BMJ Open

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Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-019731
Article Type:	Research
Date Submitted by the Author:	22-Sep-2017
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Primary Subject Heading:	Public health
Secondary Subject Heading:	Qualitative research
Keywords:	peer education, overweight, health inequalities, sociocognitive theory, adolescent health

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Word count : 7690

Abstract

Objectives

Evaluate the feasibility of an innovative peer intervention promoting healthy nutritional behaviour which purposefully selected peer facilitators according to socioeconomic status to target less-advantaged overweight receivers.

Setting

Nine high schools and 2 middle schools.

Participants

One hundred and fifty-six adolescents were approached to become facilitators of which 18 were trained. Thirty-two of 56 potential receivers accepted the intervention.

Intervention

The peer intervention was carried out in 2013-14 and embedded in the larger health programme PRALIMAP-INÈS. Facilitators were selected and trained to organise nutritional activities with specific peer receivers participating in the programme.

Primary and secondary outcome measures

Different types of data were collected to assess demand, acceptability, implementation and practicality of the intervention. For the facilitators, this included 6 training sessions, 12 mid-programme interviews, 4 end-of-programme sessions, telephone notes and SMS exchanges. All 6 potential receivers in one school were also interviewed. Sociodemographic and health characteristics were also analysed.

Results

Acceptance was more likely when asked by a peer compared to a professional (51.2% discordant pairs; P<0.02). Twelve activities, mostly based on physical activity and implemented during weekends or holidays, were carried out. The mean age of active receivers was 16 and their BMI was higher than other participants. For both facilitators and active receivers there were more participating girls. Qualitative analysis reveals key implementation challenges for facilitators. Interviews with the receivers highlight social difficulties with most feeling bad about their appearance and wanting to lose weight. Those who participated in peer activities were very positive about the experience especially social support.

Conclusions

The present study suggests the peer intervention was feasible provided organisational difficulties are addressed. Good practice recommendations are formulated including a longer training session, organising a joint meeting with the facilitators and receivers, matching dyads on place of residence and multiplying modes of contact.

Strengths and limitations of the study

- To the authors' knowledge this is the first intervention to purposefully select peer facilitators matched on the basis of the socioeconomic status of the receivers.
- The peer intervention is based on sociocognitive theory with a particular focus on peer modelling, peer support and practice opportunities for mastering desired behaviours as opposed to the traditional concept of peer education based on transmission of information.
- The intervention was embedded in a large-scale research study allowing systematic collection of data and an in-depth process analysis with different sources of qualitative material was also carried out to triangulate findings and grasp implementation challenges.

- Results provide an indication of the potential feasibility of the peer intervention but further research with a larger sample size is necessary to confirm findings on the characteristics of the participants and empirically evaluate the effectiveness of the intervention to improve the nutritional behaviour of the receivers.

Keywords:

peer education, obesity, overweight, adolescents, physical activity, health inequalities, nutrition, sociocognitive theory

INTRODUCTION

Schools are considered to be ideal settings for health promotion interventions, particularly in the context of nutrition interventions[1–3]. Indeed, it has been argued that the school setting intrinsically exposes children to dietary and physical activity factors[4]. Furthermore, students spend a significant amount of their time in school for which attendance is often compulsory. This means that it is possible for interventions to reach almost all children, regardless of socioeconomic status in a relatively short time. For this reason, it has been suggested that the school setting may be particularly important in order to reduce health inequalities[5]. However, concerns have been raised about the fact that school interventions may not benefit all children equally and the need for specific examination of minority groups has been expressed[6,7].

One reason that school-based interventions may not benefit all children or adolescents equally could be the socioeconomic gap between health experts delivering the interventions and youth of low socioeconomic status. For example, in a French evaluation of peer-led health interventions, it was highlighted that young people are critical with regard to health prevention interventions carried out by professionals[6]. It is also believed that young people feel stigmatised by adults who consider them a "risky age group" and they do not feel implicated in health policies designed for them [8]. Furthermore, there seems to be an association between adolescent nutritional behaviour and that of family and friends suggesting involvement of adolescents' social environment may enhance the effectiveness of nutritional interventions [9,10]. In fact, when health interventions are performed by peers, they seem to have a higher level of acceptability and age proximity is especially valued because of the belief that adolescents of the same age understand each other better than adults would[6]. The central tenet of the effectiveness of peer education is that the influence of peers and friends are likely to become more important as children get older[11]. For example, the review by Salvy and colleagues (2012)[11] highlights that young people are more physically active when in the company of peers and friends and overweight boys paired with non-overweight peers increase their physical activity to a level similar to the non-overweight peer.

Given these observations, a call has been made to increase the number of health promotion and prevention programmes in schools in France, especially those delivered by peers[6]. Peer education has been extensively implemented with encouraging results across settings and in several health domains, especially sexual health and HIV prevention[12–14] but also smoking prevention and substance use[15,16]. More recently, peer-based approaches have been described as promising avenues for nutritional behaviour change with positive results including weight loss, reduction in waist circumference, less sedentary behaviour, improved attitudes towards healthy eating and exercise and increased self-efficacy[2,17–24]. Across domains, a key recommendation for school-based interventions is that they be behaviourally focussed[7].

Despite promising results, the evidence for the effectiveness of peer education is unclear and one reason that has been put forward is the lack of theoretical embedding of the interventions[16,25,26]. In the present study, the choice was made to use sociocognitive theory as the theoretical basis of the intervention[27], with a particular focus on peer modelling as well

as increasing self-efficacy through peer support and practice opportunities for mastering the desired behaviours. This concept of the role of peer interveners overlaps with two types of peer interventions as recently defined by Bagnall and colleagues[28]. The first is peer mentoring as "the development of a relationship between two individuals where the mentee is able to learn from the mentor, model positive behaviour and gain experience, knowledge or skills". The second is peer support which "seeks to promote health and build people's resilience to different stressors"[28].

In terms of carrying out peer interventions in schools, it is important to note that the school setting can have a negative impact on the self-appraisal of overweight students through its normative structure[29]. This has at least one key implication for peer intervention programmes: it is important to offer the possibility of doing peer activities outside of the school context, in a new environment which is more conducive to positive self-appraisal. The peer intervention was therefore implemented as part of a larger health programme in the school setting but designed to be behaviourally focussed and non-formal in its educational approach.

The objective of this feasibility study was therefore to develop and evaluate a peer intervention to promote physical activity and healthy eating which did not widen health inequalities by purposefully selecting adolescent peer facilitators that were also of low socioeconomic status in order to target less-advantaged overweight adolescents. Given the innovative method of selecting less-advantaged adolescents as peer interveners, the feasibility study aimed to assess the earlier stages of intervention development as highlighted by Bowen and colleagues [30], namely intervention acceptability, demand, implementation and practicality.

METHODS

PRALIMAP-INÈS study

The current study was carried out during the 2013-14 academic year within a larger research programme, PRALIMAP-INÈS (Promotion de l'ALIMentation et l'Activité Physique-INEgalité de Santé), running over a three-year period for the prevention of overweight and obesity in France. The study protocol of PRALIMAP-INÈS has been described in detail elsewhere[31]. Briefly, PRALIMAP-INÈS is a mixed quasi-experimental and experimental interventional prospective trial aimed at overweight and obese adolescents aged 13 to 18 attending grades 9 and 10 in state-run middle-schools and high-schools in the Vosges department (north-eastern France). At the beginning of the school year a screening process was carried out in the school setting (T0). All adolescents were measured and those with a Body Mass Index (BMI) greater than the International Obesity Task Force (IOTF) overweight thresholds for age and gender[32], or with a waist circumference greater than the McCarthy cut-off values for age and gender, also filled out several questionnaires and were offered a series of interventions. Socioeconomic status (SES) was measured by the WHO Family Affluence Scale (FAS) questionnaire[33,34] and a score equal or below 5 was considered to indicate less-advantaged status. At the end of the academic year (T1), students were measured again and filled out several questionnaires including their appreciation of the programme and its components. The trial was approved by the French consultative committee for treatment of information in health research (no. 12.299), the French National Commission for Data Protection and Liberties (no. 912372) and the French Persons Protection Committee (no. 2012/15).

Peer intervention description and logic model

As part of the PRALIMAP-INÈS programme, the current feasibility study focussing on the peer intervention was integrated and targeted at adolescents of the "less advantaged with standard and strengthened-care » (LA.S.S) group during the 2013-14 academic year, representing 262 adolescents. In the sense that the role of the peer interveners was to encourage physical activity

and healthy eating, the term "facilitator" is preferred and "receivers" for those receiving the intervention.

The peer intervention was based on sociocognitive theory which posits four mechanisms potentially important for self-efficacy and consequently the possibility of behaviour change: 1) performance outcomes, activated here by successfully carrying out nutritional activities (mastery experiences), 2) vicarious experiences, observing facilitators carry out nutritional activities, 3) verbal persuasion, facilitators should encourage positive nutritional behaviour and 4) emotional arousal which may in the present intervention entail positive emotions through social interaction with the facilitators during nutritional activities [27]. It was expected that through simple contact with the facilitators and other peers involved in the intervention, peer receivers would benefit from general social support and develop interpersonal skills. Carrying out nutritional activities with the facilitators was expected to bring information exchange, increased self-efficacy as well as support for the target behaviour change.

In order to carry out the peer intervention, two types of peer facilitator were selected: peer ambassadors were adolescents having participated in the PRALIMAP-INÈS programme the previous year and peer entrepreneurs were adolescents screened at the beginning of the school year in 2013 and having no previous experience of the programme. Both peer ambassadors and entrepreneurs were selected according to the following criteria: an ability to control their weight as evaluated by a physician, motivation to become peer facilitators and an FAS score ≤5 suggesting that they were of similar socioeconomic background as the peers they would be organizing activities with. In addition to similarity in socioeconomic background, facilitators were peers in terms of attending the same school and age similarity; the ambassadors being a year older and the entrepreneurs being from the same year group.

Peer facilitators received a 2-hour training session delivered during school time at the beginning of the academic year by a member of the PRALIMAP-INÈS team responsible for the peer intervention (LS). Training sessions were carried out in groups ranging from 2 to 4 adolescents and if it was not possible to regroup potential facilitators, training was done on an individual basis. The first part of the training session invited each adolescent to present him/herself and to consider why they would be a good facilitator in terms of skills and motivation. The objective of this part of the training session was to reinforce motivation and feelings of self-efficacy of the adolescents. The next part of the training session consisted in presenting the role of facilitator and brainstorming potential activities to be carried out and resources they could call upon to help them with this task. By brainstorming activities together, adolescents could be inspired from each other's ideas, get direct feedback in order to detail the implementation of their ideas with a focus on feasibility and start understanding more concretely what their role would entail. Another key moment of the training session was role playing key situations that the facilitators may face including: initial contact with the receivers and difficulties motivating receivers. Each role play was followed by feedback from the participants and observers as well as debriefing tips. Satisfaction with the training session was evaluated at the end of the session.

Following the training session, the facilitators who wished to continue were assigned a small group of peers which they had to contact and with which they were encouraged to develop activities based on their common interests to pursue throughout the academic year. The initial target was to organise and carry out 4 activities anytime in the school year. Great freedom was given to the facilitators as regards the choice of activities, whether they aimed at physical activity or healthy eating, as well as the time, place and implementation method of their chosen activities. The facilitators discussed their chosen activities with the programme coordinator (LS) and financial support was offered if it was necessary for the implementation of the activities.

Throughout the school year, facilitators were contacted on a regular basis for follow-up and support for the implementation of the nutritional activities with their receivers in the form of telephone calls as well as text messages (SMS) by the programme coordinator (LS). A mid-programme face-to-face interview was also carried out with each of the facilitators in order to maintain their motivation and allow a more in-depth exchange on the implementation challenges they faced. At the end of the academic year, all facilitators were invited to a formal end-of-programme session and they were rewarded for their time and effort with a certificate.

Feasibility criteria, material and analysis

Demand was evaluated by gathering expressed interest and participation rates of the peer intervention, for ambassadors, entrepreneurs and receivers. Expressed interest for being an ambassador, entrepreneur and receiver was obtained by a member of the PRALIMAP-INÈS team at the beginning of the school year during the screening process. The intervention was then offered a second time to the receivers directly by their allocated facilitator which enabled a comparison of expressed interest of receivers whether the intervention was offered by a professional or a peer.

Acceptability of the intervention was assessed in terms of satisfaction and perceived appropriateness. Implementation was evaluated in terms of how many, what type and when nutritional activities were carried out, as well as assessing the type and extent of support needed from the programme coordinator in terms of number and purpose of SMS exchanges and calls. Finally, practicality was evaluated by a detailed analysis of the factors affecting implementation ease or difficulty. In order to answer these research questions, the training sessions, mid-programme interviews and end-of-programme sessions, on top of their functionality within the peer intervention programme, also served as focus groups. They were all audio recorded, with the consent of the adolescents present, and transcribed. The material was then coded in NVivo10 by performing a thematic analysis. Telephone notes of each conversation with the facilitators and all SMS exchanges were also added to NVivo and coded. All these sources were analysed together to obtain a general view of acceptability, implementation and practicality from the point of view of the facilitators.

Furthermore, in order to gain more insight into the experience of the receivers, all 6 potential receivers from one high school, whether they chose to participate or not, were invited for an individual interview. These interviews were also transcribed, added to the NVivo database and coded using the same coding grid as the analysis on the facilitators in terms of their experience of the peer intervention but with an additional focus on the characteristics of the potential receivers in particular the following two themes: friendship and other peers (definition and number) and health and overweight (definition and personal experience).

A descriptive analysis was also undertaken on the information on facilitators and receivers collected by measures and questionnaires as part of the larger PRALIMAP-INÈS at the start and end of the school year. Physical activity and sedentary behaviour were measured by the International Physical Activity Questionnaire (IPAQ) [35], the EAT-26[36,37] screened for anorexia and bulimia symptoms, the HAD[38] screened for anxiety and depression symptoms and the Kidscreen[39] explored perceived health and quality of life. Study sample characteristics (age, gender, school type, FAS, BMI) and health scores (physical activity level, total EAT-26 score, total HAD score as well as individual scores for anxiety and depression and the Kidscreen score) were described using percentages for categorical variables and mean ± SD (standard deviation) for quantitative variables. Statistical analyses were carried out using SAS 9.4 (SAS Inst., Cary, NC, USA).

The main research questions to assess feasibility and how each source of data collected and analysed contributed to answering those questions is summarized in Supplementary file 1.

The facilitator training sessions, mid-programme interviews, end-of-programme sessions as well as the follow up of the facilitators by phone calls and SMS exchanges were designed and carried out by the peer intervention coordinator (LS). Receiver individual interviews were designed and carried out by an MSc student (SR) in collaboration with the peer intervention coordinator. All material was coded in NVivo by the peer intervention coordinator.

To illustrate main qualitative results, quotes from the facilitators and receivers were selected and translated from French into English.

RESULTS

Recruitment and participation

The flow chart illustrating the recruitment process of facilitators is illustrated in Figure 1. Of the 39 eligible ambassadors and 117 entrepreneurs, 20 and 36 adolescents accepted to become a peer facilitator respectively. Of the 39 facilitators who volunteered and were contacted, 18 were able to benefit from a training session in school. The reasons for not benefiting from a training session are diverse and include: not answering, changing their mind about participating and also not having enough receivers in the school to justify training a facilitator. The 18 facilitators benefiting from a training session came from 10 different schools and in total 6 training sessions were carried out. Of a 4 point score, the average global satisfaction with the training session was 3.8 with scores ranging from 3.6 to 3.9 for having had a nice time, finding the training session useful, that the training session met their expectations, that it was sufficiently long and that they felt ready to become facilitators. When asked what they enjoyed most, of the 18 trained facilitators, 13 spontaneously reported the role plays.

INSERT Figure 1

The recruitment process for the receivers is detailed in Figure 2. Of the 151 receivers for which there was a trained facilitator in the school who continued after training, 56 were randomly selected for contact by the facilitators. Of the 56 potential receivers, 25 did not formally accept the peer intervention of whom only 8 actually declining to participate. Thirty-two accepted the proposition and at the end of the peer intervention, 8 adolescents had benefited from at least one nutritional activity with a facilitator. Twenty-four adolescents did not benefit from an activity which, in the majority of cases, was due to the facilitator not managing to organise one. Another main reason for not benefiting from an activity is not being able to join for a variety of reasons such as not having transport or timetable clashes. Another interesting result is that willingness to participate in a peer-led intervention had already been asked by a professional at the beginning of the year during the measurement and screening process. For the 45 potential receivers who gave an answer both to the professional and to the facilitator later on, there was a significant difference of acceptance of the peer intervention with receivers more readily accepting when offered by a peer rather than a professional (MacNemar X^2=6.55; 51,2% discordant pairs; P<0.02). Of note is that of the 32 potential receivers who accepted the peer intervention, only 7 had declared lacking friends with which to do physical activity in the IPAQ questionnaire.

INSERT Figure 2

Characteristics of facilitators and receivers

Characteristics of the 12 facilitators and 8 active receivers are described in Table 1. Individual characteristics of each facilitator and receiver are presented in Supplementary file 2. Of the 12 facilitators that continued after the training session, there were twice as many girls as boys. Facilitators were aged between 14 and 17, with ambassadors naturally being older then the

entrepreneurs on average since they belong to the year group above. The average age of active receivers is higher than the entrepreneurs, even though they came from the same year group. The BMI of the facilitators ranged from 20 to 29. Ambassadors who continued were mostly from professional high schools. Interestingly, entrepreneurs tended overall to have better health scores than the ambassadors and the receivers which may be linked to the difference in BMI. The receivers who carried out a nutritional activity seemed generally already quite active in their lives in terms of level of physical activity.

Table 1: Characteristics of entrepreneurs, ambassadors and receivers

		Entrepreneurs	Ambassadors	Receivers	Complete LA.SS group
N		7	5	8	262
Gender	Boy	2	2	3	114
	Girl	5	3	5	148
School type	General and technological High School	3	1	2	91
	Professional High School	2	4	5	117
	Middle School	2	0	1	54
Age		15.1	16.0	16.0	15.4
BMI		22.3	27.0	28.8	26.8
FAS score		4.0	4.6	4.3	4.1
EAT 26 score		8.1	13.5	14.5	13.8
HAD score		18.0	25.2	28.6	28.7
Anxiety score		30.5	33.3	38.7	34.9
Depression score		14.3	17.1	18.5	23.7
Physical activity level	High	3	0	2	61
	Moderate	1	2	6	96
	Low	1	3	0	77
	Missing	2	0	0	28
Kidscreen score		48.0	47.4	47.1	46.6

*Data was collected during the screening session at the start of the 2013-14 academic year
**Data was collected at the follow-up visit at the end of the 2012-13 academic year

The 32 receivers who agreed to participate in the peer intervention had a higher BMI than the 25 who didn't give a positive answer and this result approached significance (P=0.07). There were no other statistically significant differences between these two groups in terms of age, gender, school type, deprivation index as well as anxiety, depression, bulimia or anorexia symptoms, physical activity as well as perceived health and quality of life. The 8 receivers having carried out an activity were significantly older (15.3 vs 16.1 P=0.018) than the 24 adolescents having said yes but who did not, for various reasons, participate in an activity. There was no significant difference between the adolescents who agreed to become facilitators and those who didn't, both for entrepreneurs and ambassadors on any of the above-mentioned variables.

Nutritional activities and other tasks

Several tasks were considered important in order to be a successful facilitator. Facilitators had to think of, plan and implement an activity without giving up during the school year. In order to be considered successful they also had to come to the training session, the mid-programme

interview and the end-of-programme session. Of the 12 facilitators, 4 were considered to be very successful, having achieved all or the majority of the above-mentioned tasks.

It is clear that the task of implementing an activity was difficult for the facilitators as only half managed to do so, despite the vast majority having managed to think of and plan one. Furthermore, 3 facilitators formally quit before the end-of-programme session and 1 more tacitly quit by no longer answering any messages or calls.

In total, 12 nutritional activities were carried out by 6 facilitators (see Table 2). Facilitators who did manage to plan and implement an activity then usually implemented 2 or more activities. Facilitators had a clear preference for organising activities centred on physical activity (10) rather than healthy eating (2) and they preferred organising activities during holidays or weekends, not on school days. Walking was a simple but popular activity amongst facilitators and receivers.

Although each facilitator was initially tasked with contacting several receivers and organising group activities, in practice activities were carried out in dyads. Only two activities were carried out in a group, both for healthy eating activities. In fact, only one facilitator managed to organise activities with two different receivers. Furthermore, one facilitator was only able to carry out an activity by including her usual friends.

Table 2: Nutritional activities carried out by the facilitators

Day	Activity	Type	Receiver*	Facilitator*
weekday	Walking	Physical Activity	R4b	F4
weekday	Cooking a meal	Healthy Eating	R5a and R5b	F5
holidays	Walking	Physical Activity	R6	F6
holidays	Walking	Physical Activity	R6	F6
holidays	Walking	Physical Activity	R6	F6
holidays	Football	Physical Activity	R1	F1
holidays	Biking	Physical Activity	R1	F1
weekend	Walking	Physical Activity	R4a	F4
weekend	Walking and Wii	Physical Activity	R3	F3
weekend	School meal	Healthy Eating	R2 and friends	F2
weekend	Basketball	Physical Activity	R1	F1
weekend	Fitness trail	Physical Activity	R3	F3

*Individual receivers and facilitators are anonymously numbered with the number of the facilitators corresponding to the number of their matched receiver(s).

Although potential ambassadors were considerably more likely to accept becoming a facilitator than potential entrepreneurs (see Figure 1), entrepreneurs were much more likely to manage to organise and implement a nutritional activity with a receiver: 5 of the 6 who managed were entrepreneurs.

Facilitator need for support

The difficulty of organising nutritional activities for the facilitators is reflected in the acute need for support which is highlighted by the important number of SMS exchanges and calls between the coordinator and the facilitators (Table 3). The detail of the SMS exchanges and calls with each facilitator is presented in Supplementary file 3.

Table 3: Number and content of SMS exchanges and phone conversations between the coordinator and the facilitators

	Entrepreneurs	Ambassadors
SMS (mean)		

Plan training	4.0	2.6
Plan call	28.6	34.2
Plan interview	5.4	6.0
Activity feedback	33.3	7.8
Plan end session	9.3	7.8
Total SMS sent	105.4	81.6
Total received	85.6	78.2
Number contact days	43.3	37.4
% no answer	13.1	11.7
Call (mean)		
Missed call	7.3	7.8
Phone conversation	10.6	7.2
% missed	30.0	31.8

The SMS exchanges and telephone calls underline that intense support was necessary, whether the facilitators were more successful or not and also whether they managed to implement an activity or not. The total number of SMS sent to the facilitators ranges from 24 and 180 with corresponding contact days between 12 and 67. Between 4 and 15 telephone conversations on different days were also carried out with each facilitator.

In terms of content of the SMS exchanges, activity feedback was the main purpose of the SMS exchanges but this is closely followed by planning phone meetings for more in-depth conversations. The most successful facilitators had a maximum of 20% missed calls and for all but one, less than 10% no response rate to received SMS suggesting that despite constraints, they were organised and reliable. A general observation can also be made in that the percentage of missed calls is much higher in general than the percentage of non-response to SMS contact, suggesting that adolescents prefer this mode of contact. The fact that entrepreneurs, much more often than ambassadors, successfully implemented activities is reflected by the higher number of contact days, total SMS exchanges and phone conversations.

Insights from interviews, focus groups and process data

Facilitator views

The most illustrative quotes from the 6 training sessions, 12 mid-programme interviews, 4 end-of-programme sessions, telephone notes and SMS exchanges are presented in Supplementary file 4.

Main challenges

Organizational issues

All facilitators encountered organizational issues, whether they managed to carry out an activity or not. However, each facilitator seemed to be faced with a different combination of challenges indicating that none is in itself impossible to overcome. Major organizational issues, concerning 8 of the 12 facilitators or more include lack of time, their own or that of their receivers, as well as timetable clashes, transport problems and remembering to carry out all the necessary tasks for organising the activity. These organisational issues were so common they were evidenced in all types of process data. An unforeseen major problem was the amount of time spent away doing internships for some students in professional high schools. Other common issues included having difficulties with the logistical organisation but also bad weather which some facilitators considered as problematic.

Furthermore, a very widespread but surprising difficulty, given it was specifically addressed during training, was the lack of ideas for what activities to organize. This was very present in the telephone notes as well as several SMS exchanges.

Another unexpected organizational difficulty was contacting the facilitators, even the very successful ones. Common issues were changing numbers and phones but also having dysfunctional phones or sometimes not having a mobile phone for a certain amount of time before getting a new one. Several difficulties were also specific to working with less advantaged adolescents such as limited phone credit. The difficulty in contacting the facilitators is consistent with the sheer number of SMS sent to each facilitator (see Table 3). These communication problems were also extremely frequent between the facilitators and the receivers. In fact, not having a mobile phone was often a reason for giving up on trying to organize an activity with a receiver. This happened to at least three facilitators.

Increased need for support

Related to the organizational issues mentioned above, a general finding is that even more support would be necessary to facilitate implementation at several levels of the peer intervention. Two facilitators expressed the need for help organising activities, even though 1 had managed to implement 3 activities. More specific help for the initial meeting with the receivers was also mentioned by 4 facilitators. This finding is consistent with the result that knowing the receivers to contact, at least by sight, greatly enhanced the success of facilitators. Indeed, knowing the receiver by sight was the case of all the facilitators having managed to implement an activity.

Motivation issues

The motivation of the facilitators fluctuated throughout the programme. Facilitators got frustrated when they were not able to organize an activity or when they felt that the receivers were not very motivated. The lack of motivation of the receivers manifested itself in several ways. Six facilitators experienced not receiving an answer from a receiver or a receiver not turning up to the planned activity, although the latter only happened once. Generally, all facilitators were confronted with some receivers not being very motivated and this was evidenced in all types of process data. For some receivers, the peer intervention was rejected because it belonged to the wider PRALIMAP-INÈS programme which they had decided not to participate in.

Programme clarity

A main implementation point to improve is programme clarity in terms of the role of being a facilitator on the one hand, and links with the broader PRALIMAP-INÈS programme on the other. For example, the selection of receivers was perceived as unclear and nearly half of the facilitators spontaneously mentioned this lack of understanding at the end of the peer intervention despite it being mentioned during the training session. This reflects a gap in the perception of intervention necessity as acknowledged by a professional as opposed to the facilitators.

A related point of confusion is the link between the peer intervention and the wider PRALIMAP-INÈS programme. For example, several facilitators thought that through the peer intervention they would gain nutritional knowledge indirectly. Some also described the peer intervention as not really part of the wider programme, which was likely perceived as more formal as it was delivered by health professionals and with a clearer educational focus. Furthermore, several admitted that although they were happy being a facilitator, they would probably not have accepted being a receiver.

The training session specifically did not provide nutritional information to facilitators as this information was imparted directly to participating adolescents, who were also the potential

receivers, throughout the rest of the PRALIMAP-INÈS programme. Nevertheless, some facilitators took the initiative of talking about nutrition with their receivers and others, on the contrary, did not consider it to be part of their role. This point merits further specification during the training session.

Health problems

Another unexpected finding was the number of health problems experienced by the facilitators. All but 2 facilitators reported small health problems throughout the year, sometimes with the consequence of having to delay or re-plan an activity. For 4 facilitators, the health problems were significant enough to have to either completely give up on their role as a facilitator, or rule out a large range of activities. For example: tendinitis stopped one facilitator from doing any physical activity for several months, one potential facilitator did not continue after the training session since she had to undergo a double knee surgery, one facilitator had a severe epilepsy attack so was cautioned against physical activity and one had to quit following an ice-skating accident.

Interpersonal skills

In terms of specific difficulties, it is clear that one facilitator in middle school had great difficulty with the role, not feeling comfortable especially in terms of social relations: she asked to change her receiver because she was afraid he had feelings for her and then asked to be able to carry out the activity with her own friends as well. In general, interpersonal skills were a common issue and this finding suggests more specific training in interpersonal skills may be necessary.

Another unforeseen difficulty linked to the social context of the intervention was having several facilitators in the same school. This had initially been considered to be a motivating factor and was initially perceived as such by the facilitators concerned. However, in practice this complicated further the organizational task and actually delayed several activities being organized which impacted the motivation of some facilitators.

Good practice

In general and consistent with the implementation challenges identified above, supporting elements for successfully carrying out the role of facilitator, and evidenced principally in the telephone notes, were being proactive and having lots of ideas, having free time and living close to the receivers.

Furthermore, several programme components seemed to facilitate implementation. In general, contact between the programme coordinator and the facilitators was perceived as very positive. Adolescents appreciated the procedure of first sending an SMS in order to agree on a time for a call, even though this was quite time consuming (see Table 3). The phone calls were very clearly experienced as motivating for all facilitators, whether they had been successful in their tasks or not. Overall, it can be stated that communicating via SMS is appreciated by adolescents, both with the coordinator but also with the receivers. It is however important to acknowledge the fact that the adolescents, even the most reliable ones, can be unreachable for various reasons. It was therefore essential to have several means of contacting them. An additional possibility would be for the coordinator to contact the schools directly when there seems to be a communication problem.

When supportive of the programme, schools can be an important facilitating component to implementation. For example, some schools successfully organized the meeting between facilitators and potential receivers and one school nurse helped with selecting a receiver for a facilitator for whom previous contact with receivers had been unsuccessful.

A mixed finding was the support of parents. Although some facilitators seemed to share very little of their facilitator activities with their parents, despite sometimes being very successful,

for others their parents were clearly very supportive and for three facilitators, parents had an active role in the implementation of the activities.

For ambassadors, a consistent finding is that they agreed to become facilitators because they liked participating in the PRALIMAP-INÈS programme the previous year. For all facilitators, it is clear that once they agreed to continue beyond the initial training session, they were motivated and committed to the PRALIMAP-INÈS programme in general, they actively and informally promoted the programme to family, peers and friends, without this being specified in their role.

Receiver views

Of the 6 potential receivers interviewed, 2 had carried out an activity of which 1 girl and 1 boy. Two girls can be considered passive receivers as they say they would have participated but don't remember being offered any activities by a facilitator and the 2 boys can be considered reluctant receivers as they clearly expressed their misgiving regarding the peer intervention. The most illustrative quotes from the different types of material analysed are presented in Supplementary file 4.

Social environment

It can be noted that family problems were very frequently reported amongst the receivers and some seemed to have important household responsibilities. In terms of the broader environment in high school, views were mixed. Boys generally said they appreciated the school environment, especially those who were full boarders, but girls seemed less at ease. To a large extent, the appreciation of the school environment depended on the relationship with peers. For all adolescents, peers are important in order to laugh, talk and relax. However, a distinction is made about what is a real friend, which entails the crucial element of trust and being able to count on the person. What is very present in the description of friendship for all of the adolescents is the notion of proximity in terms of being in the same place and seeing each other frequently. This notion of proximity means that for the majority, they seem closer to their new friends in high school than their childhood friends. For some, age proximity is also important

In terms of number of friends, adolescent profiles were quite different. Two adolescents, a boy and a girl, were clearly very sociable and reported a large group of real friends. The others, including both active receivers, admitted having few close friends. Two reported just staying with a preferred best friend and the other two described a small group of 2-4 friends. For the majority, there seemed to be a general mistrust of peers and feeling of isolation. Some adolescents attributed their feeling of social exclusion to their overweight status.

Health and overweight

For the majority of adolescents, health was defined as the absence of disease but also feeling in good shape. Public health norms of healthy eating and exercising were also understood and commonly mentioned. Interestingly, for two boys, health also included not being overweight.

For the majority of adolescents, being overweight was principally defined by referring to physical appearance and was directly linked to not feeling good about oneself. In fact, all but one adolescent interviewed expressed wanting to lose weight and reported attempts in that direction, even if this was mentioned indirectly.

However, many expressed that healthy behaviour was difficult and this was particularly well illustrated by the fact that all adolescents but one reported that they frequently ate in a fast food restaurant. It is also noticeable that what was particularly experienced as difficult was controlling what one eats. However, physical activity seemed to be something that was

appreciated by the majority of adolescents.

Programme experience

The two adolescents who were active receivers were also those who enjoyed the wider PRALIMAP-INÈS programme. They found it fun and felt they were given good advice and that it was helpful for behaviour change. The others went to at least one activity to try it but did not really understand the programme and found it uninteresting.

Similarly to the facilitators, there was an overall lack of clarity as regards the peer intervention. In fact, 3 receivers did not remember being contacted for a peer intervention. Interestingly, not knowing the facilitator in advance only seemed to be a problem for 2 of the adolescents interviewed, one of whom was actually an active receiver. It seems that the others would have been quite open to the peer activities had they understood what it entailed. Only one adolescent boy was firmly against the peer intervention but could not explain why.

The receivers that had benefited from a nutritional activity with a facilitator expressed enjoying the activities, especially the social component for the receiver who did not know the facilitator beforehand. In fact, it is interesting that the relationship continued beyond the peer intervention.

DISCUSSION

Main results

The intervention was successfully implemented with a sufficient number of participants, both facilitators and receivers, in order to provide recommendation as to the feasibility of the intervention in terms of demand, acceptability, implementation and practicality. Noteworthy results are, first, that acceptance of receivers was more likely when asked by a peer compared to a professional. Furthermore, facilitators found it very difficult to implement nutritional activities and required intense support by the intervention coordinator both by SMS and phone calls. The activities were mostly based on physical activity and implemented outside of the school week. Key implementation challenges for facilitators were lack of time, timetable clashes, transport problems, contact issues with the intervention coordinator and the receivers, health problems, need for support to maintain motivation and motivate receivers as well as a need for increased programme clarity. Interviews with the receivers further revealed, for the majority, family problems, few friends and a general distrust of peers. Furthermore, most felt bad about their appearance and would have liked to lose weight. Those who participated in peer activities were very positive about the experience especially in terms of social interaction and the development of new relations. For both facilitators and active receivers there were more participating girls.

Demand and Acceptability

A specific difficulty identified by a review of interventions for the prevention of obesity in adolescents was targeting interventions to a heterogeneous group[40] and it has previously been shown that even though adolescents generally want to be more active, there is much intra-individual variation in what, where, when and with whom, suggesting that tailored activity promotion would be ideal[41]. The wide range of profiles of the receivers in the present study are in line with this finding and highlights the potential advantage of implementing nutritional activities in peer dyads. Generally, although it can be said that the school setting allows all adolescents to be reached by health interventions equally, it is noteworthy that none of the peer nutritional activities were carried out in the school and the results of the interviews with the receivers confirm that for many, the school context is not favourable to feeling at ease given the general mistrust of peers. This result suggests that health programmes taking place in the school setting could use a peer intervention component to reach adolescents which may not

otherwise participate on the school premises. The opportunity of reaching otherwise hard-to-reach adolescents with a peer intervention is also supported by the finding that the receivers who accepted the peer intervention had a higher BMI on average than those who refused. Furthermore, all of the interviews carried out with receivers confirm that these adolescents wish to lose weight but find it difficult. It therefore seems that there is a real added-value to peer interventions aimed at overweight adolescents of low socioeconomic status.

The acceptance rate of the receivers seems sufficiently high to suggest satisfactory demand and acceptability of the programme, especially since they were more readily convinced to participate in the intervention when it was offered by a peer as opposed to a health professional. However, the acceptance rate and reach of the peer intervention could certainly be greatly improved in several ways. An unexpected finding was the widespread mistrust of peers in general. In fact, Puhl and colleagues[42] found that although peers were generally sought agents for support relative to parents, teachers or health professionals, they were also those who aroused most uncertainty with nearly a quarter of adolescents unsure if they wanted their peers to intervene. Given the general mistrust of same age peers of the receivers on the one hand, and the difficulty of the facilitators to contact the receivers on the other, a key improvement point would be for the coordinator to organise a joint meeting between the facilitators and receivers shortly after them having accepted the intervention. This would also be an opportunity to clarify what the peer intervention entails and the links with the broader health programme and perhaps even plan together the first activity for the receiver and facilitator to carry out. Another improvement point which concerns both the receivers and facilitators is to multiply the contact modes available to reach them, ideally also liaising with the school for this to be possible.

In their synthesis of reviews, Khambalia and colleagues[1] recommend individualizing interventions to particular student characteristics, particularly with regard to gender. Similar to other interventions, the present study had a gender bias in terms of peer interveners. The difficulty in encouraging boys to volunteer has widely been acknowledged[6,43,44]. More research needs to be carried out in order to understand how to specifically engage boys in health interventions in general.

Implementation and Practicality

The results of the present study point to several improvements that could enhance the feasibility of a peer intervention based on the implementation of nutritional activities among less advantaged adolescents. In terms of the facilitators, contrary to expectations, it seems that entrepreneurs seem a better target than ambassadors. Indeed, although younger and less easily convinced to take on the role initially (69% refusal rate), they were by far the most successful facilitators. One reason could be that ambassadors have more academic pressure, being a year above and having state exams at the end of the year, which was not the case of the entrepreneurs. In France, students have national exams in 3ème (grade 9), the last year of middle-school when adolescents are 14-15, but then also in the last two years of high school when adolescents are 16 to 18 (grades 11 and 12). An inherent problem with the school setting is that, although health topics and transferable skill development are considered important cross-curricular themes, health and education agendas are often in competition with priority being given to core subjects[3,6,45,46]. A running question amongst peer education implemented in schools is the compatibility with students school commitments, especially national exams[46,47]. Furthermore, the entrepreneurs seemed generally to be in better health, which is conducive to finding energy for the role of facilitator and being a positive role model.

The dose of support received by the facilitators throughout the school year seems appropriate but results of this study suggest facilitators may need longer than a 2-hour training session, even if they are not expected to transmit nutritional information. The training session would particularly benefit from three additions. First, increased time spent clarifying the role of the

facilitator and the link with the broader health programme seems necessary. Second, it seems important to give facilitators practical ideas based on the local facilities which should have been previously contacted so that the facilitators can reach a contact person for these activities if they are interested. Third, it may be important to provide specific training of interpersonal skills. The idea of providing more specific skills training for social support has been previously reported[20].

The main improvement point is to facilitate the implementation of activities for the facilitators. Generally, our findings concur with the two main types of time-constraints highlighted in other peer-led programmes: constraints linked to the implementation setting such as, for the school setting, exams or internships and constraints linked to the peers themselves such as family obligations, different timetables or residence location[6]. Constraints due to the peers themselves may be even more significant when working with less advantaged adolescents, as can be illustrated by the many family problems revealed during the interviews with receivers. It seems that the main logistical modification that can be made is to match facilitators and receivers based on place of residence. This is especially true since most activities were carried out outside of the school week. Although the school environment has many advantages, it has been noted that some facilities may not be readily available for nutrition-based activities such as facilities for food preparation and consumption[48]. This was also noted in the current study. The initial assumption that peer facilitators would be able to use school facilities was never put into practice. One main reason may explain this finding on top of the lack of facilities: the organisational burden in order to use the facilities. Another reason could be the strict health and safety regulations of the school setting. An additional advantage of implementing a peer intervention programme is the fact that if the adolescents live close enough, their activities can continue during the holidays. The summer holidays have been highlighted as a potentially important period of weight gain for adolescents, especially for overweight children and adolescents and ethnic minority groups[49].

Another recommendation would be to encourage carrying out, at least at first, activities based on physical activity rather than healthy eating as this has the most potential to engage adolescents and activities in dyads rather than groups, since this is easier to organize. Although allowing people to be with their friends in order to engage in physical activity has been recognised as a key lever for behaviour change[41], in practice it is difficult to create meaningful peer relations. In fact, although the peer-led activities were originally conceived as group activities, in practice peer interveners were only able to implement nutrition activities in pairs. This could be due to timetable clashes but also perhaps the fact that with unfamiliar peers it is easier to gain each other's trust in pairs.

Strengths and limitations

Although some interventions have previously used peer education to specifically target disadvantaged children and adolescents[50], to our knowledge this is the first intervention to purposefully select peer facilitators based on socioeconomic status. The peer intervention was embedded in a large-scale research study which allowed systematic collection of data in all state run high schools in the Vosges area in France as well as some volunteer middle schools totalling 33 schools. This allows conclusions to be drawn about selection procedures of facilitators and receivers as well as the acceptability of the peer intervention. Furthermore, an in-depth process analysis with different sources of qualitative material was carried out in order to triangulate findings and inform practice as to the feasibility of the peer intervention. Limits of the present study relate to the small sample sizes of the facilitators and receivers. As a result, no statistical conclusions can be drawn with confidence as regards, first, the characteristics of the participants and, second, the impact of the peer intervention on the nutritional behaviour of the receivers. However, the peer intervention was purposefully designed as a feasibility study given the innovative selection of facilitators. With a larger sample size, further research should aim to measure the health benefits to the receivers and the cost of the intervention. It would also be

important to empirically establish the added value of selecting peer facilitators matched on receiver socioeconomic status. Furthermore, the benefits of selecting less advantaged facilitators should also be assessed as regards the potential empowerment of more vulnerable adolescents by encouraging them to take an active part in health programmes.

Contributors

LS conceived and coordinated the intervention. SB, KL, JL, LM, AYO, RdL and EL participated in the intervention design and implementation. JK participated in the conception of the focus groups and interviews. LS and SR conducted focus groups and interviews and LS conducted qualitative analyses. LS and SB conceived and drafted the manuscript with input from all members of the authorship team. SB coordinated the overall study. CA performed quantitative analyses. KL, CA, SR, JL, LM, AYO, RdL, JK and EL also reviewed the manuscript and contributed important intellectual content. All authors approve the final manuscript. Members of the PRALIMAP-INÈS trial group (PI) contributed by giving feedback during intervention implementation.

Acknowledgements

Many people worked together to make a success of the PRALIMAP-INÈS trial and have been listed in the design, methods, and rationale paper. We would like to express our gratitude to the participating students, parents, and professionals in the participating schools.

Funding statement

This work was supported by the French National Cancer Institute (INCA), a public institute, grant number 2011-239. The work of LS was supported by the University of Lorraine (PhD grant).

Competing interests

We have read and understood BMJ policy on declaration of interests and declare that we have no competing interests.

Patient consent

Obtained

Ethics approval

As an integral part of the PRALIMAP-INES trial (registered at ClinicalTrials.gov NCT01688453), ethics approval was obtained from the French consultative committee for treatment of information in health and research (no. 12.299), the French national commission for Data Protection and Liberties (no. 912372) and the French Persons Protection Committee (no. 2012/15).

Data sharing statement

No additional data are available

Figure legends

Figure 1: Recruitment process of the facilitators (ambassadors and entrepreneurs)

Figure 2: Interest and participation of the receivers

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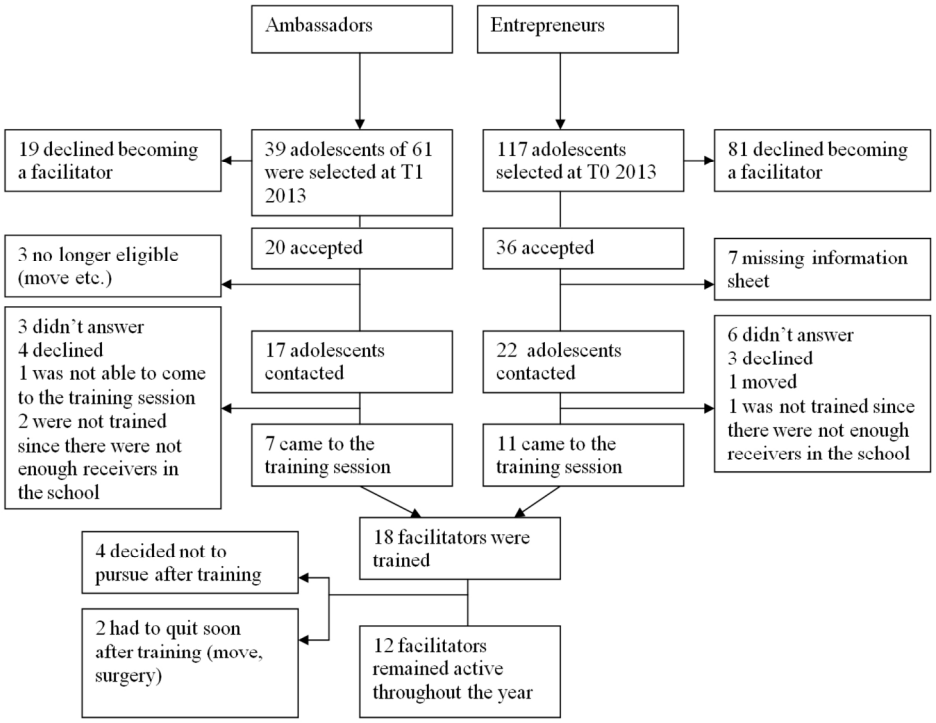

Figure 1: Recruitment process of the facilitators (ambassadors and entrepreneurs)

199x156mm (300 x 300 DPI)

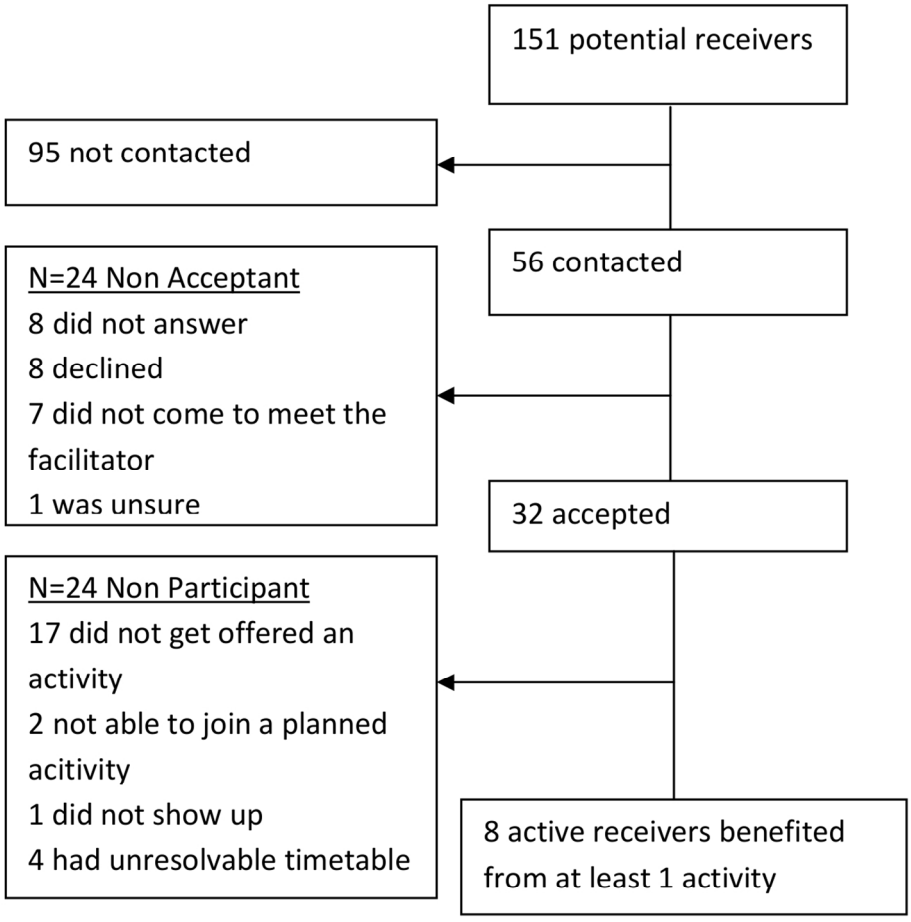

Figure 2: Interest and participation of the receivers

120x125mm (300 x 300 DPI)

Supplementary file 1: Contribution of each source of data collection to assess feasibility questions

Feasibility criteria	Outcomes of interest	Screening session	Facilitator training session	Facilitator mid-program interview	Facilitator end-of-program session	Facilitator SMS exchanges	Facilitator Telephone calls	Nutritional activities	Receiver individual interviews
Demand	Expressed interest	x							x
	Caracteristics	x							x
	Participation		x			x	x	x	
Acceptability	Appropriateness		x	x	x	x	x		x
	Satisfaction		x	x	x				x
Implementation	Intervention dose							x	
	Support needed					x	x		
Practicality	Implementation ease or difficulty		x	x	x	x	x		x

Supplementary file 2: individual characteristics of each facilitator and receiver

	Entrepreneur							Ambassadors					Active receiver							
Student number	61142	61177	101052	141026	151039	191099	241026	50011	70016	150016	210005	210012	61147	141052	141058	151098	151116	191134	211001	241089
Measurement time point	T0	T0	T0	T0	T0	T0	T0	T1	T1	T1	T1	T1	T0	T0	T0	T0	T0	T0	T0	
Gender	Girl	Girl	Girl	Boy	Boy	Girl	Girl	Girl	Boy	Boy	Girl	Girl	Girl	Boy	Boy	Boy	Girl	Girl	Girl	Girl
School type	General and technological High School	General and technological High School	Professional High School	Professional High School	Middle School	General and technological High School	Middle School	Professional High School	General and technological High School	Professional High School	Professional High School	Professional High School	General and technological High School	Professional High School	Professional High School	Professional High School	Professional High School	General and technological High School	Professional High School	Middle School
Exact age	15.04	15.39	15.94	16.54	13.97	15.02	13.99	16.38	15.44	16.15	16.23	15.77	15.62	16.58	16.12	17.55	17.41	14.90	15.87	14.22
BMI	22.49	19.04	23.07	25.92	20.06	24.31	21.55	27.17	23.70	27.75	28.98	27.43	23.76	32.97	25.73	28.99	37.42	24.30	25.83	31.68
FAS score	5	5	3	4	3	4	4	4	5	5	5	4	5	4	2	5	5	4	4	5
EAT 26 score	3.8	8	7.6	8.3	.	12.8	.	8.9	15.3	6.4	29.3	7.6	35.8	15.3	11.5	2.5	10.2	17.9	8.9	14.1
HAD score	28.57	9.52	14.29	14.29	9.52	38.10	11.90	19.05	26.19	16.67	35.71	28.57	42.86	35.71	35.71	26.19	7.14	21.43	23.81	35.71
Anxiety score	38.10	19.05	19.05	23.81	.	52.38	.	28.57	33.33	14.29	52.38	38.10	61.90	42.86	52.38	19.05	9.52	33.33	38.10	52.38
Depression score	19.05	0.00	9.52	4.76	0.00	23.81	0.00	9.52	19.05	19.05	19.05	19.05	23.81	28.57	19.05	33.33	4.76	9.52	9.52	19.05
Physical activity level	Moderate	High	High	High	.	Low	.	Low	Moderate	Low	Low	Moderate	Moderate	Moderate	High	Moderate	Moderate	Moderate	Moderate	High
KIDSCREEN score	43.35	55.07	44.48	43.35	66.86	34.70	48.29	59.85	45.67	46.94	41.24	43.35	41.24	40.24	48.29	38.34	66.86	46.94	46.94	48.29

Supplementary file 3 – SMS and Calls

SMS received	Plan training	Plan call	Plan interview	Activity feedback	Plan end session	Total SMS sent	Total received	nb contact days	% no answer
F1	2	69	9	34	25	147	142	54	4
F2	1	30	11	46	1	122	108	47	4
F3	11	47	3	41	6	140	112	57	9
F4	5	59	3	36	44	180	147	67	11
F5	0	4	0	5	0	24	15	12	29
F6	6	25	14	25	3	89	76	43	9
F7	4	43	5	29	5	88	92	38	0
F8	5	14	6	37	2	88	66	36	14
F9	5	21	4	18	6	78	58	42	17
F10	0	21	1	43	9	95	75	41	16
F11	1	6	1	5	3	29	16	23	38
F12	1	32	11	30	0	66	83	30	0

Table 3a: Content and number of SMS exchanges between the coordinator and the facilitators

	Missed call	Phone conversations	% missed
F1	2	8	20
F2	0	12	0
F3	1	15	6
F4	3	17	15
F5	26	5	84
F6	0	11	0
F7	0	10	0
F8	18	4	82
F9	0	4	0
F10	3	10	23
F11	26	5	84
F12	11	9	55

Table 3b: Number of phone conversations and missed calls between the coordinator and the facilitators

Note: The more successful facilitators are in bold and underlined

Supplementary file 4: illustrative quotes from the facilitators and receivers

FACILITATORS

Section	Main point	Source	Person	Gender	Age	Quote
Organisational issues	Time and transport and other logistical problems	Training session	F6 (vs*)	Girl	15.0	yeah that will more be it I think [activities during the holidays] since honestly during class it's until 6pm Wednesday afternoon we have class also and everything and the weekend either it's to rest or do homework so umm
		End of program session	F10	Girl	16.0	well the people I had were residents [boarding school] so um they lived in um [city far away] (…) And like even every time there were teachers that swaped their lesson hours around and things like that so
		End of program session	F9	Boy	15.4	I maybe overestimated that time [free time]
		End of program session	F3 (vs)	Girl	15.0	Well what I found difficult was to find um the same date to do an activity with several people
		End of program session	F7	Girl	16.4	Well I called them [receivers] and I explained we talked a good 15min and then um then they told me um it wasn't possible, on Wednesdays they already had activities and there were some that had to keep their little sister too.
		End of program session	F6 (vs)	Girl	15.0	For [receiver] it was a transport problem timewise honestly you could see that he didn't mind joining in the activity or exercising or anything but it was really umm an organization thing
		Telephone notes	F2	Girl	14.0	I didn't know it would be so hard. Either I forget. Either it's not possible.
		Mid program interview	F1 (vs)	Girl	15.8	Yeah I'll do it tonight because well before I had to revise for mock final exams
		SMS exchange	F7	Girl	16.4	well it's not that I don't want to do it anymore but it's tough I will soon have my exam and there are only 2 weeks left of class and [name of receiver] can't the two Wednesdays because she's looking for an internship and on Monday and Tuesday I finish class at 6pm and the other days she can't and during the holidays I can't because I will work so she's ok to do the activity in September.
		SMS exchange	F12	Girl	16.2	Coordinator: So is everything set for an activity next Wednesday? Facilitator : No the sport hall is reserved
		Mid program interview	F4 (vs)	Boy	14.0	well I did struggle a bit for exercising with good weather
	Contact issues with the coordinator	End of program session	F10	Girl	16.0	Yeah because I just didn't receive them for a while the messages. That's why I changed phone.
		End of program session	F3 (vs)	Girl	15.0	well me with my phone when I have a message I answer but well sometimes I just don't receive them
		SMS exchange	F8	Girl	15.4	Coordinator: Can I call you on a landline? Facilitator: I'm in a social home so the landline is reserved for adults
		SMS exchange	F4 (vs)	Boy	14.0	Facilitator: yes sorry I didn't have enough phone credit to answer
	Contact issues with the receivers	End of program session	F3 (vs)	Girl	15.0	well with [receiver] um since she didn't have any method of communication apart from um anyway it was really complicated
		SMS exchange	F8	Girl	15.4	Hello, I received your calls; I can't answer since I'm in study period, however I changed phone and I therefore don't have the numbers of [receiver 1] and [receiver 2] and since I plan on maybe going running tomorrow or Wednesday that would be easier to warn them by message :)
	Need for support	End of program session	F6 (vs)	Girl	15.0	Coordinator: so what could have helped you? Facilitator: well for me if everything had been organised for the time the place and the activity then umm see with the others and do it all together but if everything was organised Coordinator: Ok so ideally it would have been "ok so the court is reserved for badminton this day this time and [facilitator] is coming to do it with you" Facilitator: Exactly! That would have been really great.
		End of program session	F9	Boy	15.4	yeah or just do a um I don't know grab a room and have a little ten minute meeting and call [take out of class] all of those who are interested to come um yeah just that it would have been, it would have maybe helped a little.
		End of program session	F10	Girl	16.0	And then when um we couldn't find dates anymore and then um that's when pff I got a bit fed up I told myself yeah it's crap I don't have any activities.

Other challenges	Motivation issues	End of program session	F12	Girl	16.2	Coordinator: But you knew them right? Facilitator: Yeah but when I went to see them [receivers] they said “oh we don’t care”
		End of program session	F3 (vs)	Girl	15.0	Yeah it was rather easy. The only problem afterwards was that [receiver] thought that umm that the activities would be during um lessons. That’s why she was motivated, to skip class
		SMS exchange	F9	Boy	15.4	well it didn’t go too well [the meeting] because one came and refused and the other didn’t show
		Mid program interview	F4 (vs)	Boy	14.0	I told him “you know I have a bike in the basement I have two biked in the basement if you want we could do a bit of cycling I’ll lend you a bike” and so on [and the receiver responded] “oh no pralimap I don’t do”
	Program clarity	End of program session	F2	Girl	14.0	Like my friend [name of friend] she went to the pralimap thing but physically I mean ok she might have a little belly but she isn’t she isn’t fat she isn’t um round or anything at all she is super pretty and all that and she had to go to the pralimap thing anyway not to mention that she doesn’t eat anything so um I don’t understand
		End of program session	F6 (vs)	Girl	15.0	it’s mostly um mostly yeah having fun with the person and exercising together. I don’t really see the nutrition part because we didn’t really talk about it and and we don’t really know more than the other person I think.
	Health issues	SMS exchange	F8	Girl	15.4	Hello, I have some bad news.. I am going to have to stop all physical activity due to an ice-skating accident and the discovery of scheuermann’s disease which stops all type of physical activity. I’m really sorry for the inconvenience.
	Interpersonnal skills	SMS exchange	F2	Girl	14.0	sometimes, I doubt my abilities :/ in any case I’m not talented for organizing outings ^^” But actually, since we’re only 3 and not specially friends, I don’t really know what we could do… Should we do it with our own friends?
		Mid program interview	F9	Boy	15.4	Well because maybe I’m bossy well kind of bossy like for example pff if I think there’s a bit of noise and I say to tone it down I think I might be a bit too bossy
		Mid program interview	F1 (vs)	Girl	15.8	well last time um because of [second facilitator] well because originally we were supposed to do it [the activity] together. And I saw that she wasn’t trying and well on my own I was really struggling
Good practice	Regular contact with coordinator	End of program session	F7	Girl	16.4	Coordinator: Ok why? [was it a good system] Facilitator: well because we could get organised if we had something planned or not. And maybe we were in the middle of something
		End of program session	F6 (vs)	Girl	15.0	[following conversation above] Facilitator: same for me
		End of program session	F9	Boy	15.4	Coordinator: And in terms of content because it’s true that sometimes there wasn’t much to say was it still useful being in touch? Facilitator: Umm yeah I found it useful
		End of program session	F3 (vs)	Girl	15.0	[following conversation above] Facilitator: Yeah cause it helped us remember that it we really needed to do it (...) I had never forgotten but it, it remotivated me and stuff.
		End of program session	F1 (vs)	Girl	15.8	Coordinator: so what should the coordinator do if there are no responses to SMS
			and F12	Girl	16.2	F1 (very successful facilitator-girl): See with the school F12 (facilitator-girl): Yeah definitely Coordinator: why? F1: Yeah well I think like say the person has changed number and everything F12: They also often have the internship times if it’s to do with that
	Physical activity	End of program session	F10	Girl	16.0	They asked me “oh you can go ice skating” I said “yes” so yeah as soon as you talk more directly about activities yeah it’s actually cool they said “oh really you can do activities and everything oh well that’s cool”. (...)
	Support of parents	End of program session	F6 (vs)	Girl	15.0	There was also her [receiver] mom she um we did three activities and my dad brought her once and her mom twice so um it’s certain that if that hadn’t been there since it was super far nah it wouldn’t have been possible.

	Program commitment	Mid program interview	F4 (vs)	Boy	14.0	And just afterwards he told me "[swear word] they want me to do pralimap and everything" and I said "well why don't you want to do it? If you want I can offer to be your facilitator since we're neighbours it would be easy".

* Note: (vs)= very successful facilitator

RECEIVERS

Section	Topic	Person	Status	Gender	Age	Quote
Social environment	Family relations	R4d	Reluctant	Boy	15.8	well since my step father works in the show business he often comes home late so I cook one day out of two I do it
		R4f	Passive	Girl	15.3	Receiver (passive receiver-girl): I am tired at the moment Interviewer: why? Receiver: because I have a lot of family problems and I don't sleep well. I think too much about it. So I think I'm in bad health
	High school	R4e	Reluctant	Boy	15.2	Receiver: no it's the first time but it's different from being at home [being in boarding school] Interviewer: so what's different from home? Receiver: well you're there all the time with friends so in the evenings we chat and laugh
		R4c	Passive	Girl	15.9	you never know how the others will react if you tell them something and most people here are, how to say it, really mean. They judge people based on physical appearance that's why we like to stay just the four of us that's why we stay in our own group.
	Relationship with peers	R4d	Reluctant	Boy	15.8	Interviewer: so what is a mate then? Receiver: they're just people with who you laugh and all its not the 36 [friends] that I can actually open up to those are people who are always there for you.
		R4e	Reluctant	Boy	15.2	Receiver: badly because people from school most guys are thin and all that they chill and all talk to everyone laugh with everyone and it annoys me because I tell myself maybe if I stop eating I would talk to everyone and be in their shoes like Interviewer: so with people here at school when you see them do you say hi? Receiver: no I don't say anything I just stay with [name of best friend] and that's all.
		R4a	Active	Boy	17.6	not really we see each other only here [high school] yeah otherwise we stay in touch via telephone otherwise we don't see each other outside.
		R4f	Passive	Girl	15.3	Interviewer: so with your old friends how come you're not friends anymore? Receiver: no idea because I think we didn't see each other anymore
		R4e	Reluctant	Boy	15.2	Interviewer: and what bothers you why don't you want to talk to your family? Receiver: because we're not of the same generation
Health and overweight	Defintition	R4a	Active	Boy	17.6	Interviewer: so what is health? Receiver: to feel good Interviewer: and that means? Receiver: to feel good in your shoes not to be sick Interviewer: and what is to feel good in your shoes? Receiver: what can I say well feeling good not feeling fat
	Wanting to lose weight	R4b	Active	Girl	17.4	Receiver: well since everyone tells me I need to lose weight because of people staring (regard des gens) and all that I tell myself I don't care if people look and judge because for me it's my life it's my body and all that they're not the ones to tell me what I have to do. If I feel good I'll stay this way Interviewer: so why then do you say you want to lose a little [weight]? Receiver: it's mostly for clothes because often I can't find my size often I have to go in the big sizes and it bugs me a bit all that

		R4c	Passive	Girl	15.9	for me it depends on the days [successful healthy behaviour] if I ate well at the school cafeteria I shouldn't be hungry or sometimes I see my mom eat and it makes me want to go grab some cookies
		R4a	Active	Boy	17.6	there are times I'm not careful but also we don't have the luck of eating a balanced diet we don't eat much fruit and vegetable at mine so I don't really have the opportunity to be careful so sometimes I eat in excess but um
Program experience	PRALIMAP-INES	R4c	Passive	Girl	15.9	Interviewer: and how was it? Receiver: it was ok Interviewer: meaning? Receiver: sometimes they only talked sometimes we moved Interviewer: and you don't like talking? Receiver: no
	Lack of program clarity	R4f	Passive	Girl	15.3	Interviewer: and were you aware of the activities in pralimap that you were offered Receiver: no idea I said I didn't want to do it and that's it
		R4b	Active	Girl	17.4	Interviewer: and do you know about the peer activities in pralimap? Receiver: no Interviewer: were you not contacted by [name of facilitator]? Receiver: oh yeah but I didn't think that was it
	Potential barriers	R4e	Reluctant	Boy	15.2	Interviewer: so what stopped you? Receiver: I don't know Interviewer: was it the way he invited you? Receiver: no because I didn't know him so that's it
		R4f	Passive	Girl	15.3	Interviewer: so if I offered now what would you say? Receiver: I don't know I think I would have said no Interviewer: why? Receiver: because I don't like doing activities with too many people Interviewer: what if there were only 2 people Receiver: oh then yes maybe
	Activity experience	R4a	Active	Boy	17.6	Interviewer: and you felt comfortable? [during the activity] Receiver: well not really at first because I didn't really know him, then getting to know him I felt more at ease. (...) Interviewer: And what did you do? Receiver: we talked a lot Interviewer: about what? Receiver: we talked about ourselves he asked me why I participated in pralimap and told him and everything we talked about our jobs what we liked we talked about music too Interviewer: all this whilst walking? Receiver: yes for 2h (...) Interviewer: and so now you've become friends Receiver: yes every time we see each other we say hi and everything

BMJ Open

Using facilitator-receiver peer dyads matched according to socioeconomic status to promote behaviour change in overweight adolescents – a feasibility study

Journal:	*BMJ Open*
Manuscript ID	bmjopen-2017-019731.R1
Article Type:	Research
Date Submitted by the Author:	07-Feb-2018
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Primary Subject Heading:	Public health
Secondary Subject Heading:	Qualitative research
Keywords:	peer education, overweight, health inequalities, sociocognitive theory, adolescent health

Title : Using facilitator-receiver peer dyads matched according to socioeconomic status to promote behaviour change in overweight adolescents – a feasibility study

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Word count : 8030

Abstract

Objectives
Evaluate the feasibility of an innovative peer intervention promoting healthy eating and physical activity which purposefully selected peer facilitators according to socioeconomic status to target less-advantaged overweight receivers.

Setting
Nine high schools, 2 middle schools.

Participants
One hundred and fifty-six adolescents were approached to become facilitators of which 18 were trained. Thirty-two of 56 potential receivers agreed to participate.

Intervention
The peer intervention was carried out in 2013-14 and embedded in a larger trial: PRALIMAP-INÈS. Facilitators were selected and trained to organise weight-control activities with specific peer receivers participating in the programme.

Primary and secondary outcome measures
Different types of data were collected to assess demand, acceptability, implementation and practicality of the intervention. For the facilitators, this included 6 training sessions, 11 mid-programme interviews, 4 end-of-programme sessions, telephone notes and SMS exchanges. All 6 potential receivers in one school were also interviewed. Sociodemographic and health characteristics were also analysed.

Results
Agreeing to participate was more likely when asked by a peer compared to a professional (51.2% discordant pairs; P<0.02). Twelve activities, mostly based on physical activity and implemented during weekends or holidays, were carried out. The mean age of active receivers was 16 and their BMI was higher than other participants. For both facilitators and active receivers there were more participating girls. Qualitative analysis reveals key implementation challenges for facilitators. Interviews with the receivers highlight social difficulties with most feeling bad about their appearance and wanting to lose weight. Those who participated in peer activities were very positive about the experience especially social support.

Conclusions
The present study suggests the peer intervention was feasible provided organisational difficulties are addressed. Good practice recommendations are formulated including a longer training session, organising a joint meeting with the facilitators and receivers, matching dyads on place of residence and multiplying modes of contact.

Strengths and limitations of the study

- To the authors' knowledge this is the first intervention to purposefully select peer facilitators matched on the basis of the socioeconomic status of the receivers.
- The peer intervention is based on sociocognitive theory with a particular focus on peer modelling, peer support and practice opportunities for mastering desired behaviours as opposed to the traditional concept of peer education based on transmission of information.
- The intervention was embedded in a large-scale research study allowing systematic collection of data and an in-depth process analysis with different sources of qualitative material was also carried out to triangulate findings and grasp implementation challenges.

- There were fewer peer-led activities carried out than expected and many organisational challenges need to be addressed and serve as lessons learned in order to facilitate implementation in future interventions.
- Results provide an indication of the potential feasibility of the peer intervention but further research with a larger sample size is necessary to confirm findings on the characteristics of the participants and empirically evaluate the effectiveness of the intervention to improve the dietary and physical activity behaviour of the receivers.

Keywords:

peer education, obesity, overweight, adolescents, physical activity, health inequalities, nutrition, physical activity, sociocognitive theory

INTRODUCTION

Schools are considered to be ideal settings for health promotion interventions, particularly in the context of lifestyle interventions for weight management[1–3]. Indeed, it has been argued that the school setting intrinsically exposes children and adolescents to dietary and physical activity factors[4]. Furthermore, pupils spend a significant amount of their time in school for which attendance is often compulsory. This means that it is possible for interventions to reach almost all adolescents, regardless of socioeconomic status in a relatively short time. For this reason, it has been suggested that the school setting may be particularly important in order to reduce health inequalities[5]. However, concerns have been raised about the fact that school interventions may not benefit all adolescents equally and the need for specific examination of minority groups has been expressed[6,7].

One reason that school-based interventions may not benefit all adolescents equally could be the socioeconomic gap between health experts delivering the interventions and adolescents of low socioeconomic status. For example, in a French evaluation of peer-led health interventions, it was highlighted that young people are critical with regard to health prevention interventions carried out by professionals[6]. It is also believed that adolescents feel stigmatised by adults because they feel they are considered as a "risky age group", which is a negative prejudice, and they do not feel implicated in health policies designed for them [8]. Furthermore, there seems to be an association between adolescents' eating habits and physical activity level and that of family and friends suggesting involvement of adolescents' social environment may enhance the effectiveness of weight control interventions [9,10]. For example, it has been shown that higher levels of physical activity among friends are associated with higher levels of physical activity of the individual and that an individual's level of physical activity changes to reflect his/her friends' higher level of physical activity[10]. In addition, when health interventions are performed by peers, they seem to have a higher level of acceptability and age proximity is especially valued because of the belief that adolescents of the same age understand each other better than adults would[6]. The central tenet of the effectiveness of peer education is that the influence of peers and friends are likely to become more important as children get older[11]. For example, the review by Salvy and colleagues (2012)[11] highlights that young people are more physically active when in the company of peers and friends and overweight boys paired with non-overweight peers increase their physical activity to a level similar to the non-overweight peer.

Given these observations, a call has been made to increase the number of health promotion and prevention programmes in schools in France, especially those delivered by peers[6]. Peer education has been extensively implemented with encouraging results across settings and in several health domains, especially sexual health and HIV prevention[12–14] but also smoking prevention and substance use[15,16]. More recently, peer-based approaches have been described as promising avenues for behavioural weight-control interventions with positive

results including weight loss, reduction in waist circumference, less sedentary behaviour, improved attitudes towards healthy eating and exercise and increased self-efficacy[2,17–24]. Across domains, a key recommendation for school-based interventions is that they be behaviourally focussed[7].

Despite promising results, the evidence for the effectiveness of peer education is unclear and one reason that has been put forward is the lack of theoretical embedding of the interventions[16,25,26]. In the present study, the choice was made to use sociocognitive theory as the theoretical basis of the intervention[27], with a particular focus on peer modelling as well as increasing self-efficacy through peer support and practice opportunities for mastering the desired behaviours. This concept of the role of peer interveners overlaps with two types of peer interventions as recently defined by Bagnall and colleagues[28]. The first is peer mentoring as "the development of a relationship between two individuals where the mentee is able to learn from the mentor, model positive behaviour and gain experience, knowledge or skills". The second is peer support which "seeks to promote health and build people's resilience to different stressors"[28].

The objective of this feasibility study was therefore to develop and evaluate a peer intervention to promote physical activity and healthy eating intending not to widen health inequalities by purposefully selecting adolescent peer facilitators that were also of low socioeconomic status in order to target less-advantaged overweight adolescents. Given the innovative method of selecting less-advantaged adolescents as peer interveners, the feasibility study aimed to assess the earlier stages of intervention development as highlighted by Bowen and colleagues [29], namely intervention acceptability, demand, implementation and practicality.

METHODS

PRALIMAP-INÈS study

The current study was carried out during the 2013-14 academic year within a larger research programme, PRALIMAP-INÈS (Promotion de l'ALIMentation et l'Activité Physique-INEgalité de Santé), running over a three-year period for the prevention of overweight and obesity in France. The study protocol of PRALIMAP-INÈS has been described in detail elsewhere[30]. Briefly, PRALIMAP-INÈS is a mixed quasi-experimental and experimental prospective trial aimed at overweight and obese adolescents aged 13 to 18 attending grade 9 in state-run middle-schools (last year of "collège" in French) and grade 10 in high-schools (first year of "lycée" in French) in the Vosges department (north-eastern France). At the beginning of the school year a screening process was carried out in the school setting (T0). All adolescents were measured and those with a Body Mass Index (BMI) greater than the International Obesity Task Force (IOTF) overweight thresholds for age and gender[31], or with a waist circumference greater than the McCarthy cut-off values for age and gender[32], also filled out several questionnaires and were offered a series of interventions. Socioeconomic status (SES) was measured by the WHO Family Affluence Scale (FAS) questionnaire[33,34] and a score equal or below 5 was considered to indicate less-advantaged status. At the end of the academic year (T1), students were measured again and filled out several questionnaires including their appreciation of the programme and its components. The trial was approved by the French consultative committee for treatment of information in health research (no. 12.299), the French National Commission for Data Protection and Liberties (no. 912372) and the French Persons Protection Committee (no. 2012/15).

Peer intervention description and logic model

As part of the PRALIMAP-INÈS programme, the current feasibility study focussing on the peer intervention was integrated and targeted at adolescents of the "less advantaged with standard

and strengthened-care » (LA.S.S) group during the 2013-14 academic year, representing 262 adolescents. In the sense that the role of the peer interveners was to encourage physical activity and healthy eating, the term "facilitator" is preferred and "receivers" for those receiving the intervention.

The peer intervention was based on sociocognitive theory which posits four mechanisms potentially important for self-efficacy and consequently the possibility of behaviour change: 1) performance outcomes, activated here by successfully carrying out weight-control activities (mastery experiences), 2) vicarious experiences, observing facilitators carry out weight-control activities, 3) verbal persuasion, facilitators should encourage healthy eating and physical activity and 4) emotional arousal which may in the present intervention entail positive emotions through social interaction with the facilitators during weight-control activities [27]. It was expected that through simple contact with the facilitators and other peers involved in the intervention, peer receivers would benefit from general social support and develop interpersonal skills. Carrying out weight-control activities with the facilitators was expected to bring information exchange, increased self-efficacy as well as support for the target behaviour change.

In order to carry out the peer intervention, two types of peer facilitator were selected: peer ambassadors were adolescents having participated in the PRALIMAP-INÈS programme the previous year and peer entrepreneurs were adolescents screened at the beginning of the school year in 2013 and having no previous experience of the programme. Both peer ambassadors and entrepreneurs were selected according to the following criteria: an ability to control their weight as evaluated by a physician, motivation to become peer facilitators and an FAS score ≤5 suggesting that they were of similar socioeconomic background as the peers they would be organizing activities with. In addition to similarity in socioeconomic background, facilitators were peers in terms of attending the same school and age similarity; the ambassadors being a year older and the entrepreneurs being from the same year group.

Peer facilitators received a 2-hour training session delivered during school time at the beginning of the academic year by a member of the PRALIMAP-INÈS team responsible for the peer intervention (LS). Training sessions were carried out in groups ranging from 2 to 4 adolescents and if it was not possible to regroup potential facilitators, training was done on an individual basis. The first part of the training session invited each adolescent to present him/herself and to consider why they would be a good facilitator in terms of skills and motivation. The objective of this part of the training session was to reinforce motivation and feelings of self-efficacy of the adolescents. The next part of the training session consisted in presenting the role of facilitator and brainstorming potential activities to be carried out and resources they could call upon to help them with this task. By brainstorming activities together, adolescents could be inspired from each other's ideas, get direct feedback in order to detail the implementation of their ideas with a focus on feasibility and start understanding more concretely what their role would entail. Another key moment of the training session was role playing key situations that the facilitators may face including: initial contact with the receivers and difficulties motivating receivers. Each role play was followed by feedback from the participants and observers as well as debriefing tips. Satisfaction with the training session was evaluated at the end of the session.

Following the training session, the facilitators who wished to continue were assigned a small group of peers which they had to contact and with which they were encouraged to develop activities based on their common interests to pursue throughout the academic year. The initial target was to organise and carry out 4 activities anytime in the school year. Great freedom was given to the facilitators as regards the choice of activities, whether they aimed at physical activity or healthy eating, as well as the time, place and implementation method of their chosen activities. The peer intervention was therefore implemented as part of a larger health

programme in the school setting but designed to be non-formal in its educational approach and allow activities to be carried out outside of school premises. The facilitators discussed their chosen activities with the programme coordinator (LS) and financial support was offered if it was necessary for the implementation of the activities.

Throughout the school year, facilitators were contacted on a regular basis for follow-up and support for the implementation of the weight-control activities with their receivers in the form of telephone calls as well as text messages (SMS) by the programme coordinator (LS). A mid-programme face-to-face interview was also carried out with each of the facilitators in order to maintain their motivation and allow a more in-depth exchange on the implementation challenges they faced. At the end of the academic year, all facilitators were invited to a formal end-of-programme session and they were rewarded for their time and effort with a certificate.

Feasibility criteria, material and analysis

Demand was evaluated by gathering expressed interest and participation rates of the peer intervention, for ambassadors, entrepreneurs and receivers. Expressed interest for being an ambassador, entrepreneur and receiver was obtained by a member of the PRALIMAP-INÈS team at the beginning of the school year during the screening process. The intervention was then offered a second time to the receivers directly by their allocated facilitator which enabled a comparison of expressed interest of receivers whether the intervention was offered by a professional or a peer.

Acceptability of the intervention was assessed in terms of satisfaction (spontaneous expression and answers to specific questions) and perceived appropriateness (expression of unease, reluctance or, on the contrary, enthusiasm in discourse). Implementation was evaluated in terms of how many, what type and when weight-control activities were carried out, as well as assessing the type and extent of support needed from the programme coordinator in terms of number and purpose of SMS exchanges and calls. Finally, practicality was evaluated by a detailed analysis of the factors affecting implementation ease or difficulty. In order to answer these research questions, the training sessions, mid-programme interviews and end-of-programme sessions, on top of their functionality within the peer intervention programme, also served as focus groups. They were all audio recorded, with the consent of the adolescents present, and transcribed. The material was then coded in NVivo10 by performing a thematic analysis. Telephone notes of each conversation with the facilitators and all SMS exchanges were also added to NVivo and coded. All these sources were analysed together to obtain a general view of acceptability, implementation and practicality from the point of view of the facilitators.

Furthermore, in order to gain more insight into the experience of the receivers, all 6 potential receivers from one high school, whether they chose to participate or not, were invited for an individual interview. These interviews were also transcribed, added to the NVivo database and coded using the same coding grid as the analysis on the facilitators in terms of their experience of the peer intervention but with an additional focus on the characteristics of the potential receivers in particular the following two themes: friendship and other peers (definition and number) and health and overweight (definition and personal experience).

A descriptive analysis was also undertaken on the information on facilitators and receivers collected by measures and questionnaires as part of the larger PRALIMAP-INÈS at the start and end of the school year. Physical activity and sedentary behaviour were measured by the International Physical Activity Questionnaire (IPAQ) [35], the EAT-26[36,37] screened for anorexia and bulimia symptoms, the Hospital Anxiety and Depression scale (HAD)[38] screened for anxiety and depression symptoms and the Kidscreen[39] explored perceived health and quality of life. Study sample characteristics (age, gender, school type, FAS, BMI) and health scores (physical activity level, total EAT-26 score, total HAD score as well as individual scores

for anxiety and depression and the Kidscreen score) were described using percentages for categorical variables and mean ± SD (standard deviation) for quantitative variables. Statistical analyses were carried out using SAS 9.4 (SAS Inst., Cary, NC, USA).

The main research questions to assess feasibility and how each source of data collected and analysed contributed to answering those questions is summarized in Supplementary file 1.

The facilitator training sessions, mid-programme interviews, end-of-programme sessions as well as the follow up of the facilitators by phone calls and SMS exchanges were designed and carried out by the peer intervention coordinator (LS). Receiver individual interviews were designed and carried out by an MSc student (SR) in collaboration with the peer intervention coordinator. All material was coded in NVivo by the peer intervention coordinator.

To illustrate main qualitative results, quotes from the facilitators and receivers were selected and translated from French into English.

RESULTS

Recruitment and participation

The flow chart illustrating the recruitment process of facilitators is illustrated in Figure 1. Of the 39 eligible ambassadors and 117 entrepreneurs, 20 and 36 adolescents agreed to become a peer facilitator respectively. Of the 39 facilitators who volunteered and were contacted, 18 were able to benefit from a training session in school. The reasons for not benefiting from a training session are diverse and include: not answering, changing their mind about participating and also not having enough receivers in the school to justify training a facilitator. The 18 facilitators benefiting from a training session came from 10 different schools and in total 6 training sessions were carried out. The participants were highly satisfied with the training session: on a 4-point scale, the average global satisfaction score with the training session was 3.8. The average score for specific questions were: having had a nice time (3.9), finding the training session useful (3.8), that the training session was sufficiently long (3.8), that it met their expectations (3.7) and that they felt ready to become facilitators (3.6). All scores ranged between 3 and 4. When asked what they enjoyed most, of the 18 trained facilitators, 13 spontaneously reported the role plays.

INSERT Figure 1

The recruitment process for the receivers is detailed in Figure 2. Of the 151 receivers for which there was a trained facilitator in the school who continued after training, 56 were randomly selected for contact by the facilitators. Of the 56 potential receivers, 25 did not formally accept the peer intervention of whom only 8 actually declining to participate. Thirty-two accepted the proposition and at the end of the peer intervention, 8 adolescents had benefited from at least one weight-control activity with a facilitator. Twenty-four adolescents did not benefit from an activity which, in the majority of cases, was due to the facilitator not managing to organise one. Another main reason for not benefiting from an activity is not being able to join for a variety of reasons such as not having transport or timetable clashes. Another interesting result is that willingness to participate in a peer-led intervention had already been asked by a professional at the beginning of the year during the measurement and screening process. For the 45 potential receivers who gave an answer both to the professional and to the facilitator later on, there was a significant difference of acceptance of the peer intervention with receivers more readily accepting when offered by a peer rather than a professional (MacNemar X^2=6.55; 51,2% discordant pairs; P<0.02). Of note is that of the 32 potential receivers who accepted the peer intervention, only 7 had declared lacking friends with which to do physical activity in the IPAQ questionnaire.

INSERT Figure 2

Characteristics of facilitators and receivers

Characteristics of the 12 facilitators and 8 active receivers are described in Table 1. Individual characteristics of each facilitator and receiver are presented in Supplementary file 2. Of the 12 facilitators that continued after the training session, there were twice as many girls as boys. Facilitators were aged between 14 and 17, with ambassadors naturally being older then the entrepreneurs on average since they belong to the year group above. The average age of active receivers is higher than the entrepreneurs, even though they came from the same year group. The BMI of the facilitators ranged from 20 to 29. Ambassadors who continued were mostly from professional high schools. Interestingly, entrepreneurs tended overall to have better health scores than the ambassadors and the receivers which may be linked to the difference in BMI. The receivers who carried out a weight-control activity seemed generally already quite active in their lives in terms of level of physical activity.

Table 1: Characteristics of entrepreneurs, ambassadors and receivers

		Entrepreneurs*	Ambassadors**	Receivers	Complete LA.SS group
N		7	5	8	262
Gender	Boy	2	2	3	114
	Girl	5	3	5	148
School type	General and technological High School	3	1	2	91
	Vocational High School	2	4	5	117
	Middle School	2	0	1	54
Age		15.1	16.0	16.0	15.4
BMI		22.3	27.0	28.8	26.8
FAS score		4.0	4.6	4.3	4.1
EAT 26 score		8.1	13.5	14.5	13.8
HAD score		18.0	25.2	28.6	28.7
Anxiety score		30.5	33.3	38.7	34.9
Depression score		14.3	17.1	18.5	23.7
Physical activity level	High	3	0	2	61
	Moderate	1	2	6	96
	Low	1	3	0	77
	Missing	2	0	0	28
Kidscreen score		48.0	47.4	47.1	46.6

*Data was collected during the screening session at the start of the 2013-14 academic year
**Data was collected at the follow-up visit at the end of the 2012-13 academic year

The 32 receivers who agreed to participate in the peer intervention had a higher BMI than the 25 who didn't give a positive answer and this result approached significance (P=0.07). There were no other statistically significant differences between these two groups in terms of age, gender, school type, deprivation index as well as anxiety, depression, bulimia or anorexia symptoms, physical activity as well as perceived health and quality of life. The 8 receivers having carried out an activity were significantly older (15.3 vs 16.1 P=0.018) than the 24 adolescents having said yes but who did not, for various reasons, participate in an activity. There was no significant difference between the adolescents who agreed to become facilitators

and those who didn't, both for entrepreneurs and ambassadors on any of the above-mentioned variables.

Weight-control activities and other tasks

Several tasks were considered important in order to be a successful facilitator. Facilitators had to think of, plan and implement an activity without giving up during the school year. In order to be considered successful they also had to come to the training session, the mid-programme interview and the end-of-programme session. Of the 12 facilitators, 4 were considered to be very successful, having achieved all or the majority of the above-mentioned tasks.

It is clear that the task of implementing an activity was difficult for the facilitators as only half managed to do so, despite the vast majority having managed to think of and plan one. Furthermore, 3 facilitators formally quit before the end-of-programme session and 1 more tacitly quit by no longer answering any messages or calls.

In total, 12 weight-control activities were carried out by 6 facilitators (see Table 2). Facilitators who did manage to plan and implement an activity then usually implemented 2 or more activities. Facilitators had a clear preference for organising activities centred on physical activity (10) rather than healthy eating (2) and they preferred organising activities during holidays or weekends, not on school days. Walking was a simple but popular activity amongst facilitators and receivers.

Although each facilitator was initially tasked with contacting several receivers and organising group activities, in practice activities were carried out in dyads. Only two activities were carried out in a group, both for healthy eating activities. In fact, only one facilitator managed to organise activities with two different receivers. Furthermore, one facilitator was only able to carry out an activity by including her usual friends.

Table 2: Weight-control activities carried out by the facilitators

Day	Activity	Type	Receiver*	Facilitator*
weekday	Walking	Physical Activity	R4b	F4
weekday	Cooking a meal	Healthy Eating	R5a and R5b	F5
holidays	Walking	Physical Activity	R6	F6
holidays	Walking	Physical Activity	R6	F6
holidays	Walking	Physical Activity	R6	F6
holidays	Football	Physical Activity	R1	F1
holidays	Biking	Physical Activity	R1	F1
weekend	Walking	Physical Activity	R4a	F4
weekend	Walking and Wii	Physical Activity	R3	F3
weekend	School meal	Healthy Eating	R2 and friends	F2
weekend	Basketball	Physical Activity	R1	F1
weekend	Fitness trail	Physical Activity	R3	F3

*Individual receivers and facilitators are anonymously numbered with the number of the facilitators corresponding to the number of their matched receiver(s).

Although potential ambassadors were considerably more likely to accept becoming a facilitator than potential entrepreneurs (see Figure 1), entrepreneurs were much more likely to manage to organise and implement a weight-control activity with a receiver: 5 of the 6 who managed were entrepreneurs.

Facilitator need for support

The difficulty of organising weight-control activities for the facilitators is reflected in the acute need for support which is highlighted by the important number of SMS exchanges and calls between the coordinator and the facilitators (Table 3). The detail of the SMS exchanges and calls with each facilitator is presented in Supplementary file 3.

Table 3: Number and content of SMS exchanges and phone conversations between the coordinator and the facilitators

	Entrepreneurs	Ambassadors
SMS (mean)		
Plan training	4.0	2.6
Plan call	28.6	34.2
Plan interview	5.4	6.0
Activity feedback	33.3	7.8
Plan end session	9.3	7.8
Total SMS sent	105.4	81.6
Total received	85.6	78.2
Number contact days	43.3	37.4
% no answer	13.1	11.7
Call (mean)		
Missed call	7.3	7.8
Phone conversation	10.6	7.2
% missed	30.0	31.8

The SMS exchanges and telephone calls underline that intense support was necessary, whether the facilitators were more successful or not and also whether they managed to implement an activity or not. The total number of SMS sent to the facilitators ranges from 24 and 180 with corresponding contact days between 12 and 67. Between 4 and 15 telephone conversations on different days were also carried out with each facilitator.

In terms of content of the SMS exchanges, activity feedback was the main purpose of the SMS exchanges but this is closely followed by planning phone meetings for more in-depth conversations. The most successful facilitators had a maximum of 20% missed calls and for all but one, less than 10% no response rate to received SMS suggesting that despite constraints, they were organised and reliable. A general observation can also be made in that the percentage of missed calls is much higher in general than the percentage of non-response to SMS contact, suggesting that adolescents prefer this mode of contact. The fact that entrepreneurs, much more often than ambassadors, successfully implemented activities is reflected by the higher number of contact days, total SMS exchanges and phone conversations.

Insights from interviews, focus groups and process data

Facilitator views

The most illustrative quotes from the 6 training sessions, 11 mid-programme interviews, 4 end-of-programme sessions, telephone notes and SMS exchanges are presented in Supplementary file 4.

Main challenges

Organizational issues

All facilitators encountered organizational issues, whether they managed to carry out an activity or not. However, each facilitator seemed to be faced with a different combination of challenges

indicating that none is in itself impossible to overcome. Major organizational issues, concerning 8 of the 12 facilitators or more include lack of time, their own or that of their receivers, as well as timetable clashes, transport problems and remembering to carry out all the necessary tasks for organising the activity. These organisational issues were so common they were evidenced in all types of process data. An unforeseen major problem was the amount of time spent away doing internships for some students in professional high schools. Other common issues included having difficulties with the logistical organisation but also bad weather which some facilitators considered as problematic.

Furthermore, a very widespread but surprising difficulty, given it was specifically addressed during training, was the lack of ideas for what activities to organize. This was very present in the telephone notes as well as several SMS exchanges.

Another unexpected organizational difficulty was contacting the facilitators, even the very successful ones. Common issues were changing numbers and phones but also having dysfunctional phones or sometimes not having a mobile phone for a certain amount of time before getting a new one. Several difficulties were also specific to working with less advantaged adolescents such as limited phone credit. The difficulty in contacting the facilitators is consistent with the sheer number of SMS sent to each facilitator (see Table 3). These communication problems were also extremely frequent between the facilitators and the receivers. In fact, not having a mobile phone was often a reason for giving up on trying to organize an activity with a receiver. This happened to at least three facilitators.

Increased need for support

Related to the organizational issues mentioned above, a general finding is that even more support would be necessary to facilitate implementation at several levels of the peer intervention. Two facilitators expressed the need for help organising activities, even though 1 had managed to implement 3 activities. More specific help for the initial meeting with the receivers was also mentioned by 4 facilitators. This finding is consistent with the result that knowing the receivers to contact, at least by sight, greatly enhanced the success of facilitators. Indeed, knowing the receiver by sight was the case of all the facilitators having managed to implement an activity.

Motivation issues

The motivation of the facilitators fluctuated throughout the programme. Facilitators got frustrated when they were not able to organize an activity or when they felt that the receivers were not very motivated. The lack of motivation of the receivers manifested itself in several ways. Six facilitators experienced not receiving an answer from a receiver or a receiver not turning up to the planned activity, although the latter only happened once. Generally, all facilitators were confronted with some receivers not being very motivated and this was evidenced in all types of process data. For some receivers, the peer intervention was rejected because it belonged to the wider PRALIMAP-INÈS programme which they had decided not to participate in.

Programme clarity

A main implementation point to improve is programme clarity in terms of the role of being a facilitator on the one hand, and links with the broader PRALIMAP-INÈS programme on the other. For example, the selection of receivers was perceived as unclear and nearly half of the facilitators spontaneously mentioned this lack of understanding at the end of the peer intervention despite it being mentioned during the training session. This reflects a gap in the perception of intervention necessity as acknowledged by a professional as opposed to the facilitators.

A related point of confusion is the link between the peer intervention and the wider PRALIMAP-INÈS programme. For example, several facilitators thought that through the peer intervention they would gain knowledge on diet and physical activity indirectly. Some also described the peer intervention as not really part of the wider programme, which was likely perceived as more formal as it was delivered by health professionals and with a clearer educational focus. Furthermore, several admitted that although they were happy being a facilitator, they would probably not have accepted being a receiver.

The training session specifically did not provide information on diet and physical activity to facilitators as this information was imparted directly to participating adolescents, who were also the potential receivers, throughout the rest of the PRALIMAP-INÈS programme. Nevertheless, some facilitators took the initiative of talking about diet and physical activity with their receivers and others, on the contrary, did not consider it to be part of their role. This point merits further specification during the training session.

Health problems

Another unexpected finding was the number of health problems experienced by the facilitators. All but 2 facilitators reported small health problems throughout the year, sometimes with the consequence of having to delay or re-plan an activity. For 4 facilitators, the health problems were significant enough to have to either completely give up on their role as a facilitator, or rule out a large range of activities. For example: tendinitis stopped one facilitator from doing any physical activity for several months, one potential facilitator did not continue after the training session since she had to undergo a double knee surgery, one facilitator had a severe epilepsy attack so was cautioned against physical activity and one had to quit following an ice-skating accident.

Interpersonal skills

In terms of specific difficulties, it is clear that one facilitator in middle school had great difficulty with the role, not feeling comfortable especially in terms of social relations: she asked to change her receiver because she was afraid he had feelings for her and then asked to be able to carry out the activity with her own friends as well. In general, interpersonal skills were a common issue and this finding suggests more specific training in interpersonal skills may be necessary.

Another unforeseen difficulty linked to the social context of the intervention was having several facilitators in the same school. This had initially been considered to be a motivating factor and was initially perceived as such by the facilitators concerned. However, in practice this complicated further the organizational task and actually delayed several activities being organized which impacted the motivation of some facilitators.

Good practice

In general and consistent with the implementation challenges identified above, supporting elements for successfully carrying out the role of facilitator, and evidenced principally in the telephone notes, were being proactive and having lots of ideas, having free time and living close to the receivers.

Furthermore, several programme components seemed to facilitate implementation. In general, contact between the programme coordinator and the facilitators was perceived as very positive. Adolescents appreciated the procedure of first sending an SMS in order to agree on a time for a call, even though this was quite time consuming (see Table 3). The phone calls were very clearly experienced as motivating for all facilitators, whether they had been successful in their tasks or not. Overall, it can be stated that communicating via SMS is appreciated by adolescents, both with the coordinator but also with the receivers. It is however important to acknowledge the fact that the adolescents, even the most reliable ones, can be unreachable for various reasons. It

was therefore essential to have several means of contacting them. An additional possibility would be for the coordinator to contact the schools directly when there seems to be a communication problem.
When supportive of the programme, schools can be an important facilitating component to implementation. For example, some schools successfully organized the meeting between facilitators and potential receivers and one school nurse helped with selecting a receiver for a facilitator for whom previous contact with receivers had been unsuccessful.

A mixed finding was the support of parents. Although some facilitators seemed to share very little of their facilitator activities with their parents, despite sometimes being very successful, for others their parents were clearly very supportive and for three facilitators, parents had an active role in the implementation of the activities.

For ambassadors, a consistent finding is that they agreed to become facilitators because they liked participating in the PRALIMAP-INÈS programme the previous year. For all facilitators, it is clear that once they agreed to continue beyond the initial training session, they were motivated and committed to the PRALIMAP-INÈS programme in general, they actively and informally promoted the programme to family, peers and friends, without this being specified in their role.

Receiver views

Of the 6 potential receivers interviewed, 2 had carried out an activity of which 1 girl and 1 boy. Two girls can be considered passive receivers as they say they would have participated but don't remember being offered any activities by a facilitator and the 2 boys can be considered reluctant receivers as they clearly expressed their misgiving regarding the peer intervention. The most illustrative quotes from the different types of material analysed are presented in Supplementary file 4.

Social environment

It can be noted that family problems were very frequently reported amongst the receivers and some seemed to have important household responsibilities. In terms of the broader environment in high school, views were mixed. Boys generally said they appreciated the school environment, especially those who were full boarders, but girls seemed less at ease. To a large extent, the appreciation of the school environment depended on the relationship with peers. For all adolescents, peers are important in order to laugh, talk and relax. However, a distinction is made about what is a real friend, which entails the crucial element of trust and being able to count on the person. What is very present in the description of friendship for all of the adolescents is the notion of proximity in terms of being in the same place and seeing each other frequently. This notion of proximity means that for the majority, they seem closer to their new friends in high school than their childhood friends. For some, age proximity is also important

In terms of number of friends, adolescent profiles were quite different. Two adolescents, a boy and a girl, were clearly very sociable and reported a large group of real friends. The others, including both active receivers, admitted having few close friends. Two reported just staying with a preferred best friend and the other two described a small group of 2-4 friends. For the majority, there seemed to be a general mistrust of peers and feeling of isolation. Some adolescents attributed their feeling of social exclusion to their overweight status.

Health and overweight

For the majority of adolescents, health was defined as the absence of disease but also feeling in good shape. Public health norms of healthy eating and exercising were also understood and commonly mentioned. Interestingly, for two boys, health also included not being overweight.

For the majority of adolescents, being overweight was principally defined by referring to physical appearance and was directly linked to not feeling good about oneself. In fact, all but one adolescent interviewed expressed wanting to lose weight and reported attempts in that direction, even if this was mentioned indirectly.

However, many expressed that healthy behaviour was difficult and this was particularly well illustrated by the fact that all adolescents but one reported that they frequently ate in a fast food restaurant. It is also noticeable that what was particularly experienced as difficult was controlling what one eats. However, physical activity seemed to be something that was appreciated by the majority of adolescents.

Programme experience

The two adolescents who were active receivers were also those who enjoyed the wider PRALIMAP-INÈS programme. They found it fun and felt they were given good advice and that it was helpful for behaviour change. The others went to at least one activity to try it but did not really understand the programme and found it uninteresting.

Similarly to the facilitators, there was an overall lack of clarity as regards the peer intervention. In fact, 3 receivers did not remember being contacted for a peer intervention. Interestingly, not knowing the facilitator in advance only seemed to be a problem for 2 of the adolescents interviewed, one of whom was actually an active receiver. It seems that the others would have been quite open to the peer activities had they understood what it entailed. Only one adolescent boy was firmly against the peer intervention but could not explain why.

The receivers that had benefited from a weight-control activity with a facilitator expressed enjoying the activities, especially the social component for the receiver who did not know the facilitator beforehand. In fact, it is interesting that the relationship continued beyond the peer intervention.

DISCUSSION

The intervention was implemented with a sufficient number of participants in order to provide recommendations as to the feasibility of the intervention in terms of demand, acceptability, implementation and practicality.

Demand and Acceptability

A specific difficulty identified by a review of interventions for the prevention of obesity in adolescents was targeting interventions to a heterogeneous group[40] and it has previously been shown that even though adolescents generally want to be more active, there is much intra-individual variation in what, where, when and with whom, suggesting that tailored activity promotion would be ideal[41]. The wide range of profiles of the receivers in the present study are in line with this finding and highlights the potential advantage of implementing weight-control activities in peer dyads. Generally, although it can be said that the school setting allows all adolescents to be reached by health interventions equally, it is noteworthy that none of the peer weight-control activities were carried out in the school and the results of the interviews with the receivers confirm that for many, the school context is not favourable to feeling at ease given the general mistrust of peers. Indeed, the school setting can have a negative impact on the self-appraisal of overweight students through its normative structure[42], conducting peer activities in a new environment may be more conducive to positive self-appraisal. This result suggests that health programmes taking place in the school setting could use a peer intervention component to reach adolescents which may not otherwise participate on the school premises. The opportunity of reaching otherwise hard-to-reach adolescents with a peer intervention is also supported by the finding that the receivers who accepted the peer intervention had a

higher BMI on average than those who refused. Furthermore, all of the interviews carried out with receivers confirm that these adolescents wish to lose weight but find it difficult. It therefore seems that there is a real added-value to peer interventions aimed at overweight adolescents of low socioeconomic status.

The acceptance rate of the receivers seems sufficiently high to suggest satisfactory demand and acceptability of the programme, especially since they were more readily convinced to participate in the intervention when it was offered by a peer as opposed to a health professional. However, the acceptance rate and reach of the peer intervention could certainly be greatly improved in several ways. An unexpected finding was the widespread mistrust of peers in general. In fact, Puhl and colleagues[43] found that although peers were generally sought agents for support relative to parents, teachers or health professionals, they were also those who aroused most uncertainty with nearly a quarter of adolescents unsure if they wanted their peers to intervene. Given the general mistrust of same age peers of the receivers on the one hand, and the difficulty of the facilitators to contact the receivers on the other, a key improvement point would be for the coordinator to organise a joint meeting between the facilitators and receivers shortly after them having accepted the intervention. This would enable the dyad to get to know one another and would also be an opportunity to clarify what the peer intervention entails and the links with the broader health programme and perhaps even plan together the first activity for the receiver and facilitator to carry out. Another improvement point which concerns both the receivers and facilitators is to multiply the contact modes available to reach them, ideally also liaising with the school for this to be possible.

In their synthesis of reviews, Khambalia and colleagues[1] recommend individualizing interventions to particular student characteristics, particularly with regard to gender. Similar to other interventions, the present study had a gender bias in terms of peer interveners. The difficulty in encouraging boys to volunteer has widely been acknowledged[6,44,45]. It is likely that a strategy solely based on altruistic volunteering is more appealing to girls considering the societal feminine-associated gender role of caregiving [46]. Other strategies may be necessary to specifically motivate boys. One possibility would be to create a more competitive environment, such as is currently being developed in some peer interventions [41]. It would also be important to conduct interviews with less advantaged adolescent high school boys in order to understand which types of incentives are more engaging in this target group.

Implementation and Practicality

The results of the present study point to several improvements that could enhance the feasibility of a peer intervention based on the implementation of weight-control activities among less advantaged adolescents. In terms of the facilitators, contrary to expectations, it seems that entrepreneurs seem a better target than ambassadors. Indeed, although younger and less easily convinced to take on the role initially (69% refusal rate), they were by far the most successful facilitators. One reason could be that ambassadors have more academic pressure, being a year above and having state exams at the end of the year, which was not the case of the entrepreneurs. In France, students have national exams in 3ème (grade 9), the last year of middle-school when adolescents are 14-15, but then also in the last two years of high school when adolescents are 16 to 18 (grades 11 and 12). An inherent problem with the school setting is that, although health topics and transferable skill development are considered important cross-curricular themes, health and education agendas are often in competition with priority being given to core subjects[3,6,47,48]. A running question amongst peer education implemented in schools is the compatibility with students school commitments, especially national exams[48,49]. Having less academic pressure may also explain the higher communicational activity of the entrepreneurs. Furthermore, the entrepreneurs seemed generally to be in better health, which is conducive to finding energy for the role of facilitator and being a positive role model.

The dose of support received by the facilitators throughout the school year seems appropriate from their point of view, but is time consuming for the coordinator. This process could be improved since a very large portion of SMS exchanges were used for planning purposes, especially agreeing on a time to have more in-depth discussions through phone calls. A more time-efficient strategy may therefore be to have a contact person in the schools, and a regular weekly or bi-weekly planned meeting according to the individual facilitators' timetables. In this scenario, SMS use would shift to a more supportive function: encouraging the facilitators, checking things are going as planned and prompts for the planned meetings. This would also counteract some of the contact issues (changing phone number, lack of credit, broken phone etc.).

Results of this study also suggest facilitators may need longer than a 2-hour training session, even if they are not expected to transmit information on diet and physical activity. The training session would particularly benefit from three additions. First, increased time spent clarifying the role of the facilitator and the link with the broader health programme seems necessary. Second, it seems important to give facilitators practical ideas based on the local facilities which should have been previously contacted so that the facilitators can reach a contact person for these activities if they are interested. Indeed, the result that walking was the most popular activity carried out is likely due to the fact that it was perceived as the simplest, not requiring any equipment whatsoever. Walking could therefore be considered the best practice activity to be suggested as the first to be carried out, to put facilitators and receivers at ease. However, it was clear from multiple exchanges with the facilitators that they would have happily engaged in many other types of activity had the opportunity arisen. Another possibility would be to create more supportive environments within the school setting, for example by making it easier for facilitators and receivers to make use of existing sports facilities, which often require paperwork and adult supervision. This would require increased engagement from the school staff which would have to be promoted prior to the start of the program by involving key stakeholders in tailoring the peer intervention to the particular constraints of each school. Third, it may be important to provide specific training of interpersonal skills. The idea of providing more specific skills training for social support has been previously reported[20].

The main improvement point is to facilitate the implementation of activities for the facilitators. Generally, our findings concur with the two main types of time-constraints highlighted in other peer-led programmes: constraints linked to the implementation setting such as, for the school setting, exams or internships and constraints linked to the peers themselves such as family obligations, different timetables or residence location[6]. Constraints due to the peers themselves may be even more significant when working with less advantaged adolescents, as can be illustrated by the many family problems revealed during the interviews with receivers. Although there is evidence for an association between parental socioeconomic status and adolescents' physical activity and dietary behaviours [50,51], the many reported family problems make it unlikely that parental involvement would enhance the efficiency of the present intervention at high school level.

It seems that the main logistical modification that can be made is to match facilitators and receivers based on place of residence. This is especially true since most activities were carried out outside of the school week. Although the school environment has many advantages, it has been noted that some facilities may not be readily available for weight-control activities such as facilities for food preparation and consumption[52]. This was also noted in the current study. The initial assumption that peer facilitators would be able to use school facilities was never put into practice. One main reason may explain this finding on top of the lack of facilities: the organisational burden in order to use the facilities. Another reason could be the strict health and safety regulations of the school setting. An additional advantage of implementing a peer intervention programme is the fact that if the adolescents live close enough, their activities can continue during the holidays. The summer holidays have been highlighted as a potentially

important period of weight gain for adolescents, especially for overweight children and adolescents and ethnic minority groups[53].

Another recommendation would be to encourage carrying out, at least at first, activities based on physical activity rather than healthy eating as this has the most potential to engage adolescents and activities in dyads rather than groups, since this is easier to organize. Although allowing people to be with their friends in order to engage in physical activity has been recognised as a key lever for behaviour change[41], in practice it is difficult to create meaningful peer relations. In fact, although the peer-led activities were originally conceived as group activities, in practice peer interveners were only able to implement weight-control activities in pairs. This could be due to timetable clashes but also perhaps the fact that with unfamiliar peers it is easier to gain each other's trust in pairs.

Strengths and limitations

Although some interventions have previously used peer education to specifically target disadvantaged children and adolescents[54], to our knowledge this is the first intervention to purposefully select peer facilitators based on socioeconomic status. The peer intervention was embedded in a large-scale research study which allowed systematic collection of data in all state run high schools in the Vosges area in France as well as some volunteer middle schools totalling 33 schools. This allows conclusions to be drawn about selection procedures of facilitators and receivers as well as the acceptability of the peer intervention. Furthermore, an in-depth process analysis with different sources of qualitative material was carried out in order to triangulate findings and inform practice as to the feasibility of the peer intervention. Limits of the present study relate to the small sample sizes of the facilitators and receivers. As a result, no statistical conclusions can be drawn with confidence as regards, first, the characteristics of the participants and, second, the impact of the peer intervention on the diet and physical activity behaviour of the receivers. However, the peer intervention was purposefully designed as a feasibility study given the innovative selection of facilitators. With a larger sample size, further research should aim to measure the health benefits to the receivers and the cost of the intervention. It would also be important to empirically establish the added value of selecting peer facilitators matched on receiver socioeconomic status. Furthermore, the benefits of selecting less advantaged facilitators should also be assessed as regards the potential empowerment of more vulnerable adolescents by encouraging them to take an active part in health programmes.

Contributors

LS conceived and coordinated the intervention. SB, KL, JL, LM, AYO, RdL and EL participated in the intervention design and implementation. JK participated in the conception of the focus groups and interviews. LS and SR conducted focus groups and interviews and LS conducted qualitative analyses. LS and SB conceived and drafted the manuscript with input from all members of the authorship team. SB coordinated the overall study. CA performed quantitative analyses. KL, CA, SR, JL, LM, AYO, RdL, JK and EL also reviewed the manuscript and contributed important intellectual content. All authors approve the final manuscript. Members of the PRALIMAP-INÈS trial group (PI) contributed by giving feedback during intervention implementation.

Acknowledgements

Many people worked together to make a success of the PRALIMAP-INÈS trial and have been listed in the design, methods, and rationale paper. We would like to express our gratitude to the participating students, parents, and professionals in the participating schools.

Funding statement
This work was supported by the French National Cancer Institute (INCA), a public institute, grant number 2011-239. The work of LS was supported by the University of Lorraine (PhD grant).

Competing interests
We have read and understood BMJ policy on declaration of interests and declare that we have no competing interests.

Patient consent
Obtained

Ethics approval
As an integral part of the PRALIMAP-INES trial (registered at ClinicalTrials.gov NCT01688453), ethics approval was obtained from the French consultative committee for treatment of information in health and research (no. 12.299), the French national commission for Data Protection and Liberties (no. 912372) and the French Persons Protection Committee (no. 2012/15).

Data sharing statement
No additional data are available

Figure legends
Figure 1: Recruitment process of the facilitators (ambassadors and entrepreneurs)

Figure 2: Interest and participation of the receivers

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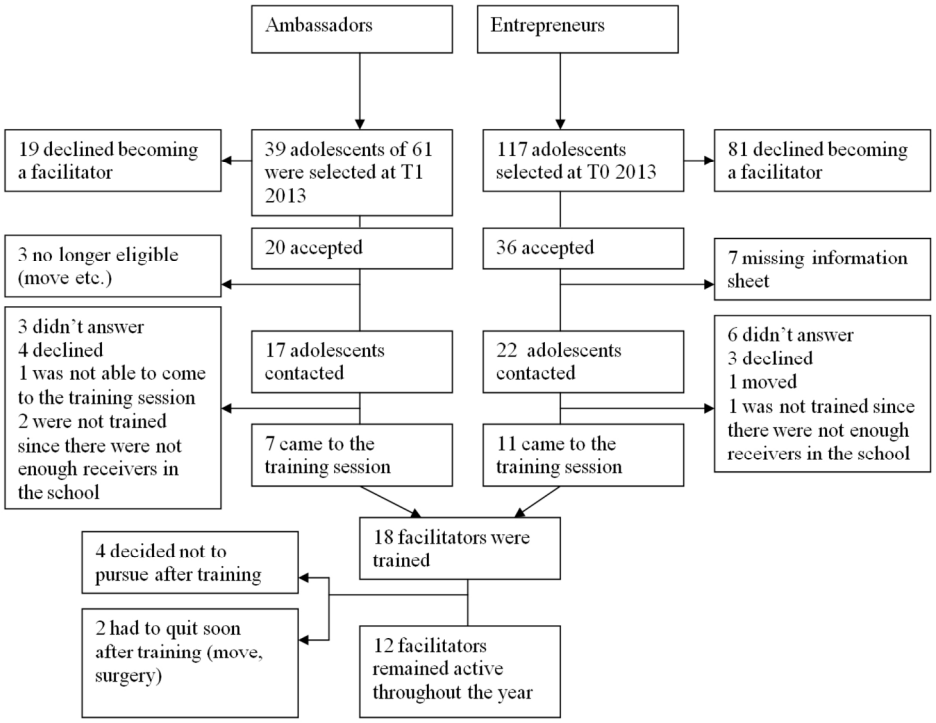

Figure 1: Recruitment process of the facilitators (ambassadors and entrepreneurs)

199x156mm (300 x 300 DPI)

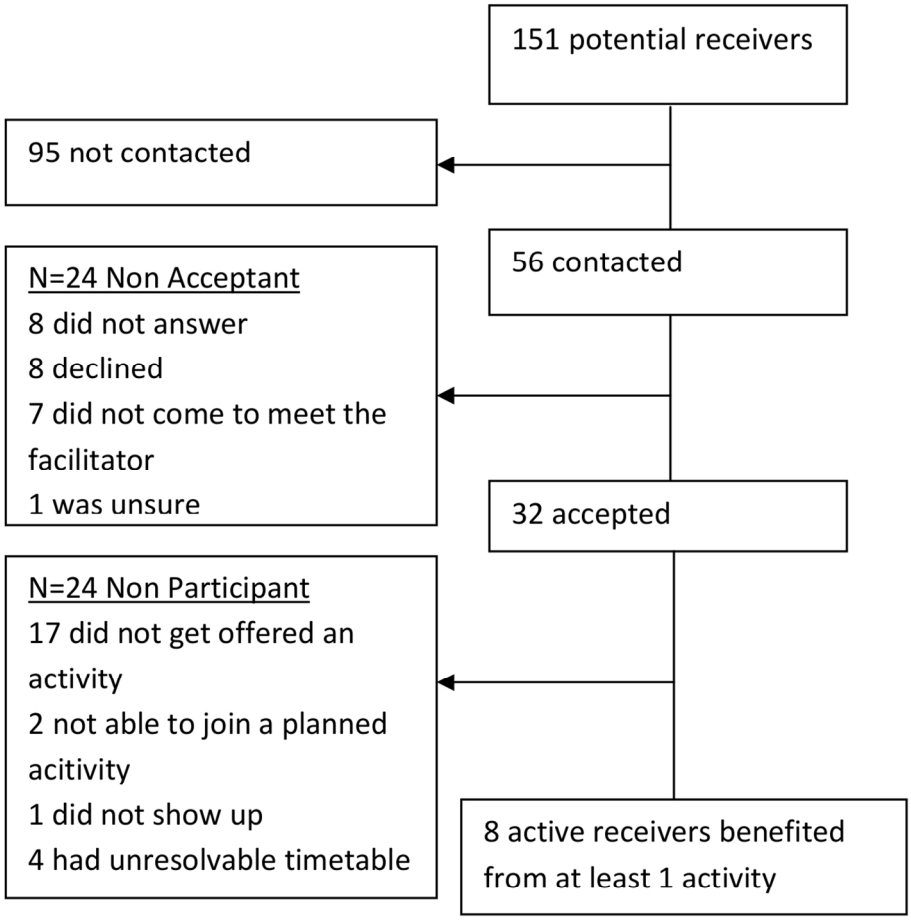

Figure 2: Interest and participation of the receivers

120x125mm (300 x 300 DPI)

Supplementary file 1: Contribution of each source of data collection to assess feasibility questions

Feasibility criteria	Outcomes of interest	Screening session	Facilitator training session	Facilitator mid-program interview	Facilitator end-of-program session	Facilitator SMS exchanges	Facilitator Telephone calls	Nutritional activities	Receiver individual interviews
Demand	Expressed interest	x							x
	Caracteristics	x							x
	Participation		x			x	x	x	
Acceptability	Appropriateness		x	x	x	x	x		x
	Satisfaction		x	x	x				x
Implementation	Intervention dose							x	
	Support needed					x	x		
Practicality	Implementation ease or difficulty		x	x	x	x	x		x

Supplementary file 2: individual characteristics of each facilitator and receiver

	Entrepreneur							Ambassadors					Active receiver							
Student number	61142	61177	101052	141026	151039	191099	241026	50011	70016	150016	210005	210012	61147	141052	141058	151098	151116	191134	211001	241089
Measurement time point	T0	T0	T0	T0	T0	T0	T0	T1	T1	T1	T1	T1	T0	T0	T0	T0	T0	T0	T0	
Gender	Girl	Girl	Girl	Boy	Boy	Girl	Girl	Girl	Boy	Boy	Girl	Girl	Girl	Boy	Boy	Boy	Girl	Girl	Girl	Girl
School type	General and technological High School	General and technological High School	Professional High School	Professional High School	Middle School	General and technological High School	Middle School	Professional High School	General and technological High School	Professional High School	Professional High School	Professional High School	General and technological High School	Professional High School	Professional High School	Professional High School	Professional High School	General and technological High School	Professional High School	Middle School
Exact age	15.04	15.39	15.94	16.54	13.97	15.02	13.99	16.38	15.44	16.15	16.23	15.77	15.62	16.58	16.12	17.55	17.41	14.90	15.87	14.22
BMI	22.49	19.04	23.07	25.92	20.06	24.31	21.55	27.17	23.70	27.75	28.98	27.43	23.76	32.97	25.73	28.99	37.42	24.30	25.83	31.68
FAS score	5	5	3	4	3	4	4	4	5	5	5	4	5	4	2	5	5	4	4	5
EAT 26 score	3.8	8	7.6	8.3	.	12.8	.	8.9	15.3	6.4	29.3	7.6	35.8	15.3	11.5	2.5	10.2	17.9	8.9	14.1
HAD score	28.57	9.52	14.29	14.29	9.52	38.10	11.90	19.05	26.19	16.67	35.71	28.57	42.86	35.71	35.71	26.19	7.14	21.43	23.81	35.71
Anxiety score	38.10	19.05	19.05	23.81	.	52.38	.	28.57	33.33	14.29	52.38	38.10	61.90	42.86	52.38	19.05	9.52	33.33	38.10	52.38
Depression score	19.05	0.00	9.52	4.76	0.00	23.81	0.00	9.52	19.05	19.05	19.05	19.05	23.81	28.57	19.05	33.33	4.76	9.52	9.52	19.05
Physical activity level	Moderate	High	High	High	.	Low	.	Low	Moderate	Low	Low	Moderate	Moderate	Moderate	High	Moderate	Moderate	Moderate	Moderate	High
KIDSCREEN score	43.35	55.07	44.48	43.35	66.86	34.70	48.29	59.85	45.67	46.94	41.24	43.35	41.24	40.24	48.29	38.34	66.86	46.94	46.94	48.29

Supplementary file 3 – SMS and Calls

SMS received	Plan training	Plan call	Plan interview	Activity feedback	Plan end session	Total SMS sent	Total received	nb contact days	% no answer
F1	2	69	9	34	25	147	142	54	4
F2	1	30	11	46	1	122	108	47	4
F3	11	47	3	41	6	140	112	57	9
F4	5	59	3	36	44	180	147	67	11
F5	0	4	0	5	0	24	15	12	29
F6	6	25	14	25	3	89	76	43	9
F7	4	43	5	29	5	88	92	38	0
F8	5	14	6	37	2	88	66	36	14
F9	5	21	4	18	6	78	58	42	17
F10	0	21	1	43	9	95	75	41	16
F11	1	6	1	5	3	29	16	23	38
F12	1	32	11	30	0	66	83	30	0

Table 3a: Content and number of SMS exchanges between the coordinator and the facilitators

	Missed call	Phone conversations	% missed
F1	2	8	20
F2	0	12	0
F3	1	15	6
F4	3	17	15
F5	26	5	84
F6	0	11	0
F7	0	10	0
F8	18	4	82
F9	0	4	0
F10	3	10	23
F11	26	5	84
F12	11	9	55

Table 3b: Number of phone conversations and missed calls between the coordinator and the facilitators

Note: The more successful facilitators are in bold and underlined

Supplementary file 4: illustrative quotes from the facilitators and receivers

** (vs)= very successful facilitator*

***Um/umm indicates hesitation in the discourse*

FACILITATORS

Section	Main point	Source	Person	Gender	Age	Quote
Organisational issues	Time and transport and other logistical problems	Training session	F6 (vs*)	Girl	15.0	yeah that will more be it I think [activities during the holidays] since honestly during class it's until 6pm Wednesday afternoon we have class also and everything and the weekend either it's to rest or do homework so umm**
		End of program session	F10	Girl	16.0	well the people I had were residents [boarding school] so um they lived in um [city far away] (…) And like even every time there were teachers that swaped their lesson hours around and things like that so
		End of program session	F9	Boy	15.4	I maybe overestimated that time [free time]
		End of program session	F3 (vs)	Girl	15.0	Well what I found difficult was to find um the same date to do an activity with several people
		End of program session	F7	Girl	16.4	Well I called them [receivers] and I explained we talked a good 15min and then um then they told me um it wasn't possible, on Wednesdays they already had activities and there were some that had to keep their little sister too.
		End of program session	F6 (vs)	Girl	15.0	For [receiver] it was a transport problem timewise honestly you could see that he didn't mind joining in the activity or exercising or anything but it was really umm an organization thing
		Telephone notes	F2	Girl	14.0	I didn't know it would be so hard. Either I forget. Either it's not possible.
		Mid program interview	F1 (vs)	Girl	15.8	Yeah I'll do it tonight because well before I had to revise for mock final exams
		SMS exchange	F7	Girl	16.4	well it's not that I don't want to do it anymore but it's tough I will soon have my exam and there are only 2 weeks left of class and [name of receiver] can't the two Wednesdays because she's looking for an internship and on Monday and Tuesday I finish class at 6pm and the other days she can't and during the holidays I can't because I will work so she's ok to do the activity in September.
		SMS exchange	F12	Girl	16.2	Coordinator: So is everything set for an activity next Wednesday? Facilitator : No the sport hall is reserved
		Mid program interview	F4 (vs)	Boy	14.0	well I did struggle a bit for exercising with good weather
	Contact issues with the coordinator	End of program session	F10	Girl	16.0	Yeah because I just didn't receive them for a while the messages. That's why I changed phone.
		End of program session	F3 (vs)	Girl	15.0	well me with my phone when I have a message I answer but well sometimes I just don't receive them
		SMS exchange	F8	Girl	15.4	Coordinator: Can I call you on a landline? Facilitator: I'm in a social home so the landline is reserved for adults
		SMS exchange	F4 (vs)	Boy	14.0	Facilitator: yes sorry I didn't have enough phone credit to answer
	Contact issues with the receivers	End of program session	F3 (vs)	Girl	15.0	well with [receiver] um since she didn't have any method of communication apart from um anyway it was really complicated
		SMS exchange	F8	Girl	15.4	Hello, I received your calls; I can't answer since I'm in study period, however I changed phone and I therefore don't have the numbers of [receiver 1] and [receiver 2] and since I plan on maybe going running tomorrow or Wednesday that would be easier to warn them by message :)
	Need for support	End of program session	F6 (vs)	Girl	15.0	Coordinator: so what could have helped you? Facilitator: well for me if everything had been organised for the time the place and the activity then umm see with the others and do it all together but if everything was organised Coordinator: Ok so ideally it would have been "ok so the court is reserved for badminton this day this time and [facilitator] is coming to do it with you" Facilitator: Exactly! That would have been really great.
		End of program session	F9	Boy	15.4	yeah or just do a um I don't know grab a room and have a little ten minute meeting and call [take out of class] all of those who are interested to come um yeah just that it would have been, it would have maybe helped a little.

Other challenges	Motivation issues	End of program session	F10	Girl	16.0	And then when um we couldn't find dates anymore and then um that's when pff I got a bit fed up I told myself yeah it's crap I don't have any activities.
		End of program session	F12	Girl	16.2	Coordinator: But you knew them right? Facilitator: Yeah but when I went to see them [receivers] they said "oh we don't care"
		End of program session	F3 (vs)	Girl	15.0	Yeah it was rather easy. The only problem afterwards was that [receiver] thought that umm that the activities would be during um lessons. That's why she was motivated, to skip class
		SMS exchange	F9	Boy	15.4	well it didn't go too well [the meeting] because one came and refused and the other didn't show
		Mid program interview	F4 (vs)	Boy	14.0	I told him "you know I have a bike in the basement I have two biked in the basement if you want we could do a bit of cycling I'll lend you a bike" and so on [and the receiver responded] "oh no pralimap I don't do"
	Program clarity	End of program session	F2	Girl	14.0	Like my friend [name of friend] she went to the pralimap thing but physically I mean ok she might have a little belly but she isn't she isn't fat she isn't um round or anything at all she is super pretty and all that and she had to go to the pralimap thing anyway not to mention that she doesn't eat anything so um I don't understand
		End of program session	F6 (vs)	Girl	15.0	it's mostly um mostly yeah having fun with the person and exercising together. I don't really see the nutrition part because we didn't really talk about it and and we don't really know more than the other person I think.
	Health issues	SMS exchange	F8	Girl	15.4	Hello, I have some bad news.. I am going to have to stop all physical activity due to an ice-skating accident and the discovery of scheuermann's disease which stops all type of physical activity. I'm really sorry for the inconvenience.
	Interpersonnal skills	SMS exchange	F2	Girl	14.0	sometimes, I doubt my abilities :/ in any case I'm not talented for organizing outings ^^" But actually, since we're only 3 and not specially friends, I don't really know what we could do… Should we do it with our own friends?
		Mid program interview	F9	Boy	15.4	Well because maybe I'm bossy well kind of bossy like for example pff if I think there's a bit of noise and I say to tone it down I think I might be a bit too bossy
		Mid program interview	F1 (vs)	Girl	15.8	well last time um because of [second facilitator] well because originally we were supposed to do it [the activity] together. And I saw that she wasn't trying and well on my own I was really struggling
Good practice	Regular contact with coordinator	End of program session	F7	Girl	16.4	Coordinator: Ok why? [was it a good system] Facilitator: well because we could get organised if we had something planned or not. And maybe we were in the middle of something
		End of program session	F6 (vs)	Girl	15.0	[following conversation above] Facilitator: same for me
		End of program session	F9	Boy	15.4	Coordinator: And in terms of content because it's true that sometimes there wasn't much to say was it still useful being in touch? Facilitator: Umm yeah I found it useful
		End of program session	F3 (vs)	Girl	15.0	[following conversation above] Facilitator: Yeah cause it helped us remember that it we really needed to do it (...) I had never forgotten but it, it remotivated me and stuff.
		End of program session	F1 (vs)	Girl	15.8	Coordinator: so what should the coordinator do if there are no responses to SMS
			and F12	Girl	16.2	F1 (very successful facilitator-girl): See with the school F12 (facilitator-girl): Yeah definitely Coordinator: why? F1: Yeah well I think like say the person has changed number and everything F12: They also often have the internship times if it's to do with that
	Physical activity	End of program session	F10	Girl	16.0	They asked me "oh you can go ice skating" I said "yes" so yeah as soon as you talk more directly about activities yeah it's actually cool they said "oh really you can do activities and everything oh well that's cool". (...)

	Support of parents	End of program session	F6 (vs)	Girl	15.0	There was also her [receiver] mom she um we did three activities and my dad brought her once and her mom twice so um it's certain that if that hadn't been there since it was super far nah it wouldn't have been possible.
	Program commitment	Mid program interview	F4 (vs)	Boy	14.0	And just afterwards he told me "[swear word] they want me to do pralimap and everything" and I said "well why don't you want to do it? If you want I can offer to be your facilitator since we're neighbours it would be easy".

RECEIVERS

Section	Topic	Person	Status	Gender	Age	Quote
Social environment	Family relations	R4d	Reluctant	Boy	15.8	well since my step father works in the show business he often comes home late so I cook one day out of two I do it
		R4f	Passive	Girl	15.3	Receiver (passive receiver-girl): I am tired at the moment Interviewer: why? Receiver: because I have a lot of family problems and I don't sleep well. I think too much about it. So I think I'm in bad health
	High school	R4e	Reluctant	Boy	15.2	Receiver: no it's the first time but it's different from being at home [being in boarding school] Interviewer: so what's different from home? Receiver: well you're there all the time with friends so in the evenings we chat and laugh
		R4c	Passive	Girl	15.9	you never know how the others will react if you tell them something and most people here are, how to say it, really mean. They judge people based on physical appearance that's why we like to stay just the four of us that's why we stay in our own group.
	Relationship with peers	R4d	Reluctant	Boy	15.8	Interviewer: so what is a mate then? Receiver: they're just people with who you laugh and all its not the 36 [friends] that I can actually open up to those are people who are always there for you.
		R4e	Reluctant	Boy	15.2	Receiver: badly because people from school most guys are thin and all that they chill and all talk to everyone laugh with everyone and it annoys me because I tell myself maybe if I stop eating I would talk to everyone and be in their shoes like Interviewer: so with people here at school when you see them do you say hi? Receiver: no I don't say anything I just stay with [name of best friend] and that's all.
		R4a	Active	Boy	17.6	not really we see each other only here [high school] yeah otherwise we stay in touch via telephone otherwise we don't see each other outside.
		R4f	Passive	Girl	15.3	Interviewer: so with your old friends how come you're not friends anymore? Receiver: no idea because I think we didn't see each other anymore
		R4e	Reluctant	Boy	15.2	Interviewer: and what bothers you why don't you want to talk to your family? Receiver: because we're not of the same generation
Health and overweight	Defintition	R4a	Active	Boy	17.6	Interviewer: so what is health? Receiver: to feel good Interviewer: and that means? Receiver: to feel good in your shoes not to be sick Interviewer: and what is to feel good in your shoes? Receiver: what can I say well feeling good not feeling fat
	Wanting to lose weight	R4b	Active	Girl	17.4	Receiver: well since everyone tells me I need to lose weight because of people staring (regard des gens) and all that I tell myself I don't care if people look and judge because for me it's my life it's my body and all that they're not the ones to tell me what I have to do. If I feel good I'll stay this way Interviewer: so why then do you say you want to lose a little [weight]? Receiver: it's mostly for clothes because often I can't find my size often I have to go in the big sizes and it bugs me a bit all that

		R4c	Passive	Girl	15.9	for me it depends on the days [successful healthy behaviour] if I ate well at the school cafeteria I shouldn't be hungry or sometimes I see my mom eat and it makes me want to go grab some cookies
		R4a	Active	Boy	17.6	there are times I'm not careful but also we don't have the luck of eating a balanced diet we don't eat much fruit and vegetable at mine so I don't really have the opportunity to be careful so sometimes I eat in excess but um
Program experience	PRALIMAP-INES	R4c	Passive	Girl	15.9	Interviewer: and how was it? Receiver: it was ok Interviewer: meaning? Receiver: sometimes they only talked sometimes we moved Interviewer: and you don't like talking? Receiver: no
	Lack of program clarity	R4f	Passive	Girl	15.3	Interviewer: and were you aware of the activities in pralimap that you were offered Receiver: no idea I said I didn't want to do it and that's it
		R4b	Active	Girl	17.4	Interviewer: and do you know about the peer activities in pralimap? Receiver: no Interviewer: were you not contacted by [name of facilitator]? Receiver: oh yeah but I didn't think that was it
	Potential barriers	R4e	Reluctant	Boy	15.2	Interviewer: so what stopped you? Receiver: I don't know Interviewer: was it the way he invited you? Receiver: no because I didn't know him so that's it
		R4f	Passive	Girl	15.3	Interviewer: so if I offered now what would you say? Receiver: I don't know I think I would have said no Interviewer: why? Receiver: because I don't like doing activities with too many people Interviewer: what if there were only 2 people Receiver: oh then yes maybe
	Activity experience	R4a	Active	Boy	17.6	Interviewer: and you felt comfortable? [during the activity] Receiver: well not really at first because I didn't really know him, then getting to know him I felt more at ease. (...) Interviewer: And what did you do? Receiver: we talked a lot Interviewer: about what? Receiver: we talked about ourselves he asked me why I participated in pralimap and told him and everything we talked about our jobs what we liked we talked about music too Interviewer: all this whilst walking? Receiver: yes for 2h (...) Interviewer: and so now you've become friends Receiver: yes every time we see each other we say hi and everything