







Adolescents' capacity to take action on obesity: A concurrent controlled before-and-after study of the European CO-CREATE project

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Summary

This study evaluated the effect on reported readiness for action and attitudes toward obesity prevention among older adolescents (mean age 17) who took part in a youth-led participatory action research European initiative (CO-CREATE Youth Alliances) compared with a comparison group that acted as controls. This was a concurrent before-and-after controlled study across five countries and took place between September 2019 and October 2020. Adolescents ($n = 159$) recruited from schools and youth organizations came together with researchers and formed 15 Youth Alliances. An online questionnaire measuring their readiness for action and attitudes toward obesity prevention was administered. Alliance members ($n = 62$) who filled in the questionnaire at both baseline and postinitiative, and adolescents from the comparison group ($n = 132$) who completed the questionnaire twice were included in the main analysis. Two-level linear mixed models controlling for country-related variance were fitted. Alliance members scored significantly higher than the comparison group on two factors in each of the readiness for action, responsibility, and drivers of behavior concepts. The findings suggest that involving youth in co-creating policies to prevent obesity may increase adolescents' readiness for action and promote a shift in adolescents' conceptualization of obesity from an individual perspective to a societal responsibility and drivers of behavior.

KEYWORDS

adolescents, obesity, prevention, youth-led participatory action research

1 | INTRODUCTION

To address the public health problem of obesity among adolescents, there is a need to approach obesity as a systemic challenge¹ resulting from the interplay of social, economic, environmental, biological, and individual drivers.² The World Health Organization (WHO)³ have thus

Abbreviations: CO-CREATE, Confronting obesity: Co-creating policy with youth; FAS, family affluence scale; I/C, intervention/comparison; ICC, intraclass correlation; PAR, participatory action research; WHO, World Health Organization; YPAR, youth-led participatory action research.

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called for a “whole-of-society” approach,⁴ and consequently to move beyond individual-level interventions, and toward policies that can influence the systems that shape obesogenic environments.¹

Engaging and empowering youth at local, national, and international levels to be agents for change through policies may be required to effectively address and change the obesogenic environments within which adolescents lead their lives.^{5,6} Capacity building is an integral aspect of empowering adolescents, as well as for ensuring readiness to be involved and act upon societal issues, such as development of obesity prevention policies targeting adolescents.⁷

Previous literature has proposed that outcomes measuring empowerment should include changes in attitudes and beliefs,⁸ and reflect key intrapersonal and interpersonal and behavioral dimensions.^{8–10} Accordingly, programs that focus on youth involvement would benefit from developing communication skills,¹¹ increasing motivation to influence, improving socio-political skills and understanding of the environment, and encouraging participatory behavior.^{8,11,12}

Attitudes toward obesity and overweight have previously been explored in policymakers¹³ and adults in general,^{14,15} but few studies have addressed these attitudes among adolescents.⁴ However, some evidence for ascribing collective responsibility for obesity was found in a study among adolescents in Australia,¹⁶ while in a study from Spain and the United Kingdom,⁴ most adolescents argued for the responsibility of schools to provide nutritional knowledge, and for governments to implement preventive obesity policies. In group model building workshops, European adolescents have highlighted advertising, accessibility, and low cost of unhealthy food and drinks, social media, and public transport as important drivers of obesity.²

Still, the majority have suggested that adolescents perceive overweight and obesity as a health issue that can be addressed through the promotion of healthy behaviors,¹⁷ and the responsibility for prevention was placed accordingly on the individual. Sikorski et al.¹⁸ proposed that this focus on individual responsibility has reduced the support for broad-based preventive measures, while Bauman et al.¹⁹ stated that it has skewed obesity policies toward individual-level factors. Hence, programs that aim to prevent obesity should also address attitudes toward obesity and preventive measures,¹⁶ shifting the thinking of the issue from being solely an individual responsibility to being seen as a systemic political issue.^{1,7}

A promising approach is the involvement of adolescents in policy research through youth-led participatory action research (YPAR), a form of participatory action research (PAR).^{11,12} PAR is “a cooperative, iterative process of research and action in which non-professional community members are trained as researchers and change agents, and power over decisions is shared among the partners in the collaboration.”^{12,20} Previous literature has reported on several benefits of YPAR, such as empowerment of adolescents,^{21,22} as well as successful promotion of civic and political engagement.^{12,23,24}

Among socially disadvantaged groups, where unhealthy behaviors²⁵ and obesity are generally more prevalent,²⁶ YPAR holds particular promise to facilitate youth development and civic participation.¹² Furthermore, as meaningful engagement of youth is necessary to represent their lived experience,^{5,21} it is important to include youth from diverse

social backgrounds to ensure the relevance and acceptability of policies.^{22,27} Although promising, youth advocacy for obesity prevention among adolescents is a novel strategy,^{28,29} and despite increasing attention to youth involvement,⁶ young people are rarely involved in PAR.³⁰

The Confronting obesity: Co-creating policy with youth (CO-CREATE) project aims to reduce the prevalence of obesity among adolescents, by combining the knowledge of adolescents, scientists, and stakeholders in the joint development of policy ideas.^{7,31} In CO-CREATE, adolescents have formed groups of young people—called Youth Alliances—where they worked toward a common goal. The goals of the Alliances should serve to “promote and support adolescent participation and political efficacy and develop transferable, novel, context-specific and science- and experience-informed policy options that would contribute to complex system-informed overweight and obesity prevention.”⁷ To facilitate this, CO-CREATE developed a Youth Alliance Activity Handbook with activities based on PAR, that local staff and Youth Alliance members could adapt and implement in their Alliances.⁷ In the present study, we investigated self-reported readiness for action and attitudes toward obesity and preventive measures in a sample of European adolescents participating in the CO-CREATE Youth Alliances.^{7,31} Specifically, we explored whether completing the Alliance activities changed the adolescents' reported readiness for action and their attitudes toward obesity and preventive measures.

2 | METHOD

2.1 | Study design and data collection

This was a concurrent controlled before-and-after study. The CO-CREATE Youth Alliance intervention aimed to set up three Youth Alliances in each of five countries; the Netherlands, Norway, Poland, Portugal, and the United Kingdom. The intention was to recruit 15–20 adolescents to each Alliance, and an equivalent number ($n = 60$) of adolescents from a similar population as the Alliance members to a comparison group in each country. To recruit youth from various social backgrounds, two geographical areas were identified in each country. Preparatory fieldwork was conducted to explore the national and local contexts, and to identify “categories of adolescents likely to be less represented in the local public scene,”⁷ and “suitable organizations to act as gatekeepers and to assist CO-CREATE researchers to reach out to and enroll the targeted adolescents,”⁷ and “suitable organizations for providing co-facilitators.”^{7,31} Initial discussions on recruitment accounted for four entry points,⁷ but feasibility checks in all countries indicated that schools and youth organizations may be the most inclusive and feasible options.

The CO-CREATE project recruited adolescents aged 16–18 years old from schools and existing youth organizations who agreed to take part in the Alliance activities, including participating in regular meetings, engage in capacity building training, and actively search for and obtain information about systemic factors that affect health-related lifestyles.⁷ In total, 199 youth participated in the 15 Youth Alliances. A comparison group ($n = 280$) was recruited through schools with a similar socio-

demographic profile as to the areas where the Youth Alliance participants were recruited from.⁶ The adolescents in the comparison group (baseline distribution) were recruited from Norway (55%), Poland (30%), Portugal (9%), and the Netherlands (6%) and were not involved in any co-creation related activities. The UK was unable to recruit a comparison group due to the COVID-19-related lockdown.

The CO-CREATE Youth Alliances' recruitment was mainly conducted between September 2019 and January 2020, but one Alliance had their first meeting in March 2020. Following the COVID-19 lockdown in March 2020, all Alliances had to move their activities to an online platform. A Youth Alliance protocol served as a starting point and offered a general outline of activities, such as group building, photovoice, system mapping, policy forms, capacity building, advocacy training, and budgeting. The activities were based on PAR, with the aim of engaging and empowering youth. In line with the objective of CO-CREATE, youth members co-decided on the activities and forms of the Alliances. Frequency of meetings varied from a small number (six to eight meetings) of long sessions to a large number (≥ 20) of short sessions, depending on the Alliances' preferences. A facilitator and a co-facilitator were trained and assigned to each Alliance. A detailed description of the various Youth Alliances and activities is provided elsewhere.⁷ The underlying hypothesis was that participation in the Youth Alliances would lead to a change in the participants'

readiness for action, and a shift in their attitudes toward obesity as an issue of individual-level drivers and responsibility to a systemic challenge.⁷

Youth Alliance members were invited to complete the CO-CREATE process evaluation questionnaire prior to their first Alliance meeting (baseline evaluation) and thereafter on a monthly basis (interim evaluations) until the end of the Alliance activities (postinitiative evaluation). Completion of the Alliances were mainly between June 2020 and July 2020, with one Alliance ending in October 2020. The participants were also invited to complete the follow-up outcome evaluation questionnaire approximately 6 months after the end of the Alliances. Time of baseline and postinitiative response for the various Alliances and the comparison group is presented in Figure 1. Frequency of measurement points and number of responses varied between the countries and Alliances. The comparison group was invited to complete the baseline evaluation questionnaire twice, in the period November 2019–February 2020 and again in May–June 2020. Informed consent from all participating adolescents was obtained prior to study participation and involvement was voluntary. In Poland and Portugal, consent was also obtained from parents (or legal guardians) of adolescents who were younger than 18 years old. The relevant ethics committees from the respective countries approved the study protocols.

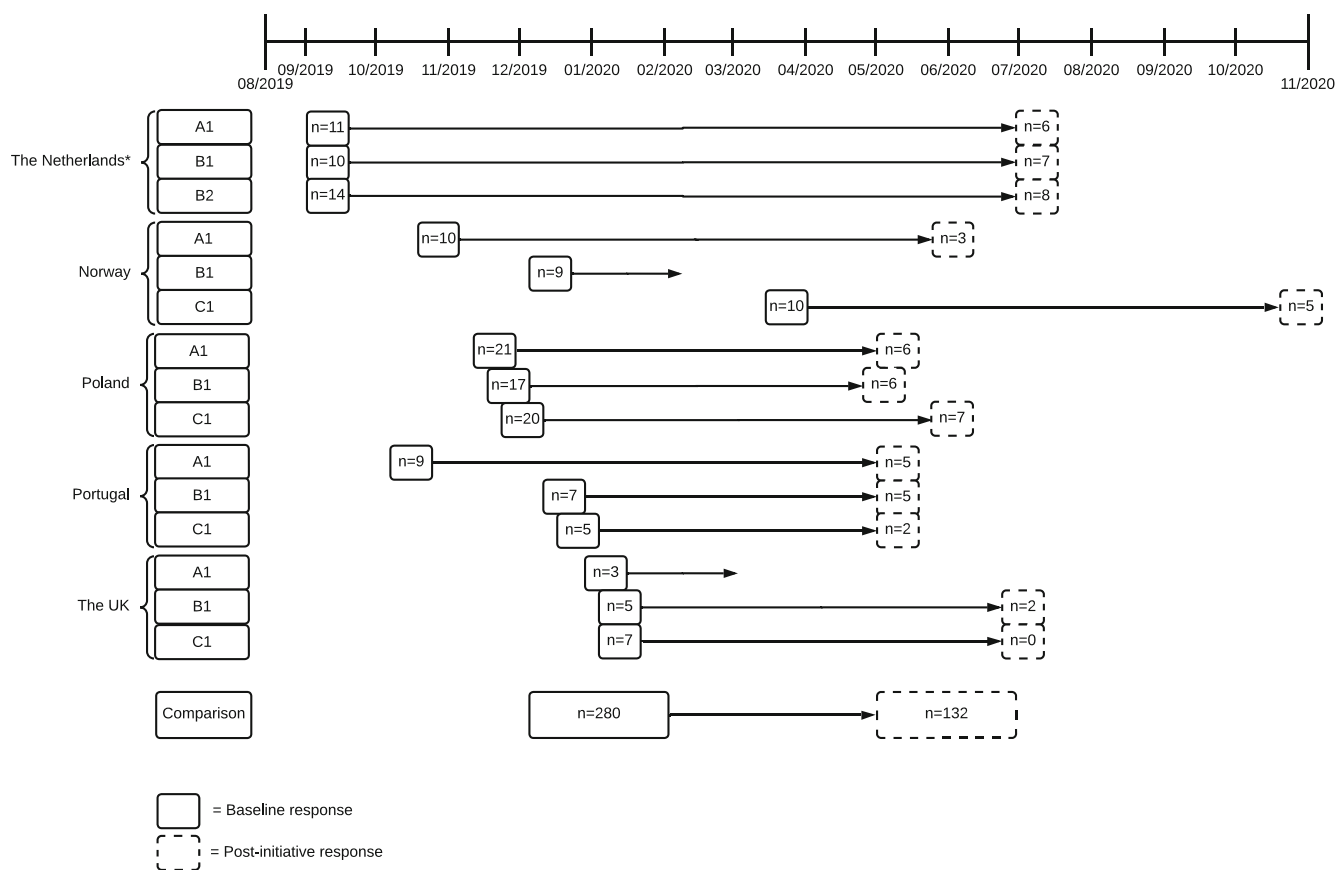


FIGURE 1 Timeline of the various CO-CREATE Youth Alliances and a concurrent comparison group responses to the CO-CREATE baseline ($n = 439$) and postinitiative evaluation questionnaires ($n = 194$). *One participant was not registered to a Youth Alliance and is not included at baseline in this figure. **Alliances without a postinitiative box were unable to continue following the COVID-19-related lockdowns.

2.2 | The CO-CREATE process evaluation questionnaire and measures

The CO-CREATE process evaluation questionnaire is a multi-item online tool developed to assess whether involvement in the CO-CREATE Youth Alliances influenced reported readiness for action and attitudes toward obesity and preventive measures among the participants.⁶ The questionnaire includes 18 items measuring readiness for action. Attitudes toward obesity prevention were covered by two concepts—“responsibility” and “drivers of behaviour”—measured by 34 items. The concepts and items chosen to measure adolescents' readiness for action and attitudes toward obesity prevention were developed based on previous literature^{9,13,14,32–34} and expert inputs from members of the CO-CREATE consortium.⁶ A detailed description of the questionnaire, and its development, reliability, factorial structure, and validity is reported in Grewal et al.⁶ The readiness for action concept included four factors, “ways of expressing political voice,” “competence for civic action,” “advocacy outcome efficacy,” and “knowledge of resources,” and one single-item, “using social networking platforms to discuss a social issue.” The responsibility component comprises four factors, “local environment,” “private business,” “food and drink industry/business,” and “government/public policy,” and five single items, “each individual,” “schools,” “companies that help people diet,” “transportation companies,” and “town and city planners.” The “drivers of behavior” component included five factors, “access to unhealthy food,” “barriers to healthy food and physical activity opportunities,” “social media,” “lack of knowledge and understanding,” and “motivation and coping,” and five single items, “increased use of motorized transportation,” “biological factors,” “lack of time to lead a healthy life,” “lack of policies preventing overweight and obesity,” and “lack of focus on healthy lifestyle among friends and family.” All items were measured on a 5-point Likert scale from *strongly disagree* (=1) to *strongly agree* (=5). The baseline questionnaire also included items on background information, such as age (reported year and month of birth), sex (“boy,” “girl,” or “prefer not to say”), and socioeconomic status assessed by the Health Behaviour in School-aged Children's Family Affluence Scale (FAS).³⁵ The FAS indicator is the sum score from the response to six items: “Does your family own a car, van, or truck,” “Do you have your own bedroom for yourself,” “How many computers do your family own,” “How many bathrooms are in your home,” “Does your family have a dishwasher at home,” and “How many times did you and your family travel out of <country> for a holiday/vacation last year.” The FAS sum score (range 0 to 13), was divided into three categories, where scores from 0 to 6 indicated low family affluence, 7 through 9 medium family affluence, and from 10 to 13 high family affluence.

2.3 | Statistical analysis

Data were directly stored from the online questionnaires and analyzed in services for sensitive data (Tjenester for sensitive data) at the University of Oslo, Norway. We calculated the mean factor score as the

sum score of items within that factor divided by the number of items in the factor. If a participant had responded to more than 50%, but less than 100% of the items within a factor, the mean factor score was calculated from items answered. The intervention/control (I/C) group variable assigned the participants to the comparison group (=0) or the Alliances (=1). Time between baseline and postinitiative response was calculated in weeks. Age at baseline was calculated from the reported month and year of birth, with the day of birth set to the 15th for all participants. Participants who reported “prefer not to say” ($n = 3$) to the sex item were set to missing and excluded from analyses including sex.

Descriptive analysis and independent samples t-tests were used to describe the baseline data ($n = 439$) and compare mean values of age, sex, family affluence, and all factors and single items measuring readiness for action and attitudes toward obesity prevention. Descriptive data are presented as mean values with SD unless otherwise stated. Pearson's r was used to assess the correlation between age, family affluence, and factors within readiness for action and attitudes toward obesity and preventive measures.

To assess the effects of the Alliance activities on adolescents' readiness for action and attitudes toward obesity and preventive measures, a subsample with Youth Alliance members who completed the questionnaire at baseline and postinitiative ($n = 62$) and adolescents from the comparison group who completed the questionnaire twice ($n = 132$) was created for the main analysis. In this sample, time between baseline and postinitiative response ranged from 12 weeks to 45 weeks, with a mean of 32 (SD = 8.0) weeks in the Alliances and 21 (SD = 5.8) weeks in the comparison group.

We calculated the intra-class correlation coefficient (ICC) for all outcome variables to assess how much of the total variation was attributed to country effects. Significant clustering effects (ICC > 0.05) were found on 12 out of 24 factors. After adjusting for I/C group, baseline score, time between baseline and postinitiative response, age, sex, and family affluence, clustering effects were found for eight factors. Thus, we fitted a two-level linear mixed model with random effects for country as clusters at the upper-level. The model included four steps, where step 1 was the “null” model without any covariates. In step 2, we added I/C group (Comparison group = 0, Alliance = 1) as a level 1 independent variable. In step 3, baseline score, time between baseline and postinitiative response, age, sex, and family affluence were added as level 1 covariates. In step 4, we added the interaction between I/C group and time between baseline and postinitiative response as a covariate. Fixed effects were estimated for I/C group and covariates in steps 2–4.

Two supplementary analyses were conducted to assess the robustness of our results. To increase the number of participants from the Alliances, we created a sample ($n = 248$) with all participants from the Alliances who had responded to the questionnaire at baseline and at least once more. If the participant had responded to multiple interim- and postinitiative evaluation questionnaires, the latest response was chosen. The follow-up outcome evaluation was only chosen for participants with a baseline response, but no interim or postinitiative response. The comparison group was the same as in the

main analysis. A two-level linear mixed model with random effects for country at the upper-level, following the model structure as in the main analysis were fitted to obtain the regression estimates with 95% confidence intervals.

Poland had the largest sample size of adolescents who responded to the questionnaire at least twice. Thus, multiple linear regression was performed on this sample of adolescents ($n = 127$), respectively, 78 and 49 adolescents from the comparison group and the Alliances to assess the results in a more homogenous group and without any country variance. The steps in the regression model followed the same structure as in the main analysis. All statistical analyses were performed in IBM SPSS statistics 28.0, and the significance level was set to $p < 0.05$.

3 | RESULTS

In total, 159 adolescents from the CO-CREATE Youth Alliances, and 280 adolescents from the comparison group responded to the questionnaire at baseline (Table 1). The participants were aged between 14 and 23 years old, with a mean age of 17.1 (1.0) years. The majority (89%) were aged 16–18 years old. Of the total sample, 72% were women or girls, 50% were in the high family affluence category, and 11% were in the low family affluence category. Baseline characteristics of Alliance members who completed the questionnaire at baseline and postinitiative of the Alliance activities ($n = 62$), and of adolescents

from the comparison group who completed the questionnaire twice ($n = 132$) is presented in Table 1. In this subsample, 50% of the adolescents were recruited in Poland, 75% were women or girls, 39% were classified in the high family affluence category, and 14% were classified in the low family affluence category.

Mean values of age and sex were similar in both groups at baseline, while adolescents in the comparison group reported higher family affluence compared to those from the Alliances (Table 2). Within the readiness for action concept, the Alliance members scored higher than the comparison group on three factors and a single item: “ways of expressing political voice,” “competence for civic action,” “advocacy outcome efficacy,” and “using social networking platforms to discuss a social issue.” Within the responsibility concept, the Alliance members scored higher than the comparison group on “private business,” “government/public policy,” “schools,” and “companies that help people diet.” Adolescents from the Youth Alliances perceived “barriers to healthy food and physical activity opportunities,” “social media,” and “lack of policies preventing overweight and obesity” as more important drivers of behavior than participants in the comparison group. The overall effect sizes ranged from -0.4 to 0.6 (Table 2).

Differences at baseline between Alliance members who participated until the end and adolescents from the comparison group who completed the questionnaire twice (Table 2) showed similar mean values of sex and age, while Alliance members reported lower family affluence. At baseline, these Alliance members scored higher than the comparison group on “ways of expressing political voice” and “social

TABLE 1 Sex, age, family affluence, and number of participants from each country in the total and subsample of European adolescents who responded to the CO-CREATE process evaluation baseline questionnaire ($n = 439$).

	Total sample at baseline ($n = 439^a$)			Subsample ($n = 194^b$)		
	Comparison ($n = 280$)	Alliance ($n = 159$)	Total	Comparison ($n = 132$)	Alliance ($n = 62$)	Total
Sex, % (n)						
Male	30 (84)	23 (37)	27 (121)	24 (31)	21 (13)	23 (44)
Female	69 (193)	76 (121)	72 (314)	74 (98)	77 (48)	75 (146)
Prefer not to say	1 (3)	-	1 (3)	2 (3)	-	2 (3)
Age, M (SD)	17.1 (1.0)	17.1 (1.0)	17.1 (1.0)	16.8 (0.9)	17.0 (1.1)	16.9 (1.0)
Family affluence, ^b % (n)						
Low	8 (23)	16 (26)	11 (49)	12 (15)	19 (12)	14 (27)
Medium	34 (96)	42 (66)	37 (162)	42 (56)	52 (32)	45 (88)
High	56 (156)	41 (65)	50 (221)	44 (58)	29 (18)	39 (76)
Country, % (n)						
The Netherlands	6 (18)	23 (36)	12 (54)	-	34 (21)	11 (21)
Norway	55 (154)	18 (29)	42 (183)	36 (48)	13 (8)	29 (56)
Poland	30 (83)	37 (58)	32 (141)	59 (78)	31 (19)	50 (97)
Portugal	9 (25)	13 (21)	11 (46)	5 (6)	19 (12)	9 (18)
The UK	-	9 (15)	3 (15)	-	3 (2)	1 (2)

^aVaried slightly for the different variables.

^bFamily affluence calculated by the formation of a composite score based on responses to the family affluence scale survey questions, graded on a scale from 0–13: low ≤ 6 , medium: 7–9, high > 9 ; age at the time of baseline response; subsample includes all Alliance members who responded to the questionnaire at baseline and postinitiative of the Alliance activities, and adolescents from the comparison group who responded to the questionnaire twice.

TABLE 2 Comparison of the mean values (SD) of sex, age, family affluence, and factors within the readiness for action, responsibility, and drivers of behavior concepts at baseline between the comparison group and Alliance members in a sample of European adolescents who responded to the CO-CREATE baseline evaluation questionnaire ($n = 439^a$), and in a subsample between participants from the comparison group who responded to the questionnaire twice and Alliance members who responded to both the baseline and postinitiative evaluation questionnaire ($n = 194^a$).

	Total sample ($n = 439^a$)				Subsample ($n = 194^a$)			
	Comparison, M (SD)	Alliance, M (SD)	p	d^d (95% CI)	Comparison, M (SD)	Alliance, M (SD)	p	d^d (95% CI)
Sex	1.7 (0.5)	1.8 (0.4)	0.12	0.2 (-0.0, 0.4)	1.8 (0.4)	1.8 (0.4)	0.17	0.1 (-0.2, 0.4)
Age	17.1 (1.0)	17.1 (1.0)	0.93	-0.0 (-0.2, 0.2)	16.8 (0.9)	17.0 (1.1)	0.68	0.2 (-0.1, 0.5)
Family affluence ^b	9.6 (2.0)	8.8 (2.2)	<0.001	-0.4 (-0.6, -0.2)	9.1 (2.05)	8.3 (2.2)	0.01	-0.4 (-0.7, -0.1)
Readiness for action								
Ways of expressing political voice	3.0 (0.9)	3.5 (0.9)	<0.001	0.5 (0.3, 0.7)	2.8 (0.9)	3.2 (0.9)	<0.001	0.5 (0.2, 0.8)
Competence for civic action	3.3 (0.9)	3.8 (0.8)	<0.001	0.6 (0.4, 0.8)	3.3 (0.8)	3.6 (0.9)	0.05	0.3 (0.0, 0.6)
Advocacy outcome efficacy	3.1 (0.8)	3.4 (0.7)	<0.001	0.4 (0.2, 0.6)	3.1 (0.7)	3.3 (0.8)	0.08	0.3 (-0.0, 0.6)
Knowledge of resources	3.8 (0.8)	3.7 (0.8)	0.22	-0.1 (-0.3, 0.1)	4.0 (0.8)	3.9 (0.8)	0.27	-0.2 (-0.5, 0.1)
Using social networking platforms to discuss a social issue ^c	3.0 (1.2)	3.4 (1.2)	<0.001	0.4 (0.2, 0.6)	3.0 (1.2)	3.4 (1.1)	0.01	0.4 (0.1, 0.7)
Responsibility								
Local environment	4.0 (0.6)	4.1 (0.7)	0.42	0.1 (-0.1, 0.3)	4.0 (0.6)	3.9 (0.9)	0.56	-0.1 (-0.4, 0.2)
Private business	2.8 (0.8)	3.1 (0.9)	0.003	0.3 (0.1, 0.5)	2.8 (0.9)	3.1 (1.0)	0.04	0.3 (0.0, 0.6)
Food and drink industry/business	3.4 (1.0)	3.4 (1.1)	0.95	-0.0 (-0.2, 0.2)	3.2 (1.0)	3.2 (1.1)	0.97	-0.0 (-0.3, 0.3)
Government/public policy	3.4 (1.0)	3.7 (1.0)	0.01	0.3 (0.1, 0.4)	3.3 (1.0)	3.6 (0.9)	0.02	0.4 (0.1, 0.7)
Each individual ^c	4.2 (0.9)	4.1 (1.0)	0.16	-0.1 (-0.3, 0.1)	4.2 (0.9)	4.0 (1.1)	0.15	-0.2 (-0.5, 0.1)
Schools ^c	3.7 (1.0)	3.9 (1.1)	0.04	0.2 (0.0, 0.4)	3.5 (1.0)	3.6 (1.1)	0.64	0.1 (-0.2, 0.4)
Companies that help people diet ^c	3.7 (1.0)	4.0 (1.0)	0.001	0.3 (0.1, 0.5)	3.8 (0.9)	3.5 (1.1)	0.08	-0.3 (-0.6, 0.0)
Transportation companies ^c	2.6 (1.0)	2.7 (1.1)	0.20	0.1 (-0.1, 0.3)	2.4 (0.9)	2.8 (1.1)	0.02	0.4 (0.1, 0.7)
Town and city planners ^c	3.3 (1.1)	3.5 (1.2)	0.09	0.2 (-0.0, 0.4)	3.3 (1.1)	3.4 (1.0)	0.36	0.1 (-0.2, 0.5)
Drivers of behavior								
Access to unhealthy food	4.2 (0.7)	4.3 (0.8)	0.50	0.1 (-0.1, 0.3)	4.1 (0.7)	4.1 (0.9)	0.83	-0.0 (-0.3, 0.2)
Barriers to healthy food and physical activity opportunities	3.5 (0.9)	3.7 (0.9)	0.02	0.2 (0.0, 0.4)	3.4 (1.0)	3.7 (0.9)	0.08	0.3 (-0.0, 0.6)
Social media	2.9 (0.9)	3.4 (0.9)	<0.001	0.6 (0.4, 0.8)	3.0 (0.9)	3.4 (1.0)	<0.001	0.5 (0.2, 0.8)
Lack of knowledge and understanding	3.7 (0.9)	3.8 (1.0)	0.18	0.1 (-0.1, 0.3)	3.8 (0.9)	3.9 (0.9)	0.26	0.2 (-0.1, 0.5)
Motivation and coping	4.1 (0.6)	4.2 (0.7)	0.24	0.1 (-0.1, 0.3)	4.2 (0.7)	3.9 (0.9)	0.03	-0.3 (-0.7, -0.0)
Increased use of motorized transportation ^c	3.5 (1.0)	3.7 (1.1)	0.07	0.2 (-0.0, 0.4)	3.5 (1.0)	3.7 (1.0)	0.23	0.2 (-0.1, 0.5)
Biological factors ^c	3.6 (1.0)	3.7 (1.0)	0.11	0.2 (-0.0, 0.4)	3.7 (1.0)	3.6 (1.1)	0.51	-0.1 (-0.4, 0.2)
Lack of time to lead a healthy life ^c	3.6 (1.2)	3.7 (1.2)	0.38	0.1 (-0.1, 0.3)	3.5 (1.2)	3.6 (1.2)	0.78	0.0 (-0.3, 0.3)

TABLE 2 (Continued)

	Total sample (n = 439 ^a)				Subsample (n = 194 ^a)			
	Comparison, M (SD)	Alliance, M (SD)	p	d ^d (95% CI)	Comparison, M (SD)	Alliance, M (SD)	p	d ^d (95% CI)
Lack of policies preventing overweight and obesity ^c	3.3 (0.9)	3.7 (1.0)	<0.001	0.4 (0.2, 0.6)	3.3 (0.9)	3.5 (1.1)	0.27	0.2 (-0.1, 0.5)
Lack of focus on healthy lifestyle among friends and family ^c	3.7 (1.0)	3.8 (0.9)	0.33	0.1 (-0.1, 0.3)	3.6 (1.1)	3.9 (1.0)	0.15	0.2 (-0.1, 0.5)

Note: Significant p values are shown in bold.

^aVaried slightly for the different variables.

^bFamily affluence calculated by the formation of a composite score based on responses to the family affluence scale survey questions, graded on a scale from 0–13.

^cSingle-item.

^dIndependent t-tests was used to compare mean values.

^dd = Cohen's d with 95% confidence interval, calculated from the mean differences (mean value of the comparison group subtracted by the mean value of the Alliance members) divided by the pooled SD; M = mean value; age at the time of baseline response; responses to the factors were given on a 5-point scale ranging from *strongly disagree* (=1) to *strongly agree* with a neutral midpoint; total sample include all participants who responded to the baseline questionnaire; subsample includes all Alliance members who responded to the questionnaire at baseline and postinitiative of the Alliance activities, and adolescents from the comparison group who responded to the questionnaire twice.

TABLE 3 Differences postinitiative of the Alliance activities between the comparison group and Alliance members who responded to the baseline evaluation questionnaire and the postinitiative evaluation questionnaire on four factors and a single item measuring readiness for action in a sample of European adolescents participating in CO-CREATE Youth Alliances (n = 191^a).

Factor		b	95% CI	p	ICC
Ways of expressing political voice	I/C group	0.1	-0.2, 0.4	0.61	0.00
	Baseline	0.7	0.6, 0.8	<0.001	
Competence for civic action	I/C group	0.2	-0.1, 0.5	0.17	0.00
	Baseline	0.6	0.5, 0.7	<0.001	
Advocacy outcome efficacy	I/C group	0.3	0.0, 0.6	0.04	0.00
	Baseline	0.5	0.3, 0.6	<0.001	
Knowledge of resources	I/C group	0.1	-0.2, 0.5	0.41	0.04
	Baseline	0.4	0.2, 0.5	<0.001	
Using social networking platforms to discuss a social issue ^b	I/C group	0.6	0.1, 1.0	0.02	0.00
	Baseline	0.5	0.4, 0.7	<0.001	

^aVaried slightly for the different factors.

^bSingle-item; Step 3 in the multilevel model with country at the upper-level; adjusted for baseline score, time between baseline and postinitiative response, sex, age, and family affluence; results are regression estimates (b), 95% confidence interval (CI), p values (p), and intraclass correlation coefficient (ICC) for variance attributed to country effects; calculated from linear mixed models; responses to the factors were given on a 5-point scale ranging from *strongly disagree* (=1) to *strongly agree* with a neutral midpoint; I/C = intervention (Alliance members)/comparison group; Comparison group = 0, Alliance members = 1; Baseline = baseline score.

media," and lower on "each individual" and "motivation and coping." The overall effect sizes ranged from -0.4 to 0.5 (Table 2).

The correlation coefficients (Pearson's r) between age, family affluence, and factors related to readiness for action and attitudes toward obesity and preventive measures at baseline ranged from -0.15 to 0.53, with only six coefficients being stronger than 0.4 (Table S1). The two strongest correlations were between "Food and drink industry/business" and "Government/public policy" (r = 0.53),

and between "Local environment" and "Schools" (r = 0.52). The majority were between 0.00 and 0.20.

All steps and results from the linear mixed models are presented in Tables S2–S4. From step 3, significant I/C group differences were found for a total of six factors and single items (Tables 3–5). Postinitiative of the Alliance activities, Alliance members scored significantly higher than the comparison group on "advocacy outcome efficacy" (b = 0.3, 95% CI = 0.0, 0.6) and "using social networking platforms to

Factor		<i>b</i>	95% CI	<i>p</i>	ICC
Local environment	I/C group	0.1	-0.2, 0.4	0.37	0.09
	Baseline	0.5	0.3, 0.6	<0.001	
Private business	I/C group	0.6	0.2, 1.0	0.01	0.11
	Baseline	0.3	0.2, 0.4	<0.001	
Food and drink industry/business	I/C group	0.2	-0.2, 0.6	0.30	0.08
	Baseline	0.4	0.2, 0.5	<0.001	
Government/public policy	I/C group	0.2	-0.2, 0.6	0.35	0.06
	Baseline	0.3	0.2, 0.4	<0.001	
Each individual ^b	I/C group	0.3	-0.1, 0.7	0.13	0.11
	Baseline	0.5	0.3, 0.6	<0.001	
Schools ^b	I/C group	0.2	-0.2, 0.6	0.34	0.01
	Baseline	0.4	0.2, 0.4	<0.001	
Companies that help people diet ^b	I/C group	-0.1	-0.5, 0.3	0.54	0.02
	Baseline	0.3	0.2, 0.5	<0.001	
Transportation companies ^b	I/C group	0.4	0.1, 0.8	0.03	0.00
	Baseline	0.3	0.2, 0.4	<0.001	
Town and city planners ^b	I/C group	0.3	-0.2, 0.7	0.22	0.00
	Baseline	0.4	0.3, 0.5	<0.001	

^aVaried slightly for the different factors.

^bSingle-item; Step 3 in the multilevel model with country at the upper-level; adjusted for baseline score, time between baseline and postinitiative response, sex, age, and family affluence; results are regression estimates (*b*), 95% confidence interval (CI), *p* values (*p*), and intraclass correlation coefficient (ICC) for variance attributed to country effects; calculated from linear mixed models; responses to the factors were given on a 5-point scale ranging from *strongly disagree* (=1) to *strongly agree* with a neutral midpoint; I/C = intervention (Alliance members)/comparison group; comparison group = 0, Alliance members = 1; Baseline = baseline score.

discuss a social issue" (*b* = 0.6, 95% CI = 0.1, 1.0). Alliance members also agreed to a higher degree than the comparison group that "private business" (*b* = 0.6, 95% CI = 0.2, 1.0) and "transportation companies" (*b* = 0.4, 95% CI = 0.1, 0.8) were responsible for reducing the number of people with overweight and obesity. "Social media" (*b* = 0.5, 95% CI = 0.1, 0.8) and "lack of focus on healthy lifestyle among friends and family" (*b* = 0.5, 95% CI = 0.0, 1.0) were perceived as more important drivers of behavior among Alliance members compared to the comparison group.

From step 4, significant interactions between I/C group and time to postinitiative response were found for six factors and single items (Tables 3-5); "ways of expressing political voice" (*b* = -0.0, 95% CI = -0.1, -0.0), "knowledge of resources" (*b* = -0.0, 95% CI = -0.1, -0.0) and "using social networking platforms to discuss a social issue" (*b* = -0.1, 95% CI = -0.1, -0.0), the responsibility of "each individual" (*b* = -0.1, 95% CI = -0.1, -0.0) and "companies that help people diet" (*b* = -0.1, 95% CI = -0.1, -0.0), and "lack of focus on healthy lifestyle among friends and family" as "drivers of behavior" (*b* = -0.1, 95% CI = -0.1, -0.0).

All significant I/C group differences from step 3 and three significant interactions between I/C group and time to postinitiative response from step 4, were also found in either the sample with all participants who had responded to the

TABLE 4 Differences postinitiative of the Alliance activities between the comparison group and Alliance members who responded to the baseline evaluation questionnaire and the postinitiative evaluation questionnaire on four factors and five single items measuring responsibility in a sample of European adolescents participating in CO-CREATE Youth Alliances (*n* = 191^a).

questionnaire at least twice (Tables S5-S7) or in the Polish sample (Table S8-S10). Across all significant and non-significant I/C group differences from step 3, the direction of the estimates was the same for 23 out of 24 factors and single items for all the three abovementioned samples. The majority of these were in the expected direction.

4 | DISCUSSION

The main objective of CO-CREATE was "to reach diverse youth, to empower them and to combine their knowledge with that of researchers and stakeholders in the joint development of policy ideas for system directed overweight and obesity prevention."^{7,31} To our knowledge, this is one of few studies assessing changes in adolescents' reported readiness for action and attitudes toward obesity and preventive measures.⁶ Based on the factor structure and single items previously identified,⁶ I/C group differences between Alliance members and the comparison group postinitiative of the Alliance activities were identified for a total of six factors and single items. Significant interactions between I/C group and time to postinitiative response were found for six factors and single items upon completion of the Alliances.

TABLE 5 Differences postinitiative of the Alliance activities between the comparison group and Alliance members who responded to the baseline evaluation questionnaire and the postinitiative evaluation questionnaire on five factors and five single items measuring drivers of behavior in a sample of European adolescents participating in CO-CREATE youth alliances ($n = 191^a$).

Factor		<i>b</i>	95% CI	<i>p</i>	ICC
Access to unhealthy food	I/C group	0.3	−0.1, 0.6	0.12	0.07
	Baseline	0.4	0.2, 0.5	<0.001	
Barriers to healthy food and physical activity opportunities	I/C group	0.4	−0.0, 0.8	0.06	0.06
	Baseline	0.5	0.4, 0.6	<0.001	
Social media	I/C group	0.5	0.1, 0.8	0.01	0.00
	Baseline	0.4	0.3, 0.5	<0.001	
Lack of knowledge and understanding	I/C group	0.3	−0.1, 0.6	0.10	0.01
	Baseline	0.5	0.4, 0.6	<0.001	
Motivation and coping	I/C group	−0.0	−0.4, 0.3	0.86	0.05
	Baseline	0.4	0.3, 0.6	<0.001	
Increased use of motorized transportation ^b	I/C group	0.3	−0.2, 0.7	0.22	0.00
	Baseline	0.3	0.2, 0.4	<0.001	
Biological factors ^b	I/C group	0.1	−0.3, 0.5	0.58	0.02
	Baseline	0.3	0.1, 0.4	<0.001	
Lack of time to lead a healthy life ^b	I/C group	0.2	−0.3, 0.6	0.52	0.01
	Baseline	0.5	0.4, 0.7	<0.001	
Lack of policies preventing overweight and obesity ^b	I/C group	0.1	−0.3, 0.5	0.50	0.01
	Baseline	0.4	0.3, 0.6	<0.001	
Lack of focus on healthy lifestyle among friends and family ^b	I/C group	0.5	0.0, 1.0	0.04	0.04
	Baseline	0.3	0.2, 0.5	<0.001	

^aVaried slightly for the different factors.

^bSingle-item; Step 3 in the multilevel model with country at the upper-level; adjusted for baseline score, time between baseline and postinitiative response, sex, age, and family affluence; results are regression estimates (*b*), 95% confidence interval (CI), *p* values (*p*), and intraclass correlation coefficient (ICC) for variance attributed to country effects; calculated from linear mixed models; responses to the factors were given on a 5-point scale ranging from *strongly disagree* (−1) to *strongly agree* with a neutral midpoint; I/C = intervention (Alliance members)/comparison group; comparison group = 0, Alliance members = 1; Baseline = baseline score.

Previous research has shown mixed effects of youth advocacy programs on adolescents' readiness to deal with social issues. While Syvertsen et al.³⁶ did not find any change in belief of adolescents that they could influence community or political change, Millstein et al.³⁷ reported on improvements in youth's advocacy, knowledge of resources, and advocacy behavior. Moreover, King et al.³² found positive effects of a youth advocacy program on adolescents' use of social networking platforms. In line with these promising findings, we discovered similar results on adolescents' reported readiness for action, as Alliance members scored higher than the comparison group on "advocacy outcome efficacy" and "using social networking platforms to discuss a social issue." This implies that the CO-CREATE experience to some degree improved Alliance members socio-political and digital skills. Although social media is a platform for civic and political engagement,³⁸ and adolescents are some of the most frequent users of social media,³⁹ "using social networking platforms to discuss a social issue" did not fit within "ways of expressing political voice."⁶ Previous research has found a positive association between media use and civic engagement among adolescents,³⁶ and it may be an important

aspect to improve to promote readiness to deal with societal issues, such as obesity.

However, for "using social networking platforms to discuss a social issue" we saw that I/C group interacted with time to postinitiative response such that the score was lower with longer time for Alliance members. While the baseline and postinitiative response were separated by the implementation of COVID-19-related lockdowns in all countries and for both groups, it may be that a "screen fatigue" influenced the Alliance members readiness for action and engagement more negatively.⁴⁰ Similar results were also seen for "ways of expressing political voice" and "knowledge of resources." As the Alliance activities aimed to influence the adolescents' understanding of obesity as a systemic issue, Alliance members may have become more aware of the complexity of obesity prevention, which consequently affected their belief about being able to make a difference. Another explanation may be ascribed to the recruitment process, as CO-CREATE recruited adolescents who were already sufficiently interested to be engaged. Thus, Alliance members may have already been comfortable with voicing societal issues and participating in civic and political work, and that a potential "ceiling" effect influenced our results.

In contrast to our study, previous research on attitudes toward obesity prevention has often been cross-sectional,^{4,13-16} and while there is some evidence of adolescents ascribing a collective responsibility to obesity prevention, it has mainly been perceived as an individual responsibility.⁴ Here, Alliance members scored higher than the comparison group on “private business” and “public transport.” Thus, supporting CO-CREATES assumption of a shift in thinking of obesity from an issue of individual responsibility to one that require systemic approaches. While some adolescents in Savona et al.² pointed to public transport as a replacement for active transport, which leads to lower levels of physical activity, adolescents are usually dependent on public transport to move around.⁴¹ Accordingly, the availability of public transport could be important to facilitate healthy behaviors, e.g., accessibility to healthy foods and opportunities for physical activity.^{42,43}

Following the evidence generally found among policymakers,¹³ adults,^{14,15} and adolescents,⁴⁴ both Alliance members and the comparison group scored relatively high for individual responsibility. However, interaction effects showed that Alliance members agreed less that obesity should be an individual responsibility as time to postinitiative response increased. Additionally, the I/C group variable interacted with time to postinitiative response such that Alliance members reported less responsibility of “companies that help people diet” with increasing time, thus further supporting a shift in Alliance members' conceptualization of obesity from an issue of individual responsibility toward a systemic perspective.

Within the drivers of behavior concept, Alliance members perceived “social media” as a more important driver of behavior than the comparison group. In a recent study,² social media was regarded as an important driver of obesity among adolescents. The role of social media was linked to, among others, advertising of unhealthy products, promotion of unhealthy foods by influencers, and exposure to unrealistic ideals.² Thus, our result represented a step away from internal drivers of obesity, to an appreciation that the wider environment, including the digital space, could influence unhealthy behaviors.^{5,45} Furthermore, Alliance members perceived “lack of focus on healthy lifestyle among friends and family” as a more important driver of behavior than the comparison group, addressing that unhealthy behaviors are influenced by the immediate context and the interplay with other people. Conversely, interaction effects also showed that with longer time between baseline and postinitiative response, Alliance members perceived “lack of focus on healthy lifestyle among friends and family” as a less important driver of behavior. Although classified as an external driver of behavior, it reflects the adolescents' microsystem of social influences in an ecological model.⁴⁶ Thus, it may be that the Alliance activities over time prompted the participants to consider broader, systemic factors more relevant to obesity prevention.

Nevertheless, I/C group differences related to responsibility and drivers of behavior covered important aspects to a “whole-of-society” approach to obesity prevention and suggest that the Alliances were at least partly successful in shifting the thinking of obesity toward a systemic perspective. However, while we report on some significant

findings, the estimate of significant I/C group differences varied in size and the 95% confidence intervals were quite wide and should be interpreted with caution.

5 | STRENGTHS AND LIMITATIONS

The strengths of the present study included the recruitment of youth in 15 Alliances in five countries, and a respective concurrent comparison group with adolescents of a similar age range. Moreover, we used a validated online questionnaire to assess changes in adolescents' reported readiness for action and attitudes toward obesity and preventive measures. Web-based surveys have several benefits, such as shorter transmitting time, lower delivery cost and less data entry time, and it may be a more efficient way to reach adolescents.⁶ Furthermore, among participants who responded to the questionnaire, few had missing data. Moreover, CO-CREATE activities were built on PAR, and included a variety of approaches to empower the participants. In line with a YPAR approach, Alliance members contributed to adapt and implement these activities depending on the Alliances preference and need, thus making it more relevant to the local context. Lastly, country variations were controlled for in the linear mixed models.

Some limitations should also be noted. Although the initial aim was to include adolescents aged 16–18 years old, we recruited from organizations that included adolescent with a wider range of ages, and as recruitment went slower than anticipated in most countries, we did not exclude participants that were just outside the targeted age group. Additionally, attendance dropped in all Alliances after moving the meetings to an online platform following the COVID-19-related lockdowns.³¹ Thus, a slight majority of Alliance members were excluded due to not responding to the postinitiative evaluation questionnaire. Moreover, a large proportion of the comparison group only responded to the questionnaire on a single occasion, and consequently had to be excluded from the analyses. This resulted in a small sample size for the main analyses and the need for careful interpretation of the results. However, our subsample was larger than in other studies which have assessed adolescents' readiness for action³² or applied an YPAR approach.^{47,48} Moreover, COVID-19 and related restrictions may have influenced the participants in several ways. However, as we did not collect any data on how COVID-19 and related restrictions affected the participants, or whether any effects varied according to weight status or self-perceived body image, we were unable to discuss the impact of COVID-19.

We aggregated results across 15 Alliances, and as the content and form of the activities and engagement varied between the Alliances, we cannot determine if the effects were due to the content or merely participating in the Alliances. Furthermore, generalizing the results to youth in all participating countries is problematic, as the majority at baseline was from either Norway or Poland, while the distribution was skewed toward a larger proportion of adolescents from Poland in the multilevel analysis. We were not able to assess response rate or selection bias, as we did not register information

about adolescents who were invited but did not participate. Lastly, it is often recommended that multilevel analysis accounts for a minimum of 10 clusters to obtain appropriate estimates,⁴⁹ while we only had five. However, across both significant and non-significant I/C group differences, most of the estimates were in the expected direction.

6 | CONCLUSION

This study explored adolescents' readiness for action and attitudes toward obesity and preventive measures before and after participating in the CO-CREATE Youth Alliance activities. We identified several I/C group differences between the comparison group and Alliance members on reported readiness for action and attitudes toward obesity and preventive measures. Thus, involving adolescents in activities based on PAR and policy design can increase readiness for action and promote a shift in adolescents' conceptualization of obesity in terms of individual or societal responsibility and drivers of behaviors. However, as the sample size used in these analyses was small, our findings will benefit from replication in larger studies.

AUTHOR CONTRIBUTIONS

Knut-Inge Klepp, Aleksandra Luszczynska, Ana Rito, Harry Rutter, and Nanna Lien were involved in designing the CO-CREATE study. Navnit Kaur Grewal, Anna Banik, Aleksandra Luszczynska, Ana Rito, Cecile Knai, Sofia Mendes, and Nanna Lien developed the questionnaire and conducted the data collection. Sondre Haugsbø Herstad drafted the paper and were responsible for the analysis. Nanna Lien, Aleksandra Luszczynska, Harry Rutter, and Knut-Inge Klepp contributed to the conceptualization of the paper and the interpretation of the analysis. All authors reviewed the paper and contributed to the content. All authors read and approved the final manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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