Executive Summary: The Effect and Predictive Value of the Complete Health Improvement Program on Weight Loss for University Employees

Elizabeth Wang, BSN, RN

School of Nursing, Purdue University

NUR 689: DNP Project II

Azza Ahmed, DNSc, RN, IBCLC, CPNP, FAAN

July 7, 2020

Problem Statement and Significance

Obesity is a costly and pervasive risk factor that requires attention if chronic disease rates are to decrease in the United States (US). It is on the rise with an alarming prevalence of 42.4% in 2017-2018, up from 30.5% in 1999-2000 (CDC, 2020). This translates to 88.7 million US adults who live with this serious condition. Weight gain during adulthood (18-55 years old) is associated with a considerably increased risk of chronic diseases, as well as decreased odds of healthy aging (Zheng et al., 2017). Obesity has a significant annual cost burden of $147 billion due to the direct and indirect medical costs associated with this epidemic. The per capita medical cost for people with obesity was $1,429 more, or 42% higher than those of normal weight (CDC, 2020; Gillis, 2019). These striking statistics point to the need for effective strategies that reduce the adverse health consequences and increasing mortality associated with this major risk factor.

Because obesity is a major contributor to preventable chronic diseases, it is essential to determine if holistic lifestyle interventions like the Complete Health Improvement Program (CHIP) are effective strategies for weight reduction. A promising solution that utilizes a combination of weight loss methods is CHIP, a lifestyle medicine intervention unique for its ability to be adapted to clinical, corporate, or community settings (Morton et al., 2016). The program promotes whole-food, plant-based eating, daily moderate- to high-intensity physical activity, adequate water intake, and stress reduction (Morton et al., 2014). The purpose of this study was to evaluate the effect of CHIP on the primary outcome of weight loss, as well as secondary variables of blood pressure, body fat, lipid levels, and A1c among Purdue University employees using retrospective data from the Center for Healthy Living. Another aim was to build a preliminary predictive model with significant variables for computing the potential weight change that would result for new CHIP participants based on their baseline biomarkers.

Methodology

A pretest-posttest study was conducted on a convenience sample of 68 university employees following institutional review board (IRB) approval. The inclusion criteria for the sample comprised adults aged 18 years or older who completed one of four CHIP classes offered by the Center for Healthy Living between July 2018 and November 2019, regardless of weight status. Each CHIP class at the clinic consisted of 20 sessions total, two sessions per week for the program's 10-week duration. Each session typically lasted one to two hours and involved educational videos, physical exercises, cooking demonstrations, and group discussions.

Biometric assessments were conducted at baseline and around the conclusion of CHIP at 8-10 weeks. Prior to the program, demographic and static data like age, gender, and height were collected on each participant. Number of sessions attended was recorded after CHIP. Biometric data collected at baseline prior to CHIP intervention and following program completion included weight, body mass index (BMI), body fat mass (BFM), percent body fat (PBF), systolic blood pressure (SBP), diastolic blood pressure (DBP), total cholesterol (TC), low-density lipoprotein (LDL), high-density lipoprotein (HDL), triglycerides (TG), and hemoglobin A1c.

Descriptive statistics were computed to obtain measures of central tendency and variability for each biomarker before and after CHIP. Paired *t*-tests were conducted to assess whether biomarker changes were statistically significant from baseline to post-intervention, both for the overall and stratified data. Cohen's *d* statistic was calculated for each stratum to yield effect size. All 15 independent variables were assessed for multicollinearity. Regression analyses performed to create predictive models of weight loss include best subsets, stepwise, and least squares regressions. Statistically significant biomarkers were incorporated into a linear model designed to predict weight loss in new CHIP participants, as validated by the mean square error.

Results

A total of 68 adults completed the CHIP intervention, with a mean age of 46.9 ± 11.7 years and a range of 26-71 years. Of these 68 participants, 11.8% were male (n = 8) and 88.2% were female (n = 60). The mean number of CHIP sessions attended out of 20 was 16.3 ± 2.8, with a range of 9-20 sessions. After 8-10 weeks, participants achieved significant mean reductions in nine out of eleven chronic disease risk factors (Table 1), including the primary outcome of weight ($p < 0.001$), as well as secondary outcomes of BMI ($p < 0.001$), BFM ($p < 0.001$), PBF ($p = 0.017$), DBP ($p = 0.003$), TC ($p < 0.001$), LDL ($p = 0.006$), HDL ($p < 0.001$), and A1c ($p = 0.027$). The data in all substrata improved for all risk factors excluding those in the normal range for SBP, DBP, LDL, and TG, in addition to those in the second category for TG (Table 2). Participants who enrolled with the highest risk factor classifications often experienced the greatest improvements by the end of the CHIP intervention with large effect sizes.

Five variables, BFM, PBF, weight, TC, and DBP, were removed from the original 15 to minimize multicollinearity related to their strong correlation ($|r| \geq 0.7$) with other independent variables. The resulting 10 noncollinear variables, age, gender, height, sessions attended, as well as baseline BMI, SBP, LDL, HDL, TG, and A1c, were introduced as independent variables in best subsets and stepwise regressions. According to best subsets regression, the cumulative order in which variables should be included based on number of desired predictors is SBP for the best-fitting one-predictor model, then sessions attended, age, LDL, gender, BMI, A1c, HDL, TG, and height (Figure 1). The model that yielded the highest adjusted R^2 was the four-predictor model with SBP, sessions attended, age, and LDL, while the one with the least-biased Mallows' C_p-statistic and lowest BIC value was the one-predictor model with SBP. Stepwise regression also selected the one-predictor model with SBP as the most statistically significant.

A statistical comparison between the one-predictor and four-predictor models showed that adding three predictors in the latter did not lead to a significantly improved fit over the simpler, one-predictor model (Table 3). Ordinary least squares regression was conducted on the one significant variable, SBP, which revealed a negative correlation (Figure 2). The coefficient value signifies that a participant can expect to lose a mean of 2.31 pounds more for every one millimeter of mercury higher the baseline SBP. A test for the exclusion of all variables except for SBP was performed using the *F*-statistic, which yielded a non-significant *p*-value ($F = 0.4833$; $p = 0.8779$). This indicates that the inclusion of all 10 noncollinear predictors did not lead to a significantly improved fit over the one-predictor model. Based on our dataset, the best predictive model for weight loss comprises SBP as the sole predictor with a mean square error of 56.145.

Discussion

The aim of this study was to evaluate the effect of the CHIP intervention on weight, blood pressure, body fat, lipid levels, and A1c. Our findings validate the short-term effectiveness of CHIP for weight loss and reduction of cardiovascular risk factors in a Midwestern community setting. The significant decrease in weight, BMI, DBP, TC, and LDL is consistent with past CHIP studies, though one distinction is that this study did not identify substantial differences in SBP or TG. Three previous studies reported that participants with the highest classifications of BMI, SBP, TC, LDL, FPG, and TG at program entry experienced the greatest reductions in these measures after 30 days (Kent et al., 2014; Morton et al., 2013; Morton et al., 2014). Likewise, our results revealed that participants in the highest classifications of BMI, SBP, TC, LDL, and TG observed the greatest reductions in these measures following 8-10 weeks of intervention.

Results from our linear regression analyses affirmed the one-predictor model with SBP as the best model for predicting change in weight following the CHIP intervention. SBP was the

only statistically significant variable for predicting weight loss, demonstrating that changes in SBP are associated with changes in weight at the population level. It is the most useful predictor of weight loss out of all 10 noncollinear variables investigated. The negative regression coefficient suggests that the higher the baseline SBP, the more weight one can expect to lose through CHIP (Figure 2). The association between weight and blood pressure is well-supported by past epidemiological studies, which established that weight gain is a decisive risk factor in the development of hypertension (Mertens & van Gaal, 2000).

One key strength of this study includes the regression analyses conducted to build a preliminary linear model projecting how much weight loss a new participant might experience following CHIP, based on their baseline biomarkers. This can have important implications. With more data, a robust model can motivate adults to participate in lifestyle interventions when they see how much weight they are likely to lose. One limitation of this study is that only one setting was used; therefore, the results from this study may not be generalized to other contexts. The inclusion of a single setting also contributed to a small sample size relative to a large university employee population, which may increase variability and the margin of error. It is also vital to take the small sample size and R^2 into account as limitations for the chosen one-predictor model. The model's R^2 value indicates that the predictor variable, SBP, only explains about 20% of the variance in weight change. Therefore, further analysis is needed on larger samples to create a robust model that delivers more precise weight loss predictions for future CHIP participants.

Implications

Systems

The Center for Healthy Living was created out of Purdue University's commitment to employee health (Purdue HR Benefits, 2019). Services include both acute and primary care,

enabling employees to establish long-term, trusting relationships with local providers. The purpose of primary care is to deliver comprehensive, whole-person care for individual health needs across the lifespan, ranging from promotion and prevention to treatment and rehabilitation (World Health Organization [WHO], 2019). It also addresses interrelated physical, emotional, mental, and social determinants of health. Purdue University upholds these principles by offering CHIP, which empowers employees to enact positive lifestyle changes (Purdue University, 2018).

CHIP's fundamental components of lifestyle, nutrition, exercise, and attitude encompass the educational goals of primary care (Morton et al., 2016). Purdue University ultimately reaps the economic and productivity benefits from an intervention that promotes weight loss and healthy lifestyle practices among employees. On a larger scale, Ford et al. (2009) estimated that approximately 80% of chronic diseases could be prevented by adhering to four healthy lifestyle factors, including not smoking, eating healthily, being physically active for more than 3.5 hours per week, and maintaining a BMI less than 30. This has far-reaching implications of lowering the mortality and expenditures largely driven by chronic diseases within the US health care system.

A key advantage of administering CHIP is that both professional and volunteer-facilitated delivery have resulted in similarly low dropout rates and significant health outcomes in the past (Morton et al., 2016). Training workshops, curriculum packages, and presentations are available to health professionals and non-health-trained volunteers to facilitate CHIP in local communities. The accessible and flexible nature of delivery in clinical, corporate, or community settings makes the program a prime candidate for enacting health promotion and prevention on a national scale.

Economics

In the US, the annual cost burden of obesity is $147 billion, placing 1 in 5 children and 1 in 3 adults at risk for chronic diseases like heart disease, cancer, and diabetes (NCCDPHP,

2020). Six in 10 adults suffer from a chronic disease, and four in 10 adults live with two or more (NCCDPHP, 2019b). Heart disease, cancer, and diabetes are not only the leading causes of death and disability in the US, but also key drivers in the nation's $3.5 trillion in annual health care expenditures (NCCDPHP, 2019a). In fact, 90% of these costs are attributed to those with chronic conditions (NCCDPHP, 2020). Heart disease and stroke kill more than 859,000 Americans per year, accounting for one-third of all deaths. The health cost of cardiovascular diseases is rivaled only by their staggering economic toll, which costs the US health care system $214 billion per year and $137 billion in lost productivity from premature death alone (NCCDPHP, 2019c).

Despite evidence that increased use of primary care is associated with lower costs, higher patient satisfaction, fewer hospitalizations and emergency department visits, and lower mortality, primary care spending in the US accounts for a mere 5-7% of all health expenditures (Jabbarpour et al., 2019). This represents a gross underinvestment compared to the 14% of all health spending devoted to primary care in other industrialized countries. An investment of $10 per person per year in disease prevention programs could save $16 billion in annual health care costs within five years, and the return-on-investment (ROI) in community-based prevention is $5.60 for every $1 invested (Levi et al., 2008). Lifestyle interventions with diet counseling and exercise sessions improve quality of life and are highly cost-effective at $1,668 to $4,813 per gained quality-adjusted life year (QALY) with a net savings of $47 per participant (Eriksson et al., 2010).

Baicker et al. (2010) suggests that medical and absenteeism costs fall by $3.27 and $2.73, respectively, for every dollar spent on workplace wellness programs like CHIP. Furthermore, Shurney et al. (2012) found that the ROI for offering workplace CHIP was $1.38 for every dollar invested within six months. In one study, CHIP participants slashed health services utilization costs by 43% and medication costs by 14% compared to the control group that increased

utilization costs by 13% and medication costs by 10% (Shurney et al., 2012). The cost of the CHIP course ranges from $250 to $450 and includes two biometric assessments, food samples, resource books, a water bottle, and pedometer (Leibold et al., 2016). The clinical benefits and cost-effectiveness of CHIP make it an optimal intervention for promoting community health.

Policy

Initiatives focused on primary care and health promotion are crucial for improving health outcomes. In 2019, the Center for Medicare & Medicaid Innovation (CMMI) introduced five new primary care payment and delivery models, and seven states passed legislation to expand primary care investment while curbing increases in health care spending (Jabbarpour et al., 2019). In 2007, patient-centered medical homes (PCMH) were implemented as an advanced primary care model for delivering comprehensive, accessible, and high-quality care. Evidence shows that PCMHs and primary care-oriented health care systems result in reduced costs and improved clinical quality, health equity, patient satisfaction, and utilization (Jabbarpour et al., 2019). However, there is a major disconnect between this robust evidence and the current US underinvestment of 5-7% in primary care, hindering PCMHs from realizing their full potential and preventing primary care practices from giving patients the scope of services they deserve.

A common theme among the eight states that have enacted primary care investment policies is multistakeholder collaboration, which involves the engagement of stakeholders from all parts of the community and health care system (Jabbarpour et al., 2019). These collaboratives include discussions on measurement, or how primary care investment should be standardized for tracking and reporting in the long term. This data collection can facilitate state efforts to allocate resources toward programs that identify improved clinical and economic outcomes as a result of increased investment. One such potential program is CHIP, an intervention grounded in health

promotion and prevention. A major advantage of CHIP is its integrated measurement of pre- and post-CHIP biometric data, which researchers have capitalized on to validate its effectiveness for reducing chronic disease risk factors and health-related costs. Although the program was initially developed for middle to high socioeconomic groups in the US, studies have shown similar levels of effectiveness in other areas like Australasia and Canada, in addition to low socioeconomic and rural communities with high levels of poverty in the US (Kent et al., 2015). Because CHIP can be contextualized for inner city or rural communities with lower literacy rates, greater investment and emphasis on policies supporting programs like CHIP are needed to benefit population health.

Practice

Although multistakeholder collaboratives are often discussed in the context of leading states' primary care-oriented policies, collaboration may also be the key to finding success in clinical practice. Center for Healthy Living exemplifies the multidisciplinary collaboration that must occur between providers, health coaches, dieticians, and counselors to promote CHIP as a tool for engaging in healthy practices. The significant mean reductions in nine out of eleven risk factors, including weight, validate the health coaches' effective delivery of the intervention. When participants return to the clinic after the program, providers have the opportunity to follow up on dietary and exercise changes they have implemented and ask about their progress toward establishing a healthy lifestyle. This discussion can be seamlessly integrated into wellness visits, where emphasis is already placed on primary, secondary, and tertiary prevention. These goals of primary care are addressed precisely by CHIP through holistic education on nutrition, exercise, water, stress, and sleep (primary), screening through pre- and post-CHIP labs (secondary), and treatment by using lifestyle as medicine to potentially reverse existing chronic diseases (tertiary).

An important distinction about CHIP is its ability to be adapted to and yield similarly effective results in clinical, corporate, and community settings alike (Morton et al., 2016). The program provides participants with resources and tools to sustain healthy lifestyle changes long-term, giving providers the opportunity to reinforce this learning at each wellness visit. One possible barrier to implementing CHIP in a new setting is lack of training or knowledge about the program. Therefore, to maximize CHIP's benefit, it would be beneficial for providers and other clinical professionals to familiarize themselves with CHIP's core values in order to encourage ongoing healthy habits. In addition, this study's regression model can be used to motivate individuals to join the program when they see how much weight they would predictably lose based on their baseline biomarkers. Research has demonstrated the effectiveness of CHIP in diverse settings around the world. With today's alarming rates of obesity and chronic disease, changes will become increasingly urgent and necessary to reorient the U.S. health care system toward primary care by investing in clinically and economically beneficial programs like CHIP.

References

Baicker, K., Cutler, D., & Song, Z. (2010). Workplace wellness programs can generate savings. *Health Affairs*, *29*(2), 304–311. https://doi.org/10.1377/hlthaff.2009.0626

Centers for Disease Control and Prevention. (2020, February 27). *Adult obesity facts*. https://www.cdc.gov/obesity/data/adult.html

Eriksson, M. K., Hagberg, L., Lindholm, L., Malmgren-Olsson, E.-B., Österlind, J., & Eliasson, M. (2010). Quality of life and cost-effectiveness of a 3-year trial of lifestyle intervention in primary health care. *Archives of Internal Medicine*, *170*(16). https://doi.org/10.1001/archinternmed.2010.301

Ford, E. S., Bergmann, M. M., Kröger, J., Schienkiewitz, A., Weikert, C., & Boeing, H. (2009). Healthy living is the best revenge: Findings from the European prospective investigation into cancer and nutrition–Potsdam study. *Archives of Internal Medicine*, *169*(15), 8. doi:10.1001/archinternmed.2009.237

Gillis, L. J. (2019). The effect of a lifestyle intervention on weight loss for university employees. *Journal of Community Health Nursing*, *36*(4), 208–223. https://doi.org/10.1080/07370016.2019.1665309

Jabbarpour, Y., Greiner, A., Jetty, A., Coffman, M., Jose, C., Petterson, S., Pivaral, K., Phillips, R., Bazemore, A., & Kane, A. N. (2019, July). *Investing in primary care: A state-level analysis.* Robert Graham Center. https://www.graham-center.org/content/dam/rgc/documents /publications-reports/reports/Investing-Primary-Care-State-Level-PCMH-Report.pdf

Kent, L. M., Reierson, P., & Morton, D. P. (2015). “Live more”: Study protocol for a

community-based lifestyle education program addressing non-communicable diseases in low-literacy areas of the South Pacific. *BMC Public Health*, *15*(1), 1221. https://doi.org/10.1186/s12889-015-2560-1

Kent, L. M., Morton, D. P., Rankin, P. M., Mitchell, B. G., Chang, E., & Diehl, H. (2014). Gender differences in effectiveness of the Complete Health Improvement Program (CHIP) lifestyle intervention: An Australasian study. *Health Promotion Journal of Australia: Official Journal of Australian Association of Health Promotion Professionals, 25*(3), 222–229. https://doi.org/10.1071/HE14041

Leibold, C., Shubrook, J. H., Nakazawa, M., & Drozek, D. (2016). Effectiveness of the Complete Health Improvement Program in reducing risk factors for cardiovascular disease in an Appalachian population. *The Journal of the American Osteopathic Association*, *116*(2), 84–91. https://doi.org/10.7556/jaoa.2016.020

Levi, J., Segal, L. M., & Juliano, C. (2008). *Prevention for a healthier America: Investments in disease prevention yield significant savings, stronger communities.* Trust for America's Health. https://www.preventioninstitute.org/sites/default/files/publications/Prevention%20for%20a%20Healthier%20America_0.pdf

Mertens, I. L., & van Gaal, L. F. (2000). Overweight, obesity, and blood pressure: The effects of modest weight reduction. *Obesity Research, 8*(3), 270–278. https://doi.org/10.1038/oby.2000.32

Morton, D., Rankin, P., Kent, L., & Dysinger, W. (2016). The Complete Health Improvement Program (CHIP): History, evaluation, and outcomes. *American Journal of Lifestyle Medicine*, *10*(1), 64–73. https://doi.org/10.1177/1559827614531391

Morton, D., Rankin, P., Kent, L., Sokolies, R., Dysinger, W., Gobble, J., & Diehl, H. (2014). The

Complete Health Improvement Program (CHIP) and reduction of chronic disease risk factors in Canada. *Canadian Journal of Dietetic Practice & Research, 75*(2), 72–77. https://doi.org/10.3148/75.2.2014.72

Morton, D. P., Rankin, P., Morey, P., Kent, L., Hurlow, T., Chang, E., & Diehl, H. (2013). The effectiveness of the Complete Health Improvement Program (CHIP) in Australasia for reducing selected chronic disease risk factors: A feasibility study. *The New Zealand Medical Journal*, *126*(1370), 43–54.

National Center for Chronic Disease Prevention and Health Promotion. (2019a, October 23). *About chronic diseases*. Centers for Disease Control and Prevention. https://www.cdc.gov/chronicdisease/about/index.htm

National Center for Chronic Disease Prevention and Health Promotion. (2019b, October 23). *Chronic diseases in America.* Centers for Disease Control and Prevention. https://www.cdc.gov/chronicdisease/resources/infographic/chronic-diseases.htm

National Center for Chronic Disease Prevention and Health Promotion. (2020, March 23). *Health and economic costs of chronic disease*. Centers for Disease Control and Prevention. https://www.cdc.gov/chronicdisease/about/costs/index.htm

National Center for Chronic Disease Prevention and Health Promotion. (2019c, March 21). *Heart disease and stroke*. Centers for Disease Control and Prevention. https://www.cdc.gov/chronicdisease/resources/publications/factsheets/heart-disease-stroke.htm

Purdue HR Benefits. (2019, April 30). *Why we created the Center for Healthy Living* [Video]. YouTube. https://www.youtube.com/watch?v=pydC4Vwn4Iw&list=PLlDBMgfK13jxFO8Ny-O6VWg9gz-Pc7Hqt

Purdue University. (2018, June 28). *Center for Healthy Living introduces CHIP, a new intensive lifestyle program.* https://www.purdue.edu/newsroom/purduetoday/releases/2019/Q1/center-for-healthy-living-offers-education,-programming-focused-on-plant-based-diets.html

Shurney, D., Hyde, S., Hulsey, K., Elam, R., Cooper, A., & Groves, J. (2012). CHIP lifestyle program at Vanderbilt University demonstrates an early ROI for a diabetic cohort in a workplace setting: A case study. *Journal of Managed Care Medicine, 15*(4), 5-15. Retrieved May 25, 2020, from https://pdfs.semanticscholar.org/a99c/9719f9f1c271916ad36c8ae4807219276339.pdf

World Health Organization. (2019, February 27). *Primary health care*. https://www.who.int/news-room/fact-sheets/detail/primary-health-care

Zheng, Y., Manson, J. E., Yuan, C., Liang, M. H., Grodstein, F., Stampfer, M. J., Willett, W. C., & Hu, F. B. (2017). Associations of weight gain from early to middle adulthood with major health outcomes later in life. *Journal of the American Medical Association, 318*(3), 255. https://doi.org/10.1001/jama.2017.7092

Table 1

Mean Changes in Chronic Disease Risk Factors from Baseline to Post-Intervention

Factor	N	Baseline mean (SD)		Post-intervention mean (SD)		Mean change	% Mean change	*t*-statistic	*p*-value
Weight (lb)	68	199.2	54.1	193.5	52.6	-5.6	-2.8	8.3	<0.001
BMI (kg/m^2)	68	32.2	7.7	31.3	7.4	-0.9	-2.8	8	<0.001
BFM (lb)	67	85.5	37	82.2	36.2	-3.4	-3.9	4.2	<0.001
PBF (%)	67	41.5	8.1	41.1	8.2	-0.5	-1.1	2.4	0.017
SBP (mmHg)	68	120.8	15.8	119.1	13.3	-1.7	-1.4	1.1	0.256
DBP (mmHg)	68	80.5	9.9	77.9	8.1	-2.6	-3.2	3.1	0.003
TC (mg/dL)	68	189.9	41.9	172.3	36.9	-17.6	-9.3	5.3	<0.001
LDL (mg/dL)	60	106.4	33.2	96.2	29.1	-10.2	-9.6	2.9	0.006
HDL (mg/dL)	68	59.6	17.3	53.6	12.9	-6	-10	5.2	<0.001
TG (mg/dL)	67	135.5	89	129.1	77.3	-6.3	-4.7	0.7	0.458
A1c (%)	68	5.3	0.4	5.2	0.4	-0.1	-2	2.3	0.027

Note. BMI = body mass index; BFM = body fat mass; PBF = percent body fat; SBP = systolic blood pressure; DBP = diastolic blood pressure; TC = total cholesterol; LDL = low-density lipoprotein cholesterol; HDL = high-density lipoprotein cholesterol; TG = triglycerides; A1c = glycated hemoglobin; SD = standard deviation

Table 2

Changes in Chronic Disease Risk Factor Levels within 10 Weeks According to Initial Risk Factor Classification

Risk factor	Baseline number	Post-intervention number	Baseline mean (SD)	Post-intervention mean (SD)	Mean change	% Mean change	*p*-value	Cohen's *d*
BMI (kg/m^2)								
18.5-24.99	13	14	23.1 (1)	22.5 (1.2)	-0.6	-2.6	0.001	0.634
25-30	16	17	27.2 (1.4)	26.7 (1.4)	-0.5	-1.8	0.015	0.355
>30	39	37	37.3 (6.1)	36.2 (6)	-1.2	-3.1	<0.001	0.192
SBP (mmHg)								
<120	32	37	106.9 (7.1)	110.7 (8.7)	3.8	3.6	0.019	-0.538
120-140	28	27	128.8 (6.3)	125.1 (12.4)	-3.7	-2.9	0.111	0.59
>140	8	4	148 (4.9)	131.5 (11.6)	-16.5	-11.1	0.001	3.368
DBP (mmHg)								
<80	31	37	72.1 (5.3)	73.6 (6.2)	1.5	2.1	0.105	-0.289
80-90	31	28	85.3 (3.8)	79.9 (6.4)	-5.4	-6.4	<0.001	1.434
>90	6	3	99.7 (6.7)	90.3 (8)	-9.3	-9.4	0.004	1.384
TC (mg/dL)								
<160	17	25	137.7 (15.8)	135.4 (23.1)	-2.3	-1.7	0.658	0.146
160-199	26	29	182.2 (10.8)	163.4 (22)	-18.8	-10.3	<0.001	1.74
200-240	16	11	218.1 (12.1)	205.8 (27.1)	-12.4	-5.7	0.065	1.021
>240	9	3	260.6 (20.1)	207.9 (25.5)	-52.7	-20.2	0.001	2.625
LDL (mg/dL)								
<100	28	42	77 (17.7)	80 (19.9)	3	3.9	0.539	-0.168
100-129	26	16	111.7 (8.7)	97.2 (22.7)	-14.5	-13	0.002	1.675
130-160	10	8	145 (8)	125.2 (29.1)	-19.8	-13.6	0.088	2.486
>160	4	2	181.2 (12.3)	130.5 (40.3)	-50.8	-28	0.136	4.131
HDL (mg/dL)								
<40	7	7	37.3 (1.7)	36.1 (4.3)	-1.1	-3.1	0.544	0.671
40-60	32	41	50.1 (5.5)	49.4 (8)	-0.8	-1.5	0.554	0.136
>60	29	20	75.3 (14)	62.4 (12.1)	-12.9	-17.2	<0.001	0.921
TG (mg/dL)								
<100	27	26	74.6 (16.2)	90.8 (39.9)	16.3	21.8	0.022	-1.003
100-199	33	33	136.4 (29.2)	139.1 (70.6)	2.6	1.9	0.83	-0.09
200-300	3	4	250.3 (32.1)	130.3 (14.2)	-120	-47.9	0.046	3.733
>300	5	5	389.2 (89.9)	270 (119.2)	-119.2	-30.6	0.017	1.327
A1c (%)								
<5.7	57	57	5.2 (0.2)	5.1 (0.3)	0	-0.5	0.549	0.128
5.7-6.4	9	11	5.9 (0.2)	5.5 (0.3)	-0.5	-7.9	0.001	2.985
≥6.5	2	0	6.8 (0.5)	6.2 (0.4)	-0.7	-10.2	0.451	1.414

Note. BMI = body mass index; SBP = systolic blood pressure; DBP = diastolic blood pressure; TC = total cholesterol; LDL = low-density lipoprotein cholesterol; HDL = high-density lipoprotein cholesterol; TG = triglycerides; A1c = glycated hemoglobin; SD = standard deviation

Table 3

Comparison of Linear Regression Models with 4 Predictors (Model 1) vs. 1 Predictor (Model 2)

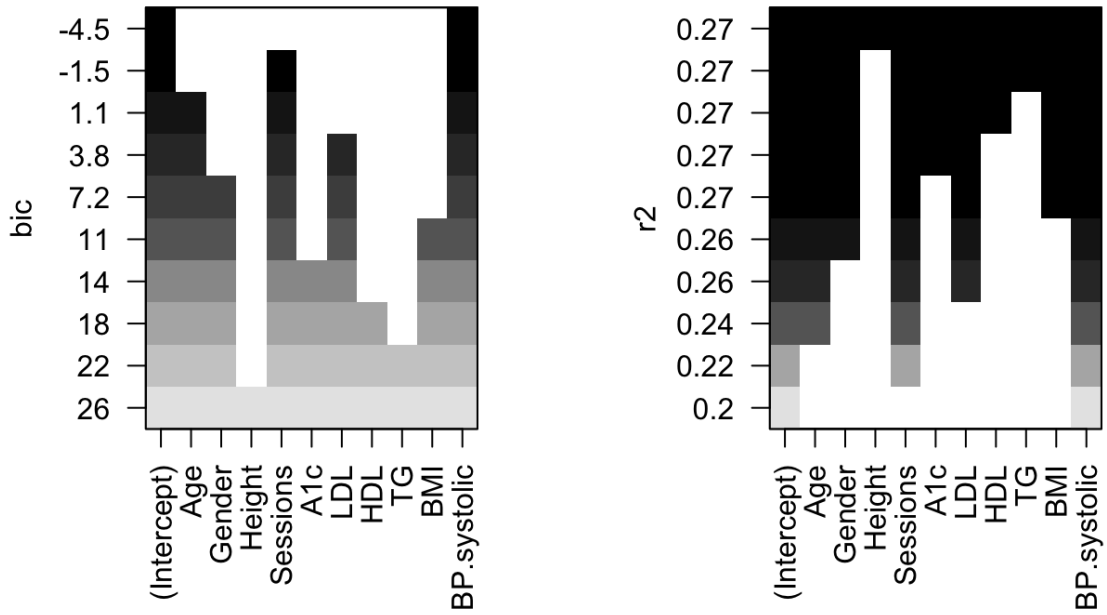
	Model 1 Est. (SE)	Model 2 Est. (SE)
(Intercept)	-4.89 ***	-4.89 ***
	(0.62)	(0.62)
BP.systolic	-2.24 **	-2.31 ***
	(0.65)	(0.63)
Sessions	-0.85	
	(0.65)	
Age	0.92	
	(0.68)	
LDL	-0.71	
	(0.66)	
R^2	0.255	0.203
F	4.281	13.497
p	0.005	0.001
N	55	55

Note. Est = estimate of coefficient; SE = standard error. All continuous predictors are mean-centered and scaled by 1 standard deviation.

*** p < 0.001; ** p < 0.01; * p < 0.05

Figure 1

Graphical Plots of Best Subsets Model at Each Variable Number with Evaluation Metrics (BIC, R^2)



Note. BIC = Bayesian information criteria; R^2 = proportion of variance for weight loss based on independent predictors

Figure 2

Relationship between Systolic Blood Pressure and Weight Difference with Line of Best Fit