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Attainment of targets of the 20-year infancy-onset dietary intervention and blood pressure across childhood and young adulthood: The Special Turku Coronary Risk Factor Intervention Project (STRIP)

Short Running Title: Diet and blood pressure from infancy to adulthood

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ABSTRACT

We examined whether success in achieving the key targets of an infancy-onset 20-year dietary intervention was associated with blood pressure (BP) from infancy to young adulthood. In the prospective randomized Special Turku Coronary Risk Factor Intervention Project (N=877 children), dietary counseling was provided biannually based on the Nordic Nutrition Recommendations primarily to improve the quality of dietary fat in children's diets and secondarily to promote intake of vegetables, fruits, and whole grains. Dietary data and BP were accrued annually from the age of 13 months to 20 years. The dietary targets for fat quality were defined as the ratio of saturated fatty acids (SAFA) to monounsaturated and polyunsaturated fatty acids (MUFA+PUFA) <1:2 and intake of SAFA<10E%; dietary fiber intake in the top age-specific quintile; and dietary sucrose intake as being in the lowest age-specific quintile. Attaining a higher number of the dietary targets was associated with lower systolic BP (mean [SE] systolic BP 107.3[0.3], 107.6[0.3], 106.8[0.3], and 106.7[0.5]mmHg in participants meeting 0, 1, 2, and 3-4 targets, respectively; P=0.03), and diastolic BP (mean [SE] diastolic BP, 60.4[0.2], 60.5 [0.2], 59.9 [0.2], and 59.9 [0.3] mmHg; P=0.02). When the lowest age-specific quintile of dietary cholesterol was added as an additional target, the association with systolic BP remained significant (P=0.047), but the association with diastolic BP attenuated (P=0.13). Achieving the key targets of an infancy-onset 20-year dietary intervention, reflecting dietary guidelines, was favorably albeit modestly associated with systolic and diastolic BP from infancy to young adulthood.

Keywords: diet; blood pressure; infancy; adolescence; epidemiology

INTRODUCTION

Dietary composition is related to hypertension and cardiometabolic diseases that together result in considerable health and economic burdens[1]. Dietary guidelines universally emphasize consumption of unsaturated fats and limiting saturated fat intake, together with increased consumption of fruits, vegetables, whole grains, and dietary fiber, and avoidance of added sugar and salt[2,3].

Elevated blood pressure (BP) in childhood increases the risk for adult hypertension and predicts subclinical atherosclerosis and cardiovascular disease events[4-8]. Previous data suggest that nutrition during the first years of life may have an important role in programming of the future BP[4,9]. In the Special Turku Coronary Risk Factor Intervention Project (STRIP), we have earlier shown that both systolic BP and diastolic BP were an average 1.0 mmHg lower in children receiving low-saturated-fat dietary counseling from infancy to 15 years of age compared to control children[10]. However, it has not been explored how meeting the key STRIP dietary intervention targets, reflecting dietary guidelines, associates with blood pressure from early childhood to adulthood.

Using data from the 20-year dietary intervention trial, the STRIP study, we therefore examined whether success in achieving the key dietary targets, reflecting dietary guidelines of fat quality, dietary fiber, and sugar intake were associated with blood pressure between 13 months and 20 years of age regardless of the original study group allocation.

METHODS

Because of the sensitive nature of the data collected for this study, requests to access the dataset from qualified researchers trained in human subject confidentiality protocols may be sent to the STRIP Steering Committee (University of Turku) at katja.pahkala@utu.fi.

Design and Participants

The STRIP study, a prospective, randomized, controlled trial to prevent atherosclerosis beginning in infancy, recruited families with 5-month-old infants at well-baby clinics in Turku, Finland from 1990-1992[11]. Initial power calculations of the STRIP showed that 334 participants were required to achieve 5% probability of type I error and 80% power for repeated measures ANOVA (total sequence of 21 measurements) for the desired effect of 0.2 mmol/l reduction in serum total cholesterol in the intervention group. At the age of 7 months, 1062 infants (56.5 % of the eligible age cohort) were randomly allocated to dietary intervention (n=540) or control (n=522) groups.

Intervention group received individualized dietary counseling provided by nutritionists at least biannually beginning at the age of 7 months until the age of 20 years[11,12]. The counselling was given to parents until the child was seven years old, and thereafter, gradually more information was given directly to the child. The main aim of the intervention was to replace saturated fat with unsaturated fat in order to lower LDL-cholesterol levels. Reduction in total fat intake was not targeted. From the age of 12 months, use of skim milk was recommended over milks containing more milkfat. To maintain adequate fat intake, the parents were instructed to add daily 2-3 teaspoons (10 g) of soft margarine or vegetable oil to the child's food from age 12 to 24 months. The counseling also promoted intake of vegetables, fruits, and whole-grain products, and low intake of cholesterol and salt was favored. The dietary recommendations were based on Nordic Nutrition Recommendations available at the time. The control group was seen biannually until the age of 7 years and annually thereafter until 20 years of age[11]. Similar measurements, including keeping of food diaries, were performed for both study groups, and they met the same study personnel. Children in the control group received only the standard health education given at all Finnish well-baby clinics and school health care.

The STRIP study is conducted according to the guidelines of the Declaration of Helsinki and the study protocol is approved by the local ethics committee. Written informed consent was received from the participants' parents in the beginning of the study. At the ages of 15 and 18 years, the participants gave their own informed consent.

The present study comprised participants who provided data on diet and BP between ages 13 months and 20 years.

Assessment of dietary intake and dietary targets

Food consumption was recorded using a 4-day food records (consecutive days; at least one weekend day included)[13]. A nutritionist checked the food records for accuracy, and the food and nutrient intakes were analyzed with Micro Nutrica program, which was continuously updated according to the most recent food and nutrient databases[14].

According to the targets of the dietary intervention given in STRIP, the targeted quality of dietary fat was defined using two criteria: the ratio of saturated fatty acids (SAFA) to monounsaturated and polyunsaturated fatty acids (MUFA+PUFA) <1:2, and the intake of SAFA <10 E%[14]. Intake of fiber indicated the success of achieving the other key intervention target, favoring whole-grain products, and consumption of fruits and vegetables. We defined the targeted intake of dietary fiber being at the top age-specific quintile[15]. In the absence of a consensus recommendation on sucrose intake, we used the lowest age-specific quintile as the definition of desired sucrose intake[15]. Participants were given 1 point for meeting each of the four targets: SAFA/(MUFA+PUFA) <1:2, SAFA<10 E%, dietary fiber≥80th age-specific percentile, and sucrose<20th age-specific percentile. The range of the dietary target score was 0-4 points. Because of the low prevalence of participants meeting all 4 targets, participants meeting 3 or 4 targets were combined for statistical analysis[15].

The current Nordic Nutrition Recommendation or Dietary Guidelines for Americans do not set an upper intake level for dietary cholesterol[2,3]. However, low dietary cholesterol was one of the initial targets of the intervention when the study was launched in 1990[16]. Thus, in sensitivity analyses of the present study, we added dietary cholesterol to the target score. The percentage of the STRIP study participants having dietary cholesterol <300mg/d, as recommended e.g. in the Dietary Guidelines for Americans in 2010[17], ranged between 65-91% at different time points. Since majority of the study participants reached this goal, we defined being in the lowest age-specific quintile as the desired cholesterol intake in this study.

Anthropometric measurements and smoking

Weight was measured to the nearest 0.1 kg with an electronic scale (S10, Soehnle, Murrhardt, Germany) and height to the nearest 0.1 cm with a Harpender stadiometer (Holtain, Crymych, UK). Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Smoking habits were assessed with questionnaires. Participants who reported daily smoking were defined as smokers.

Blood pressure

Sitting BP of children was measured annually from 13 months to 20 years of age using an oscillometric noninvasive BP monitor (Critikon Dinamap 1846 SX until 2001, thereafter Critikon Dinamap Compact T) after a rest of ≥15 minutes[10]. The accuracy of the device was regularly checked against a mercury manometer. Appropriate cuff size according to the size of the child's right arm was used. Until 7 years of age BP was measured once; at 8 to 9 years of age, it was measured 2 to 4 times; and from 10 years of age onwards the protocol included two measurements at each visit. The average of all available measurements was used in statistical analyses. BPs of the children were measured annually at times of day suitable for the family. Intervention and control groups were seen by the study team at the same time of year in the same environment, and both study groups were seen multiple times throughout the study, thereby minimizing tension and stress in both groups[10].

Statistical analyses

In analyses, all of the BP values of children who had dietary data available at the same timepoint between 13 months and 20 years of age were used (maximum number of observations: 20). Association of the dietary target score with systolic BP, diastolic BP, height, BMI, total energy intake, and intakes of sodium and potassium over the study period was investigated with a linear mixed-effects model for repeated measures using compound symmetry covariance structure. In the repeated measurements model compound symmetric covariance structure for each individual was specified. Because multiple groups were compared simultaneously, Tukey-Kramer adjustment for multiple testing was used. All models included age and sex as covariates. When examining the association of the dietary target score with systolic BP and diastolic BP, the analyses were also additionally adjusted for height, BMI, total energy intake, or intakes of sodium and potassium, as these factors might be on the pathway (mediators) between dietary targets and blood pressure, or antecedents (confounders) of dietary targets. Age × dietary target score, sex × dietary target score, and STRIP study group × dietary target score interactions were studied to investigate if the associations with BP were similar at different ages, in males and females, and in the STRIP intervention and control groups. Sex-stratified analyses for the associations of dietary target score with systolic BP and diastolic PB were conducted. In addition, STRIP study group -stratified analyses for the associations of dietary target score with systolic BP and diastolic BP were conducted. No age × dietary target score interactions were detected indicating the effect of dietary target score on systolic and diastolic blood pressure was similar at different ages, and thus, all age groups were analyzed combined. Statistical significance was inferred at a 2-tailed P value <0.05. The statistical analyses were performed with SAS version 9.4.

RESULTS

Characteristics of the study participants stratified by sex and STRIP study group are shown in Table 1 and supplemental Table S1, respectively. The total number of observations between 1 and 20 years of age for both systolic BP and diastolic BP was 11063, of which 5278 (47.7%) were for those in the intervention group and 5785 (52.3%) for participants belonging to the control group, while 5340 (48.3%) of the observations were provided by females, and 5723 (51.7%) by males.

Average levels of total energy intake, body mass index, height, and intakes of sodium and potassium between ages 13 months and 20 years according to the number of dietary targets met are shown in Table 2. Participants with higher dietary target score had a higher intake of potassium, and lower total energy intake. In addition, participants in the dietary target score groups had differing intakes of sodium, but the association was not linear. No differences in height or BMI were detected among participants achieving different number of dietary targets.

Meeting a higher number of the dietary targets was associated with lower systolic BP and diastolic BP between 13 months and 20 years of age (Figure 1.). In Table 3, these data are summarized by giving the age- and sex-adjusted means across the entire follow-up. The results for diastolic BP were similar after additional adjustment for sodium and potassium, total energy intake, height, or BMI (all, $P \leq 0.04$) (Table 3). The results for systolic BP were of borderline significance after adjustment for sodium and potassium, total energy intake, height, or BMI (all $P \leq 0.10$) (Table 3).

The association of the dietary target score with systolic BP was different between sexes (P for interaction = 0.0004). In sex-stratified analyses, the score was associated with systolic BP in females, but not in males (Table 4). In females, the association remained similar also after adjustment for sodium and potassium consumption, total energy intake, height, and BMI (all, $P \leq 0.002$). The association of the dietary target score with systolic BP was different in the STRIP study groups (P for interaction =0.04). In study group -stratified analyses, the score was associated with systolic BP in the control group, but not in the intervention group (Table 4). In the control group, the association remained similar also after adjustment for sodium and potassium consumption, total energy intake, and BMI (all, $P \leq 0.04$). After adjustment for height, the association slightly attenuated (P=0.07). The association of the dietary target score with diastolic BP remained essentially similar to those shown after further adjustment of the STRIP study group (P=0.04). In sex-stratified analyses for diastolic BP, the association of the score with diastolic BP was borderline significant (P=0.07) in males while in the study group -stratified analyses, the association of the score with diastolic BP in the intervention group was also borderline significant (P=0.07) (Table 4).

We made two sensitivity analyses. First, the lowest age-specific quintile of dietary cholesterol was added to the score in order to reflect the dietary counseling given in the early years of the study. In these analyses, the association with systolic BP remained unaltered, but the association with diastolic BP attenuated (Table 5). Second, because smoking may be a potential confounder for the observed associations, we analyzed the data also after excluding participants with daily smoking (total of 145 observations; at age 20 years n=33 participants smoked). In these analyses, the associations with systolic BP and diastolic BP remained significant (supplemental Table S2).

DISCUSSION

We show that achieving the dietary targets of the STRIP, reflecting dietary guidelines, resulted in lower BP levels in healthy children from infancy to young adulthood. Although the differences in systolic BP and diastolic BP observed between dietary target groups in this study were relatively modest, these findings have a public health importance as cumulative exposure to higher BP levels beginning in childhood has been shown to be harmful[4-8] and even these small differences might have a substantial effect on future cardiovascular health if maintained for decades.

During the 20-year intervention period, the STRIP study has shown that the repeated dietary counselling results in dietary and phenotypic changes in children receiving the intervention, pointing to a reduced risk of atherosclerotic-related cardiovascular diseases[10, 16, 18-24]. Results of the study have influenced dietary and cardiometabolic risk reduction guidelines aimed at primordial and primary prevention[25]. An alternative way to examine the effects of diet on cardiovascular risk factors is to treat the STRIP participants as a cohort and compare individuals based on their dietary characteristics regardless of their study group allocation. Using such an approach, we show here that that achieving the key targets of an infancy-onset 20-year dietary intervention, reflecting dietary guidelines, was associated with lower systolic BP and diastolic BP between the age of 13 months and 20 years. The results of this study are in line with the limited previous data examining the association of diet and BP among healthy children and adolescents. We previously reported that both systolic BP and diastolic BP were 1.0 mmHg lower in children receiving low-saturated-fat counseling from infancy to 15 years of age than in control children[10]. Dietary Approaches to Stop Hypertension (DASH) -style dietary pattern, emphasizing fruits, vegetables and low-fat dairy products, was associated with lower BP levels in girls aged 10±0.6 years at baseline and followed up until 18–20 years of age[26]. In addition, a DASH-style dietary pattern was linked with lower systolic BP in a cross-sectional study of Iranian primary school children aged 6-12 years[27].

In the Coronary Artery Risk Development in Young Adults Study, diastolic BP was suggested to be the strongest predictor of subsequent cardiovascular events among young, normotensive, white population[28]. In this study, achieving more dietary targets resulted in lower diastolic BP throughout the early life-course in all participants. For systolic BP, however, the association was only evident in females. We have no plausible explanation for this sex difference. Also, in a previous short-term study, dietary changes within the first two decades of life were shown to reduce the rate of increase of blood pressure in females, but not in males[29]. In addition, the favorable association of the dietary target score with systolic BP in the present study was found only in the control group, but not in the intervention group. This might be due to both overall lower blood pressure levels[10,30] and higher achievement of dietary targets[15] observed in the intervention group. Here we showed that participants in the control group who met 3-4 dietary targets had on average 2.1 mmHg lower systolic BP compared to those who did not meet any of the targets. Long-term exposure to higher systolic BP and diastolic BP levels even in normal range has been shown to increase the risk for future cardiovascular disease[31,32].

In addition to diet, overweight and obesity are associated with increased systolic and diastolic BP[4,32]. In this study, however, the effect of the dietary target score on systolic and diastolic BP is not explained by these links, since there were no differences in body mass index between the score groups. In addition, we observed in this study that the effect of the score on systolic and diastolic BP remained essentially similar after adjustment for intakes of dietary sodium and potassium that are major BP-related nutrients in adolescents[33]. Further, the associations remained essentially similar after adjustment for total energy intake. These results suggest that variations in the relative high levels of sodium and potassium intakes measured by dietary food records do not modify the associations of STRIP dietary targets to BP, and that the associations on BP seem to be independent of caloric intake. It is well accepted that high sodium intake is one of the quantitatively most important, preventable mass exposures causing an unfavorable population-wide BP pattern that is a major risk factor for cardiovascular disease[34]. However, it has been suggested that the benefits of sodium restriction on BP may be greater with higher BPs, strengthen as subjects enter middle age, and may especially be dependent of recent sodium intake[29, 35, 36]. In addition, the sensitivity of BP to sodium may be higher in adolescents with obesity or other cardiovascular risk factors[37, 38].Since this study was conducted in young, apparently healthy individuals of whom the majority were non-obese and normotensive, only a small effect may have been anticipated.

Potential limitations of our study include loss-to-follow-up, which is inevitable in a study where intensively repeated study visits have been conducted over a period of two decades. The number of intervention participants compared with the controls was slightly lower at the end of the intervention period, probably because of the more intense study schedule (44 vs. 27 basic study visits). The characteristics of those participating in the study and those lost to follow-up have been compared repeatedly and no differences have been found regarding e.g. bodyweight, BMI, serum total cholesterol, or saturated fat intake[11,18,39]. In detailed loss-to-follow-up analyses regarding components of the metabolic syndrome, we found that discontinuation in the study was not affected by these characteristics nor did they modify the discontinuation in the intervention and control groups[21]. Most recent extensive loss-to-follow-up analyses further confirmed that those who have stayed in the study have had similar dietary, lifestyle, socioeconomic, and cardiometabolic risk characteristics compared to those who withdrew[30].Thus, a systematic selection bias is unlikely to affect our results. It is, however, possible that due to progressive attrition over time, the repeated-measurements models can be weighted towards the results seen in the youngest ages. In addition, generally normal BP levels in the cohort may also hamper the detection of associations between meeting the dietary targets and BP. We also acknowledge chance as a possible contributor to the differences in BP observed between the dietary target score groups. As children in the STRIP study are all Caucasian the results may not be generalizable to other ethnicities. Further, the oscillometric BP monitor was used throughout the study, and BP measurements were taken only once at the study visits prior to 7 years of age. Moreover, relatively high sodium intake overall and particularly in older male participants may have influenced the findings of this study. Clear strengths of the study are its extensive follow-up period beginning from infancy, coupled with serial assessments of BP and detailed dietary data.

PERSPECTIVES

In this study, achievement of key targets of the 20-year dietary intervention, reflecting dietary guidelines of fat quality, dietary fiber, and sugar intake, was favorably albeit modestly associated with BP throughout early life. This may be due to the fact that the dietary intervention in STRIP aimed primarily to lower LDL-cholesterol levels, not BP. In the future, interventions promoting lower intake of dietary sodium could potentially lead to greater reductions in BP levels.

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DISCLOSURES

None.

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NOVELTY AND SIGNIFICANCE

What Is New?

Limited data are available concerning associations between diet and BP among healthy children and adolescents. The aim of this study was to examine whether success in achieving the key dietary targets, reflecting dietary guidelines of fat quality, dietary fiber, and sugar intake were associated with blood pressure between 13 months and 20 years of age

What Is Relevant?

The findings of this study are clinically important, because elevated BP in childhood predisposes to adult hypertension, metabolic syndrome, coronary artery calcification and increased carotid intima-media thickness

Summary

Achieving the dietary targets, reflecting dietary guidelines, resulted in modestly lower BP levels in healthy children from infancy to young adulthood.

FIGURE LEGEND

Figure 1. Average systolic (A) and diastolic blood pressure levels (B) between 1 and 20 years of age according to the number of dietary targets met (score) in all participants of the STRIP study.

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Table 1. Characteristics of study participants with dietary data at the age of 13 months, 5, years, 10 years, 15 years, and 20 years.

Variable	**Age 13 months**				**Age 5 years**				**Age 10 years**				**Age 15 years**				**Age 20 years**			
	Female (n=417)		Male (n=460)		Female (n=320)		Male (n=356)		Female (n=252)		Male (n=278)		Female (n=215)		Male (n=243)		Female (n=170)		Male (n=122)	
Body mass index (kg/m^2)	16.7	1.3	17.1	1.3	15.5	1.6	15.3	1.2	17.7	2.8	17.1	2.4	20.7	3.3	20.2	3.1	22.8	4.0	22.4	3.0
Height (cm)	77.0	2.5	78.7	2.5	111.4	4.3	112.3	4.0	141.6	6.7	141.6	6.0	166.1	5.9	174.0	7.5	167.7	5.9	181.5	5.7
Systolic BP (mmHg)	95.6	15.2	94.9	13.9	96.7	10.0	95.4	9.8	105	10	105	9	113.5	11.0	120.1	12.3	115.8	12.6	126.9	11.9
Diastolic BP (mmHg)	62.6	13.2	60.7	11.8	57.5	6.9	57.2	7.1	58	7	59	7	61.1	6.4	62.0	7.3	66.3	8.1	65.9	8.5
Total fat intake (E%)	27.4	5.3	26.7	5.5	31.2	4.6	31.4	4.4	30.9	4.8	31.6	5.2	30.5	5.7	31.7	5.1	33.8	5.9	34.5	5.6
Saturated fat intake (E%)	11.4	3.2	10.8	3.3	13.1	2.9	13.0	2.7	12.6	2.9	12.5	2.8	11.9	3.0	12.2	2.8	12.6	2.8	13.2	2.8
Fiber intake (g/MJ)	2.2	0.6	2.2	0.6	2.0	0.5	2.0	0.5	1.9	0.5	1.9	0.5	2.2	0.7	1.9	0.6	2.3	0.8	1.9	0.7
Sucrose intake (E%)	5.5	3.0	5.5	2.7	9.6	3.0	10.0	3.1	9.4	3.1	9.5	3.2	8.6	3.1	8.3	3.4	8.2	3.4	7.5	3.6
Intake of dietary potassium (mg)	2107	458	2252	508	2465	441	2621	542	2825	608	3128	681	2950	736	3836	957	2770	785	3896	995
Intake of dietary sodium (mg)	1468	466	1594	512	2051	470	2221	511	2321	552	2647	563	2543	660	3427	882	2491	795	3748	1000
Total energy intake (MJ)	3.93	0.75	4.17	0.77	5.69	0.92	6.16	1.00	6.88	1.28	7.74	1.39	7.20	1.70	9.32	2.17	6.48	1.78	9.68	2.59
Intake of SAFA <10 E% (%)	32.6		40.2		14.7		13.2		18.7		20.9		29.3		23.1		18.8		12.3	
Ratio of SAFA to MUFA and PUFA <1:2 (%)	14.9		20.2		4.1		6.2		9.9		12.2		15.4		14.4		22.9		18.9	
Intake of dietary fiber	6.2		9.6		2.2		3.4		4.0		2.9		8.8		4.1		17.1		9.0	

>3g/MJ (%)											
Distribution of the dietary score (%)	Score= 0	43.4	41.7	60.9	59.6	57.1	52.5	47.9	50.2	46.5	53.3
	Score= 1	32.9	28.4	25.6	26.4	24.6	28.8	30.7	29.6	32.3	29.5
	Score= 2	16.6	19.6	8.8	9.3	12.3	13.3	13.0	14.0	15.3	11.5
	Score= 3,4	7.2	10.2	4.7	4.8	6.0	5.4	8.4	6.2	5.9	5.7

Values are presented as mean and standard deviation except as proportion for meeting dietary targets. Abbreviations: BP = blood pressure; MUFA = monounsaturated fatty acid; SAFA = saturated fatty acid; SD = standard deviation; PUFA = polyunsaturated fatty acid

Table 2. Average levels of dietary intake of potassium and sodium, total energy intake, body mass index and height between ages 13 months and 20 years according to the number of dietary targets met in all participants of the STRIP study.

	The number of dietary targets met								
Variable	0		1		2		3-4		P-value
	Adjusted mean#	SE	Adjusted mean#	SE	Adjusted mean#	SE	Adjusted mean#	SE	
Intake of dietary potassium (mg)	2888	15	2931	16	2954	20	3045	28	<0.0001
Intake of dietary sodium (mg)	2497	13	2549	15	2501	19	2510	27	0.001
Total energy intake (MJ)	7.11	0.03	6.83	0.03	6.63	0.04	6.48	0.06	<.0001
Body mass index (kg/m^2)	18.5	0.1	18.5	0.1	18.4	0.1	18.4	0.1	0.19
Height (cm)	139.7	0.2	139.6	0.2	139.5	0.2	139.4	0.2	0.14

#All models were adjusted for age and sex. Dietary score included four following targets: SAFA/(MUFA + PUFA) <1:2, SAFA <10 E%, dietary fiber ≥80th age-specific percentile, and sucrose ≤20th age-specific percentile. The range of the score was 0–4 points. Because of the low prevalence of participants meeting all targets, participants meeting three, and four targets were combined for the analyses.

Table 3. Average systolic and diastolic blood pressure levels between 1 and 20 years of age according to the number of dietary targets met in all participants of the STRIP study

Adjustments		The number of dietary targets met								
		0		1		2		3-4		P-value
		Adjusted mean#	SE	Adjusted mean#	SE	Adjusted mean#	SE	Adjusted mean#	SE	
Age, sex	Systolic blood pressure (mmHg)	107.3	0.3	107.6	0.3	106.8	0.3	106.7	0.5	0.03
	Diastolic blood pressure (mmHg)	60.4	0.2	60.5	0.2	59.9	0.2	59.9	0.3	0.02
Age, sex, consumption of sodium and potassium	Systolic blood pressure (mmHg)	107.1	0.3	107.3	0.3	106.6	0.3	106.4	0.5	0.052
	Diastolic blood pressure (mmHg)	60.4	0.2	60.5	0.2	59.9	0.2	59.9	0.3	0.02
Age, sex, total energy intake	Systolic blood pressure (mmHg)	106.9	0.3	107.4	0.3	106.8	0.3	106.8	0.5	0.06
	Diastolic blood pressure (mmHg)	60.4	0.2	60.5	0.2	59.9	0.2	59.9	0.3	0.03
Age, sex, height	Systolic blood pressure (mmHg)	102.9	0.3	103.3	0.3	102.6	0.4	102.5	0.5	0.06
	Diastolic blood pressure	59.9	0.2	60.0	0.2	59.4	0.3	59.4	0.4	0.04

	(mmHg)									
Age, sex, body mass index	Systolic blood pressure (mmHg)	106.6	0.2	106.8	0.3	106.2	0.3	106.1	0.3	0.10
	Diastolic blood pressure (mmHg)	60.3	0.2	60.3	0.2	59.7	0.2	59.8	0.3	0.04

Dietary score included four following targets: SAFA/(MUFA + PUFA) <1:2, SAFA <10 E%, dietary fiber ≥80th age-specific percentile, and sucrose ≤20th age-specific percentile. The range of the score was 0–4 points. Because of the low prevalence of participants meeting all four targets, participants meeting three or four targets were combined for the analyses.

Table 4. Average blood pressure levels between 1 and 20 years of age according to the number of dietary targets met stratified by either sex or study group.

Sex or study group		The number of dietary targets met 0		1		2		3-4		P-value
		Adjusted mean#	SE	Adjusted mean#	SE	Adjusted mean#	SE	Adjusted mean#	SE	
Girls	Systolic blood pressure (mmHg)	105.7	0.4	106.5	0.4	105.0	0.5	104.6	0.6	0.0004
	Diastolic blood pressure (mmHg)	60.3	0.3	60.7	0.3	60.0	0.4	60.2	0.5	0.20
Boys	Systolic blood pressure (mmHg)	109.0	0.3	108.9	0.4	109.0	0.5	109.4	0.6	0.92
	Diastolic blood pressure (mmHg)	60.5	0.2	60.4	0.3	59.8	0.3	59.7	0.5	0.07
Intervention group	Systolic blood pressure (mmHg)	106.8	0.4	106.9	0.4	106.2	0.4	106.8	0.5	0.31
	Diastolic blood pressure (mmHg)	60.1	0.3	59.9	0.3	59.4	0.3	59.4	0.4	0.07
Control group	Systolic blood pressure (mmHg)	107.8	0.4	108.4	0.4	107.8	0.5	105.7	0.9	0.01
	Diastolic blood pressure (mmHg)	60.8	0.2	61.2	0.3	60.5	0.4	61.0	0.7	0.24

#All models adjusted for age and study group specific analyses additionally adjusted for sex.

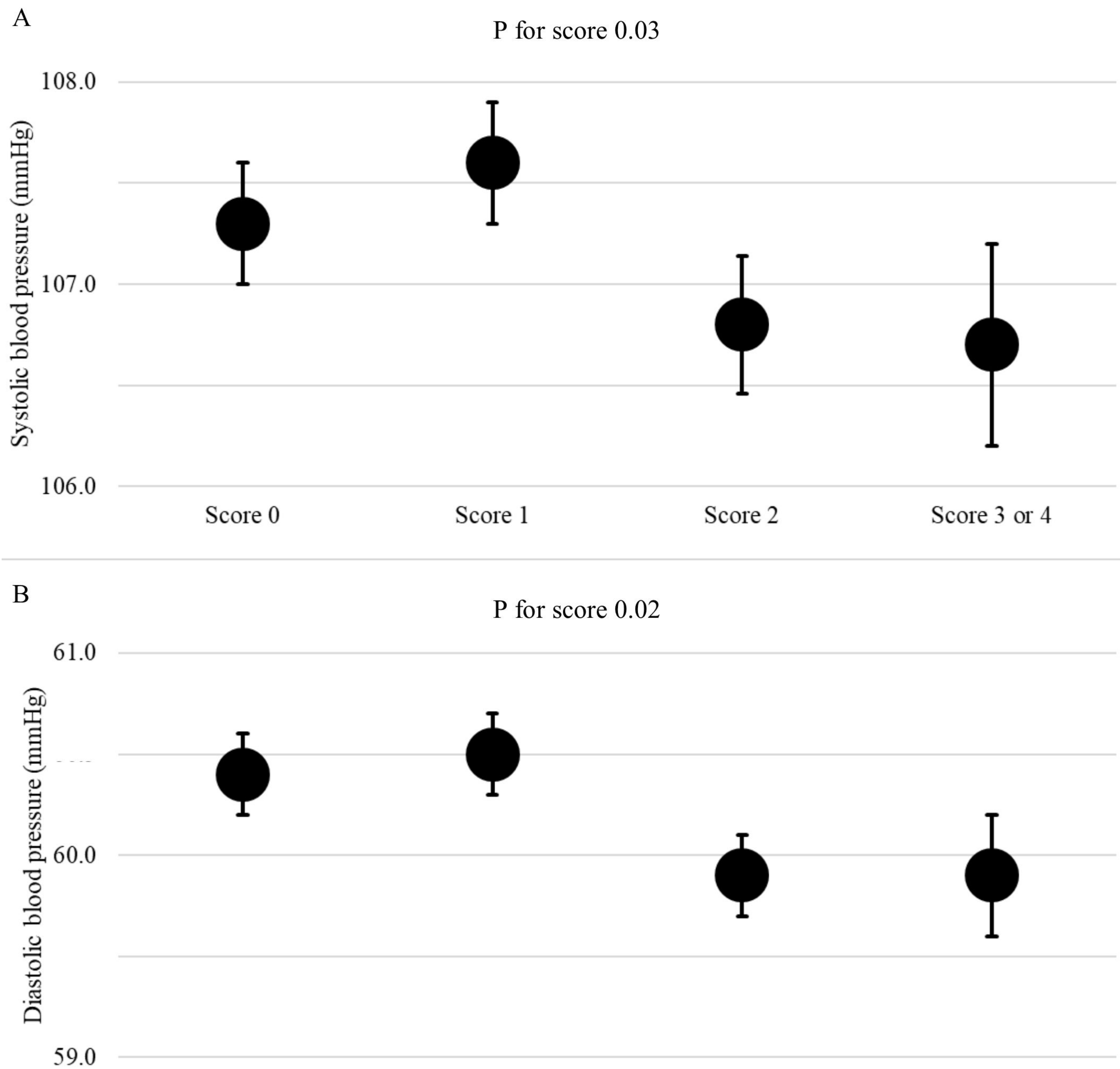
Dietary score included four following targets: SAFA/(MUFA + PUFA) <1:2, SAFA <10 E%, dietary fiber ≥80th age-specific percentile, and sucrose ≤20th age-specific percentile. The range of the score was 0–4 points. Because of the low prevalence of participants meeting all four targets, participants meeting three or four targets were combined for the analyses.

Table 5. Average systolic and diastolic blood pressure levels between ages 13 months and 20 years according to the number of dietary targets met including an additional target for dietary cholesterol in all participants of the STRIP study.

	The number of dietary targets met								
Blood pressure	0		1		2		3-5		P-value
	Adjusted mean#	SE	Adjusted mean#	SE	Adjusted mean#	SE	Adjusted mean#	SE	
Systolic blood pressure (mmHg)	107.5	0.3	107.4	0.3	106.9	0.3	106.7	0.4	0.047
Diastolic blood pressure (mmHg)	60.5	0.2	60.4	0.2	60.2	0.2	59.9	0.3	0.13

#All models were adjusted for age and sex.

Dietary score included five following targets: SAFA/(MUFA + PUFA) <1:2, SAFA <10 E%, dietary fiber ≥80th age-specific percentile, sucrose ≤20th age-specific percentile, and dietary cholesterol ≤20th age-specific percentile. The range of the score was 0–5 points. Because of the low prevalence of participants meeting multiple targets, participants attaining three, four and five targets were combined for the analyses.


A
P for score 0.03
Systolic blood pressure (mmHg)
108.0
107.0
106.0
Score 0
Score 1
Score 2
Score 3 or 4
B
P for score 0.02
Diastolic blood pressure (mmHg)
61.0
60.0
59.0
Score 0
Score 1
Score 2
Score 3 or 4