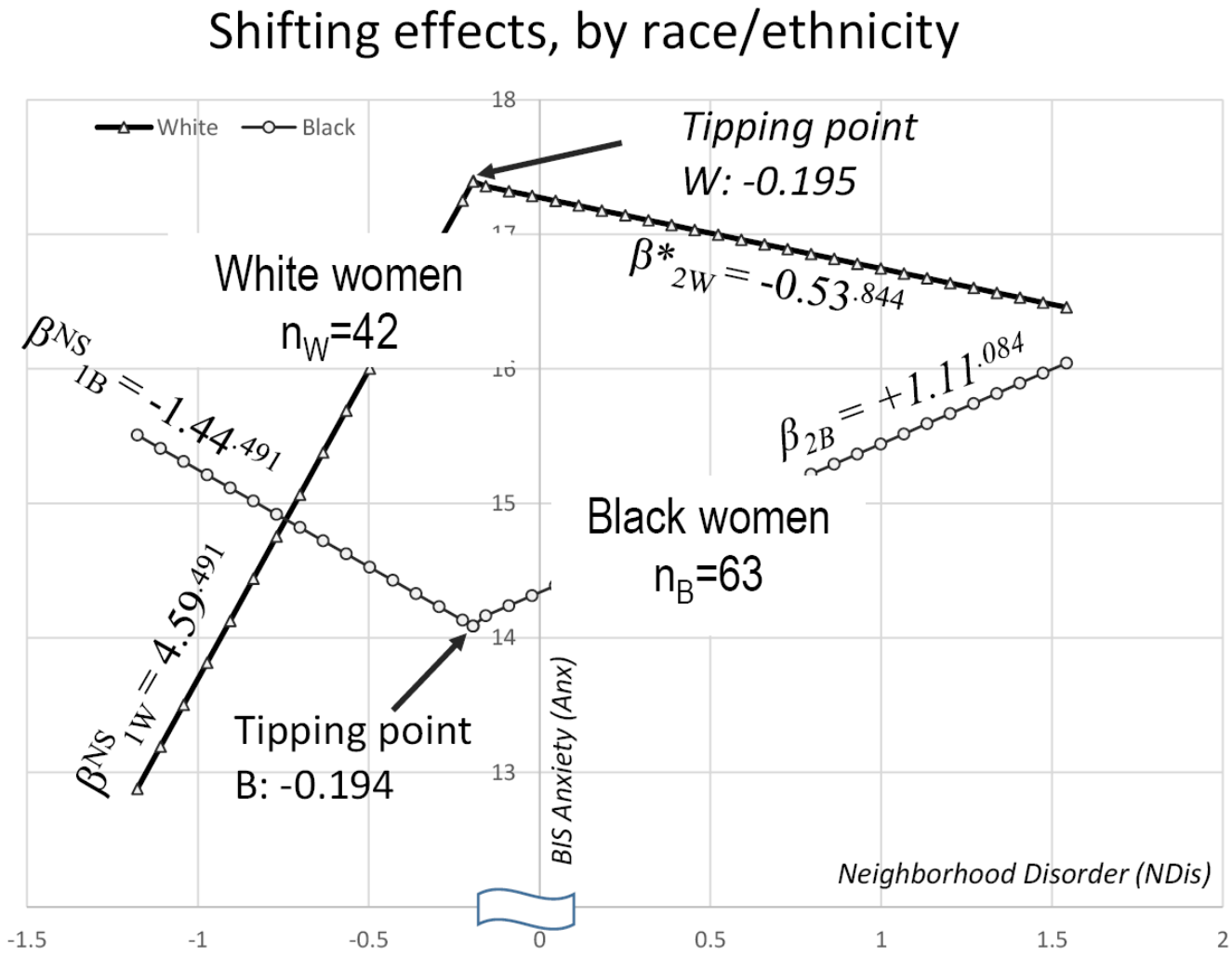


Figure 1. Conceptual model. SES = Socioeconomic status; BMI = Body mass index.

Bradshaw, M., Kent, B. V., Henderson, W. M., & Setar, A. C. (2017). Subjective social status, life course SES, and BMI in young adulthood. *Health Psychology, 36(7), 682-694. doi:10.1037/hea0000487*

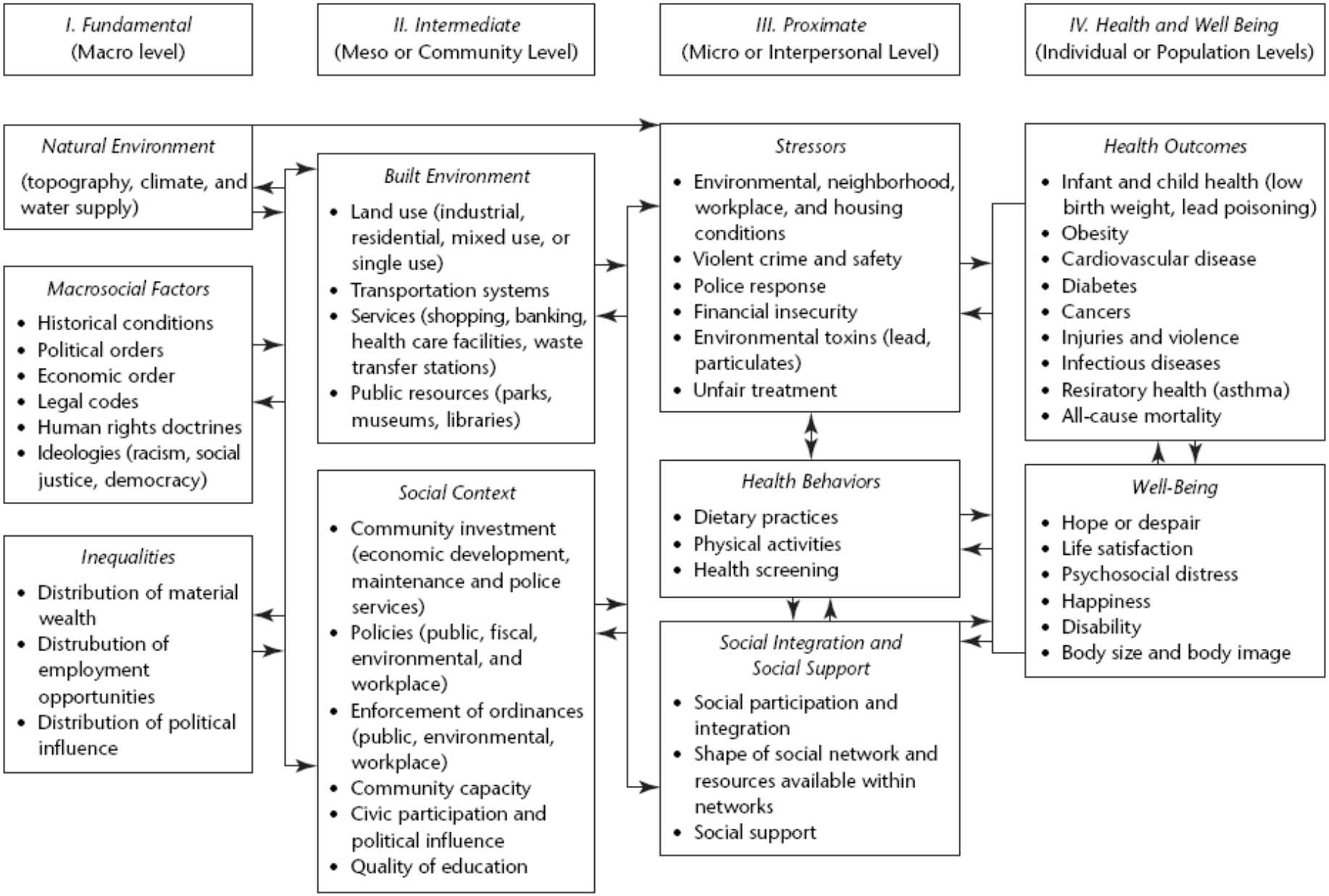
A test of the changing effect

Figure 1. Linear slopes for neighborhood disorder -> anxiety effects, shifting around similar tipping points.



Coman, E. N., & Wu, H. (2018). Examining Differential Resilience Mechanisms by Comparing 'Tipping Points' of the Effects of Neighborhood Conditions on Anxiety by Race/Ethnicity. *Healthcare, 6(1), 18.*

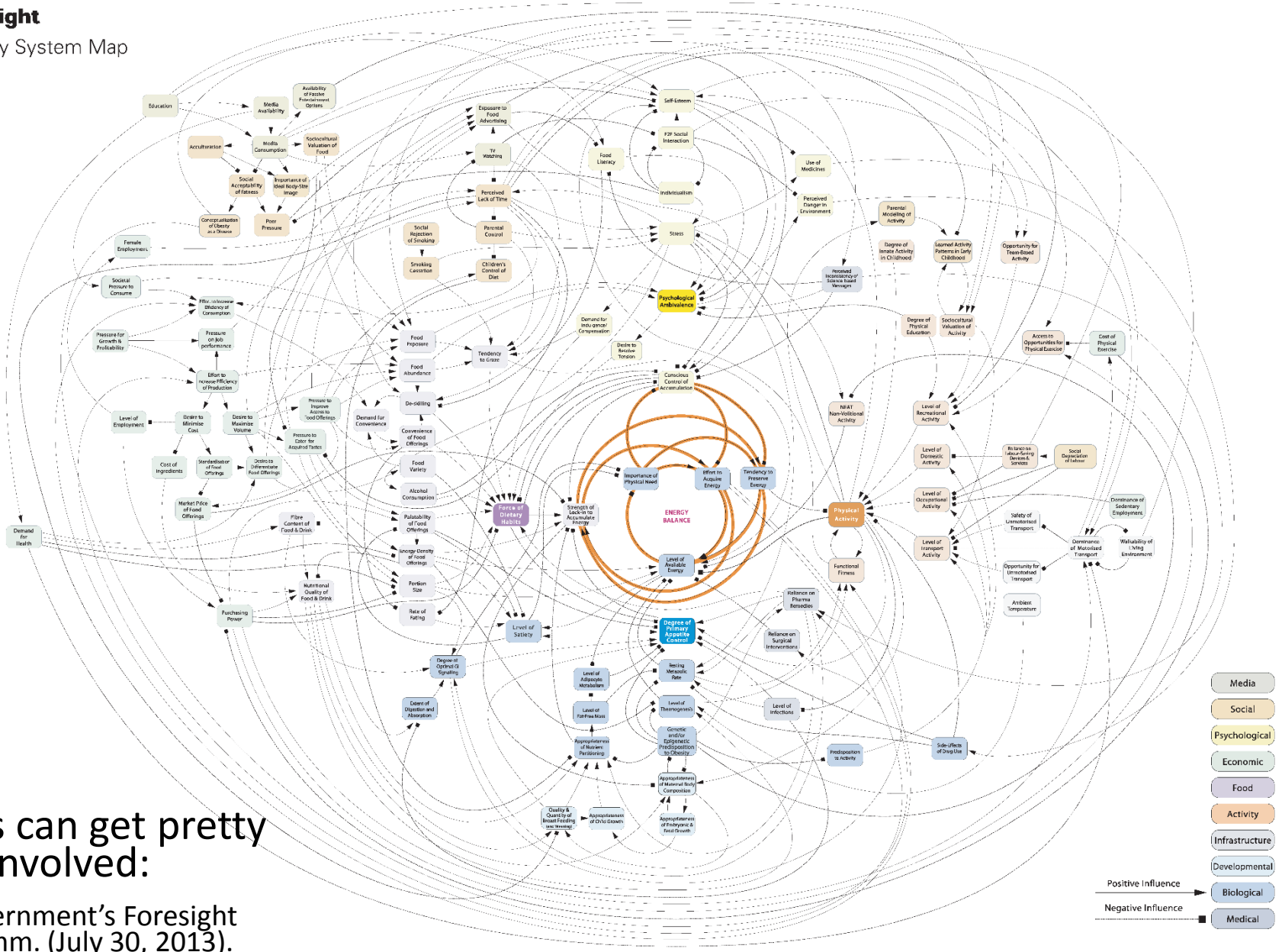
FIGURE 5.3. Environmental levels and their impact on health.



Bartholomew Eldredge, L. K., Markham, C. M., Ruiter, R. A., Fernández, M. E., Kok, G., & Parcel, G. S. (2016). Planning health promotion programs: an intervention mapping approach. P. 221

Foresight

Obesity System Map



Models can get pretty involved:

UK Government's Foresight Programm. (July 30, 2013). *Tackling Obesities Future Choices – Building the Obesity System Map. p. 63*

Models: Logic->Theoretical->Conceptual->Causal

What relates to what in what way

The task is to develop candidate causal models as detailed as possible.

Developing a model requires first an extensive causal search for the 'Big picture': next.

1

A methodical review of the causal role of socioeconomic determinants of health disparities v.1

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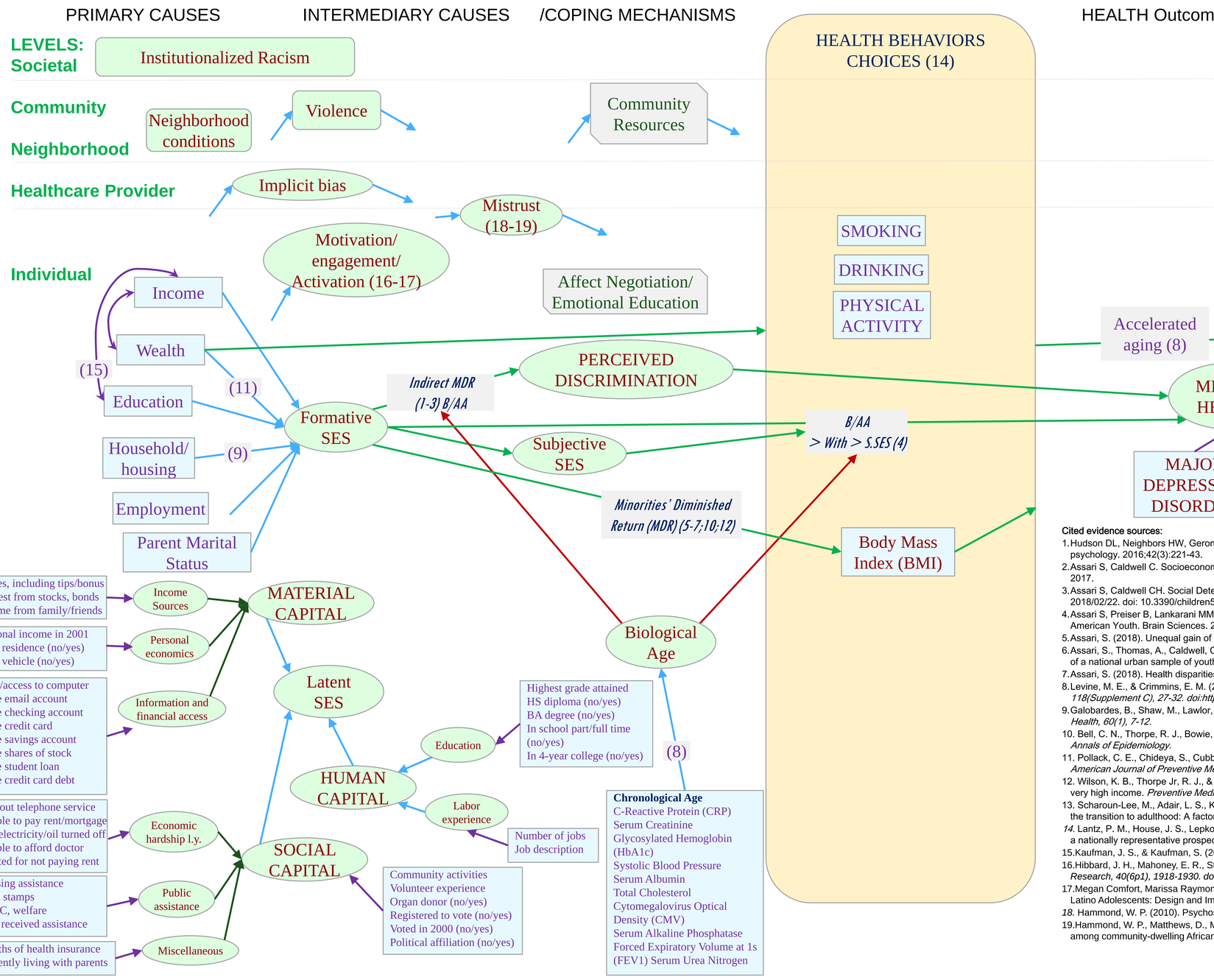

Notes:

- For intuition, we use the Black (B) vs. White (W) comparison example throughout.

1. The 1-group models with Black/White binary regressand (predictor)
- (SES+B/W)->health outcome allowing for interaction between predictors too can test whether the difference in health vary with the levels of SES (as in [10]).
    1. Such models cannot conclude 'SES fully/not explains racial differences in health' as in [11].
    2. An overlooked issue: assumes the same causal structure in B vs. W. e.g.
2. 2-group (B and W) model SES->health can test whether an average health difference (B vs. W), net of SES (whose effect can differ B/W), exists or not.
    1. 2 big groups – classic regression.
    2. Propensity matching models like [11].
    3. A multiple-matched-on-SES-dyads (B and W) model of the variable B vs. W difference score can assess the variability of HDs, then what predicts them too.
3. SES is normally a formative=causal indicator latent measure, sometimes a reflective indicator one too, as in [13] (32 indicators).

Cited evidence sources:

1. Hudson DL, Neighbors HW, Geronimus AT, Jackson JS. Racial discrimination, John Henryism, and depression among African Americans. Journal of Black psychology. 2016;42(3):221-43.
2. Assari S, Caldwell C. Socioeconomic status a vulnerability factor among African American youth; a study of discrimination–depression link. Behavioral Sciences 2017.
3. Assari S, Caldwell CH. Social Determinants of Perceived Discrimination among Black Youth: Intersection of Ethnicity and Gender. Children. 2018;5(2). Epub 2018/02/22. doi: 10.3390/children5020024. PubMed PMID: 29462893; PMCID: PMC5835993.
4. Assari S, Preiser B, Lankarani MM, Caldwell CH. Subjective Socioeconomic Status Moderates the Association between Discrimination and Depression in African American Youth. Brain Sciences. 2018. doi: doi:10.3390/brainsci8040071.
5. Assari, S. (2018). Unequal gain of equal resources across racial groups. *International Journal of Health Policy and Management, 7(1), 1-9.*
6. Assari, S., Thomas, A., Caldwell, C. H., & Mincy, R. B. (2018). Blacks' diminished health return of family structure and socioeconomic status; 15 years of follow-up of a national urban sample of youth. *Journal of Urban Health, 95(1), 21-35.*
7. Assari, S. (2018). Health disparities due to diminished return among black Americans: public policy solutions. *Social Issues and Policy Review, 12(1), 112-145.*
8. Levine, M. E., & Crimmins, E. M. (2014). Evidence of accelerated aging among African Americans and its implications for mortality. *Social Science & Medicine, 118(Supplement C), 27-32. doi:https://doi.org/10.1016/j.socscimed.2014.07.022*
9. Galobardes, B., Shaw, M., Lawlor, D. A., Lynch, J. W., & Smith, G. D. (2006). Indicators of socioeconomic position (part 1). *Journal of Epidemiology & Community Health, 60(1), 7-12.*
10. Bell, C. N., Thorpe, R. J., Bowie, J. V., & LaVeist, T. A. (2017). Race disparities in cardiovascular disease risk factors within socioeconomic status (SES) strata. *Annals of Epidemiology.*
11. Pollack, C. E., Chideya, S., Cubbin, C., Williams, B., Dekker, M., & Braveman, P. (2007). Should health studies measure wealth?: A systematic review. *American Journal of Preventive Medicine, 33(3), 250-264.*
12. Wilson, K. B., Thorpe Jr, R. J., & LaVeist, T. A. (2017). Dollar for dollar: racial and ethnic inequalities in health and health-related outcomes among persons with very high income. *Preventive Medicine, 96, 149-153.*
13. Scharoun-Lee, M., Adair, L. S., Kaufman, J. S., & Gordon-Larsen, P. (2009). Obesity, race/ethnicity and the multiple dimensions of socioeconomic status during the transition to adulthood: A factor analysis approach. *Social Science & Medicine, 68(4), 708-716. doi:https://doi.org/10.1016/j.socscimed.2008.12.009*
14. Lantz, P. M., House, J. S., Lepkowski, J. M., Williams, D. R., Mero, R. P., & Chen, J. (1998). Socioeconomic factors, health behaviors, and mortality: results from a nationally representative prospective study of US adults. *JAMA, 279(21), 1703-1708.*
15. Kaufman, J. S., & Kaufman, S. (2001). Assessment of Structured Socioeconomic Effects on Health. *Epidemiology, 12(2), 157-167. doi: 10.2307/3703617*
16. Hibbard, J. H., Mahoney, E. R., Stockard, J., & Tusler, M. (2005). Development and Testing of a Short Form of the Patient Activation Measure. *Health Services Research, 40(6p1), 1918-1930. doi:10.1111/j.1475-6773.2005.00438.x*
17. Megan Comfort, Marissa Raymond-Flesch, Colette Auerswald, Linda McGlone, Marisol Chavez, & Minnis, A. (2018). Community-engaged Research with Rural Latino Adolescents: Design and Implementation Strategies to Study the Social Determinants of Health. *Stroke, 11(1), 90-108*
18. Hammond, W. P. (2010). Psychosocial correlates of medical mistrust among African American men. *American journal of community psychology, 45(1-2), 87-106.*
19. Hammond, W. P., Matthews, D., Mohottige, D., Agyemang, A., & Corbie-Smith, G. (2010). Masculinity, medical mistrust, and preventive health services delays among community-dwelling African-American men. *Journal of General Internal Medicine, 25(12), 1300-1308.*

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