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Implementing international osteoarthritis guidelines in primary care: uptake and fidelity among health professionals and patients

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SUMMARY

Objective: This paper evaluates the implementation fidelity of a strategy and intervention used to implement osteoarthritis (OA) treatment recommendations in primary care. We also evaluate uptake of core treatment (patient information, exercise and referral to weight management) among OA patients.
Design: A stepped-wedge cluster-randomised controlled study (RCT) in primary care. The study involved general practitioners (GPs), physiotherapists (PTs) and patients with hip and/or knee OA in six Norwegian municipalities (clusters). Workshops for general practitioners (GPs) and PTs represented the main implementation activity. Uptake of core treatment (patient education, exercise and weight management) was evaluated using self-reported data from the patient intervention and control group, analysed with logistic regression models. Fidelity was evaluated using six components representing adherence to the content and dose instructions in the implementation strategy and assessed against a-priori criteria for high adherence.
Results: Data were collected from 40 GPs, 37 PTs and 393 OA patients. The patient-reported data showed statistically significant higher uptake for exercise, patient education and referral to support for weight reduction, among the intervention group compared to the control group ($P < 0.05$).
Evaluation of fidelity showed high adherence to GP and PT workshop attendance and physiotherapy use, partly adherence to PT knowledge after workshops, and low adherence to exercise attendance, dose and progression instructions.
Conclusions: The implementation strategy and intervention successfully improved OA patients' access to physiotherapy and uptake of recommended core treatment. However, the strategy was less effective in providing exercise programs with sufficient dose and progression and in supporting patients' adherence to the exercise program.
Trial registration: ClinicalTrials.gov NCT02333656.

Introduction

International treatment guidelines recommend patient education, exercise and weight management as first-line, core treatment options to reduce pain and improve physical function in people with hip and knee osteoarthritis (OA)[1–4]. Although the guidelines have existed for decades, and since 2012 been updated to include strong recommendations for exercise[1,3], previous research demonstrates limited knowledge and usage among health professionals in primary care, which affects the quality of provided care for OA patients[5–7]. Although a previous study among Norwegian physiotherapists (PTs) found that exercise was the most frequently provided treatment for knee OA patients, it was also revealed that other treatment modalities with moderate to low evidence or no evidence from systematic reviews were frequently used[5]. Many OA patients in Norwegian primary care also encounter long waitlists for access to physiotherapy. Hence, more structured treatment approaches, providing access to effective and high quality care for this large and growing patient group is currently needed.

Still, it is a challenge to successfully implement treatment guidelines in health care[8]. Strategies to implement OA treatment

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guidelines have been developed in a limited number of countries[9–12], but the effectiveness of the strategies varies[13–16]. It is demanding to examine the result of complex implementation processes, and within the field of OA different approaches have been tried, for instance examining change in uptake of recommended core treatment[15], or through evaluation of more specific implementation outcomes such as fidelity[17].

Implementation fidelity has been defined as *"The extent to which the core components of an intervention are delivered as intended in the protocol"*[18]. Evaluation of implementation fidelity can contribute to a better understanding of the implementation process and enable researchers to attribute unsuccessful outcomes to a failure of either the implementation strategy or the intervention[19,20]. For OA, implementation fidelity has previously been evaluated using checklists representing the content of the program, by direct observation of exercise classes and by recording patients' attendance rates to the prescribed program[15,17]. Evaluation of fidelity can be applied to all parts of the implementation process such as study design, provider training, treatment delivery and treatment receipt[21].

The current study has evaluated the uptake of core treatment and implementation fidelity in a large randomised controlled trial, the SAMBA study (Box 1), which intended to implement current treatment recommendations for OA care[22]. The SAMBA model for integrated OA care was developed by the research team and comprised a structured pathway for patients with OA through the health care system (Fig. 1). While the SAMBA study primary and secondary outcomes (Box 1) will be reported elsewhere (paper submitted), the current study concerns the uptake of recommended core treatment (patient information, exercise and weight management), and fidelity to the implementation strategy and intervention in the SAMBA study, with a main focus on fidelity to

Box 1
The SAMBA study

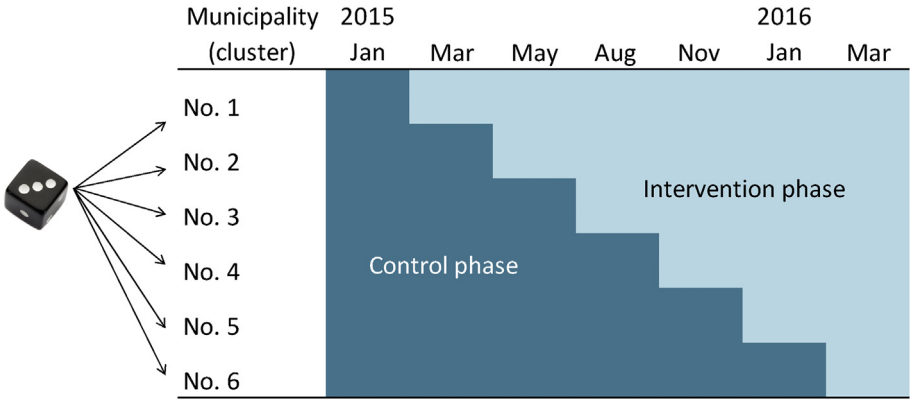
Main aim: The main aim of the SAMBA study was to assess the effectiveness, feasibility and cost of implementing the SAMBA model (Fig. 1) in primary care.

Design: A stepped-wedge cluster-randomized controlled study.

Intervention and implementation strategy: The SAMBA model for integrated OA care was developed by the research team and represented the study intervention. The model comprised a structured pathway for the patient through the health care system. The model should ensure that recommended care was delivered at the right time by the right provider and included all aspects of recommended OA care, with a special emphasize on patient-education and exercise. The model included a GP consultation, physiotherapist (PT) led OA education and exercise program, an optional Healthy Eating Program and a GP review. The GPs were instructed to explain the OA diagnosis and treatment alternatives, provide pharmacological treatment when appropriate and suggest referral to physiotherapy. The PT led OA patient education program was groups-based and lasted 3 h. This was followed by an 8–12 week exercise program with twice weekly 1 h supervised group sessions.

The main component of the implementation strategy included educational, inter-active workshops for the participating GPs and PTs.

Methods: All six municipalities (clusters) started the trial simultaneously. The municipalities were randomly allocated to one of the six sequences for time of crossover from control to intervention phase. The GPs and PTs in each municipality provided usual care for their OA patients until the time point when their municipality was scheduled to switch from control to intervention phase. One by one, the municipalities crossed from control (usual care) to intervention phase (implementing the SAMBA model) approximately every second month until all six municipalities were exposed to the intervention. Patients recruited to the study during the control phase constituted the control group, whereas patients recruited during the intervention phase constituted the intervention group.



The stepped wedge cluster-randomised controlled design applied for the SAMBA study

Outcomes: The primary outcome was patient-reported quality of osteoarthritis care collected with the OsteoArthritis Quality Indicator (OA-QI) questionnaire at 6 months. Secondary outcomes included patient-reported referrals to PT, imaging and referrals to the orthopaedic surgeon as well as treatment satisfaction, symptoms, physical activity level, body weight, self-reported and measured lower limb functionat 3 and 6 months.

treatment delivery and receipt. The intervention comprised the implementation of the SAMBA model, whereas inter-active workshops for general practitioners (GPs) and PTs represented the main component of the implementation strategy. The results of the current study will aid in the interpretation of the results on the primary and secondary outcomes in the SAMBA study. Our research questions are:

- Was the uptake of patient information, exercise and referral to services for support on weight reduction higher among the intervention group compared to the control group?
- How was the fidelity to the implementation strategy and intervention in the study?

Methods

Design, participants and setting

This study concerns secondary analyses of uptake of core treatment and fidelity in the SAMBA study, a stepped-wedge cluster-randomised controlled trial conducted between January 2015 and September 2017. The SAMBA study involved general practitioners (GPs) and PTs, as well as patients with hip and/or knee OA residing in six Norwegian municipalities. The main features of the SAMBA study are summarized in Box 1, with further details in the published study protocol[22].

All GPs and PTs working in private practice or Healthy Life Centre[23] in the six municipalities were invited to participate in the SAMBA study. The inclusion criteria for the patient participants reflected the broad range of OA patients in primary care: age ≥45 years with symptomatic hip and/or knee OA diagnosis verified clinically or radiologically. Patients who did not understand Norwegian, had no native hip or knee joints, inflammatory rheumatic diseases, malignant illness or other major conditions that restricted their ability to adhere to the recommended OA treatment were excluded.

According to the stepped wedge design, all six municipalities started the study at the same time point (Box 1). During the control phase the GPs and PTs provided usual care for their OA patients. The usual care may vary largely and could include any treatment the GP and/or PT considered appropriate. When a municipality switched to intervention phase, the GPs and PTs were invited to attend the educational workshops and would then start treating their OA patients according to the SAMBA model of care (Fig. 1). Patients recruited to the study during the control phase constituted the control group, whereas patients recruited during the intervention phase constituted the intervention group.

Intervention and implementation strategy

Inter-active workshops for GPs and PTs represented the main implementation activity to ensure uptake of treatment recommendations and promote use of the SAMBA model (Fig. 1).

The PT workshop was a 1-day seminar including:

- General update on OA including epidemiology, clinical features and treatment recommendations
- Education in delivery of a standardised patient-education program
- Education and practical training in delivery of an individually tailored semi-standardised exercise intervention and use of performance tests
- Education about healthy nutrition and weight management

The multidisciplinary workshop organized in the GP offices lasted 1.5 h and included a general update on OA including treatment recommendations. An orthopaedic surgeon gave a presentation about the appropriate time to refer patients to surgical treatment. The importance of exploiting conservative treatment before considering surgery was emphasized. The research team presented the SAMBA model and facilitated a discussion on OA care between the GPs, PTs and orthopaedic surgeon.

After completing the workshop, the PTs received access to the "ready-to-use" standardised patient education program (PowerPoint file and manuscript). They also received access to a database with recommended exercises and dose recommendations. The exercises were selected from previously published exercise programs of high-quality studies for hip and knee OA[24,25]. Dose recommendations were based on The American College of Sports Medicine (ACSM) Guidelines for Developing and Maintaining Cardiorespiratory, Musculoskeletal and Neuromotor Fitness in Apparently Healthy Adults[26].

All patients recruited during the intervention phase and referred to physiotherapy went through an individual examination and specified performance tests to assess level of physical function. The results were used to make individually tailored exercise programs. The PTs organised group-based patient educational sessions and twice weekly supervised exercise groups, where patients performed their individual exercise programs. The research team emphasized the need for the PTs to provide regular individual adjustments of the exercise program regarding progression of exercises and dose. Patients who did not wish to attend the group sessions had the option of performing their exercise at home.

Data collection

To examine uptake and fidelity in the SAMBA study we have analysed study notes and self-reported data from the participating health professionals and patients. Overview of the implementation strategy and evaluations of uptake and fidelity are summarized in Fig. 2.

The PTs answered a short questionnaire before and after attending the educational workshop. The questionnaire was used to map background information and information about the practice of the PTs. It also included eight statements regarding knowledge and attitudes towards evidence-based OA treatment recommendations, answered on five-point Likert scales ranging from "strongly disagree" to "strongly agree" (Additional file 1). These statements were developed by the research team based on previously published work[27]. The GPs answered a short questionnaire before attending the educational workshop, to map information about their background and clinical practice.

All patient participants answered web-based questionnaires (CheckWare®) at baseline (before receiving the PT led intervention) and at three and 6 months.

Throughout the exercise period, the intervention group patients kept an exercise diary to register number of exercise sessions and time spent performing resistance - and cardiorespiratory exercise. They reported intensity levels using the Borg RPE scale, which is a 15-point scale, ranging from 6 (very light) to 20 (very hard)[28]. In addition, the patients used the exercise diaries to report if the PT adjusted their exercise program from week to week.

Evaluation of uptake of recommended core OA care

The percentage of patient participants receiving the core treatments was compared between the intervention and control group using patient-reported data at three and 6 months follow-ups. The patients responded with yes/no to questions regarding whether

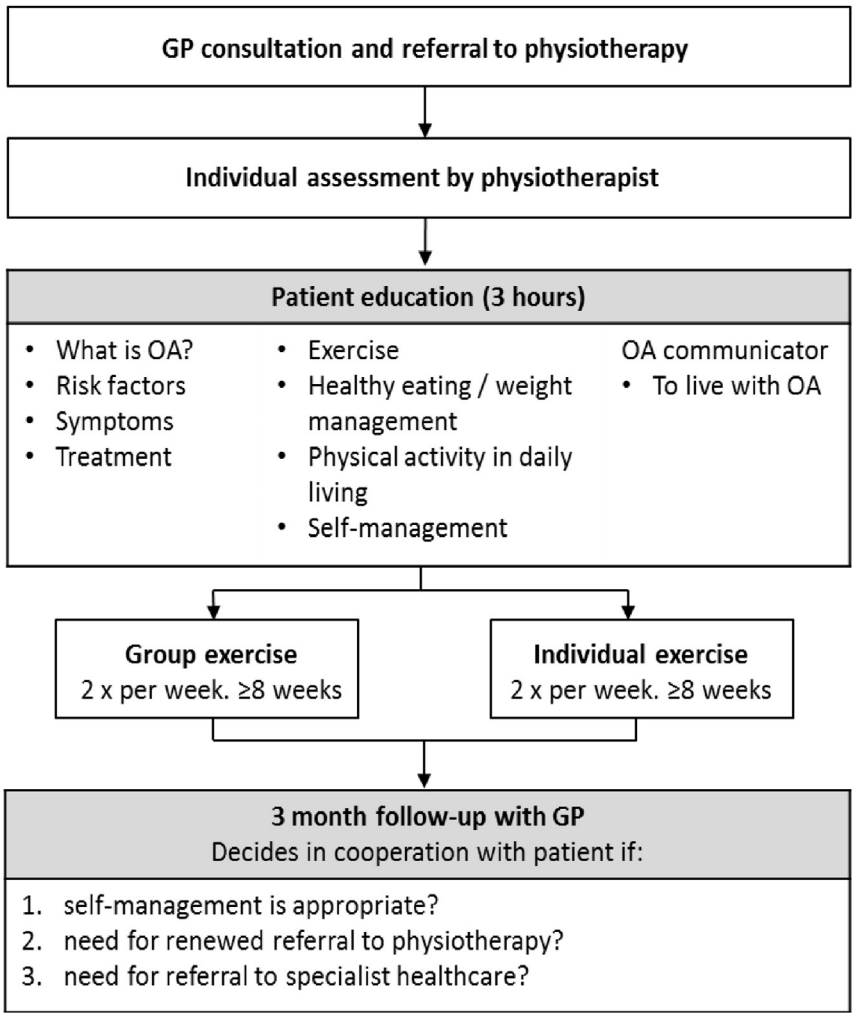


Fig. 1. The SAMBA model for integrated OA care.

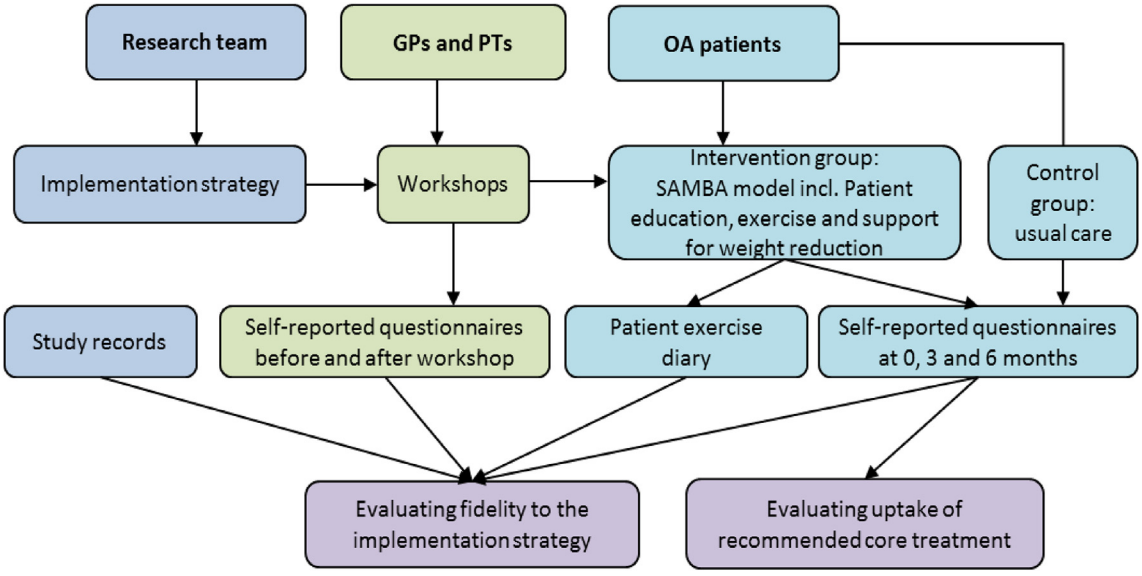


Fig. 2. Overview of the structure, implementation strategy and evaluations of uptake and fidelity in the SAMBA study.

they in the past 3 months had: 1) participated in OA patient education or received information on OA; 2) performed resistance or cardiovascular exercises or received only passive treatment modalities (not recommended) or; 3) had been referred to services to receive support on losing weight. The three and 6 months follow-up responses were combined in the analyses, meaning that if the recommended treatment was reported at one or both time points, it was regarded "received". We chose to combine the time points because some participants were delayed between answering the baseline questionnaires and initiating the PT led intervention. Hence, some had not completed the PT led intervention at 3 months.

Evaluation of fidelity to the implementation strategy

Evaluation of implementation fidelity was inspired by the framework of Carroll and colleagues[20]. The bottom-line measure of fidelity within this framework is the evaluation of *adherence*. Adherence should be addressed through the subcategories *content* and *dose*.

To evaluate adherence in the SAMBA study, six core components representing content and dose of the implementation strategy were classified as either "high adherence", "partly adherence" or "low adherence" (Table III). The components were: 1) *Proportion GPs and PTs attending the workshops*; 2) *PT knowledge and attitudes after the workshop towards eight statements on evidence-based OA treatment*; 3) *Number of times the PT adjusted their patients' exercise programs*; 4) *Proportion of patients who received physiotherapy*; 5) *Proportion of patients who completed the patient education and exercise period* and 6) *Proportion of patients who exercised according to dose recommendations from ACSM*. The criteria for classifying the components' adherence were set a-priori, and are presented in Table III. The specific cut-off's for defining high adherence was discussed in the research group until consensus was reached.

Analyses

Descriptive statistics were used to profile PTs, GPs and the patient participants. Crude and adjusted logistic regression models were fitted to investigate uptake of core treatment modalities differences between the intervention and control groups. The adjusted models included the following covariates: age, gender, cluster and time (number of months from study start to completion of the 3 month questionnaire). To account for the effect of clusters (municipalities), a two-level hierarchical mixed model was fitted. Since there were no significant effects of cluster, we decided to use a conventional (one-level) logistic regression. Descriptive statistics and Chi^2 tests were used to evaluate the components according to the a-priori defined criteria for high adherence (implementation fidelity). The statistical analyses were performed using IBM SPSS Statistics version 25 and Stata/IC version 14.

Ethics

The Norwegian Regional Committee for Medical and Health Research Ethics decided that ethical approval was not required for this study (ref.no: 2014/1739). The study is in accordance with the Personal Data Act and the Personal Health Data Filing System Act as approved by the Data Inspectorate, December 22, 2014. The data collection was conducted in compliance with Good Clinical Practices protocol and the Declaration of Helsinki principles. The participants with OA received written and oral information about the study, and written informed consents was obtained prior to baseline data collection.

Results

Data were collected from 40 GPs, 37 PTs and 393 hip and/or knee OA patients with 284 patients in the intervention group and 109 in the control group. The baseline characteristics are outlined in Table I. The proportion of female patient participants in the intervention group (75 %) was significantly higher compared to the control group (62 %) ($P < 0.05$). There were also a higher proportion of participants with knee OA compared to hip OA in the intervention group. No other statistically significant baseline differences between the patient intervention and control group were observed. Between baseline and 6 months 31 patients in the intervention group and one patient in the control group withdrew from the study. In addition, 22 patients in the intervention group and two in the control group did not return the three or the 6 month questionnaire, or did not respond to the questions evaluating uptake of core treatment. Participants that either withdrew from the study or did not respond were included and regarded as non-receivers of the recommended treatment in the analysis of uptake. A total of 182 (64 %) of the intervention group patients returned the exercise diary after the exercise period.

Table I
Baseline characteristics of patient participants, physiotherapists and general practitioners

Variable	Patient participants			
	Intervention group ($n = 284$)	Control group ($n = 109$)	Physiotherapists ($n = 37$)	General practitioners ($n = 40$)
Sex, female, *n* (%)	211 (74)*	68 (62)	24 (65)	17 (42)
Age, mean (SD)	63 (10)	65 (10)	42 (8)	50 (12)
BMI, mean (SD)	29 (6)	28 (5)		
Education, *n* (%)				
Elementary school	83 (29)	38 (35)		
High school	98 (34)	36 (33)		
University (≤4 yrs)	66 (23)	25 (23)		
University (>4 yrs)	35 (12)	10 (9)		
Main affected joint, *n* (%)				
Knee	174 (61)*	54 (49)		
Hip	100 (35)	46 (42)		
Hand	0 (0)	7 (6)		
Other	9 (3)	2 (2)		
Work years, median (IQR)			8 (2,14)	8 (3,23)
Number of treatments per day, mean (SD)			12 (4.2)	21 (4)
Exercise groups per week, mean (SD)			2 (2)	
List size, mean (SD)				1,130 (296)

* Significant difference at 5 % level between the patient intervention and control groups.

Uptake of recommended core OA treatment

The combined three and 6 months patient-reported data showed a statistically significant higher uptake for all the core treatment components for the intervention group compared to the control group (Table II). Regarding patient information, 70 % ($n = 199$) of the intervention group vs 5 % ($n = 6$) of the control group participated in OA patient education (adjusted OR (aOR) = 82.2, 95 % CI 24.6, 274.7; $P < 0.001$) (Table II). A total of 67 % ($n = 190$) of the intervention group vs 47 % ($n = 51$) of the control group received information from their PT on relevant aspects of OA (aOR = 3.5, 95% CI 1.6, 8.0 $P < 0.05$).

For exercise therapy, 74 % ($n = 209$) of the intervention group vs 41 % ($n = 45$) of the control group reported having performed resistance exercise (aOR = 5.0, 95% CI 2.1, 12.3; $P < 0.001$) (Table II). A total of 64 % ($n = 182$) of the intervention group vs 31 % ($n = 34$) of the control group conducted cardiorespiratory exercise (aOR = 5.7, 95% CI = 2.5, 13.1; $P < 0.001$). Only 0.4 % ($n = 1$) of the intervention group vs 7 % ($n = 8$) of the control group received only passive treatment (not recommend) ($P < 0.05$).

Ninety-seven intervention-patients and 51 control-patients reported being overweight (Table II). Among these, 25 % ($n = 33$) in the intervention group vs 9 % ($n = 5$) in the control group were referred for support on losing weight (OR 3.5 95% CI 1.3, 9.4; $P < 0.05$).

Fidelity to the implementation strategy

The component "*proportion GPs and PTs attending the workshops*" met the a-priori defined criterion for high adherence, as 50 % of the GPs and PTs from private practice and 100 % of the PTs from Healthy Living Centres participated (Table III).

The data from the post-workshop, eight statements on PT knowledge and attitudes towards evidence-based OA treatment, was evaluated as partly adherent. On seven of eight statements, ≥90 % of the PTs answered in line with the recommendations for OA care (Table III). For the item "Patients with hip or knee OA should only seek PT if the diagnosis is verified through conventional X-ray" 81 % of the PTs responded "disagree" or "strongly disagree" (Additional file 1). Hence, the item did not fulfil the criteria of ≥90 %s responding according to the desired answer.

The component "*number of times the PT adjusted their patients' exercise programs*" was evaluated as low adherence against the criteria, as only 16 % of the intervention group patients reported four or more adjustments during the 8-week exercise program (Table III).

For patient participants, 95 % of the intervention group patients received physiotherapy, which was above the criteria for high adherence to the implementation strategy (Table III). The number receiving physiotherapy was also significantly higher in the intervention group compared to the control group ($P < 0.001$).

The proportion of the intervention group patients who attended the patient education and completed the exercise intervention (exercised ≥2×/week for ≥8 weeks) was below the criteria for high adherence. Also, the proportion of patients who exercised according to the dose recommendations from ACSM was far below the criteria for high adherence to the implementation strategy.

Discussion

The implementation strategy and intervention used in the SAMBA study was highly successful in increasing the uptake of recommended core treatment for patients with hip and knee OA in primary care. However, fidelity to the implementation strategy did only show high adherence to the components "*proportion of GPs and PTs attending the workshops*" and "*proportion of OA patients receiving physiotherapy*". Partly adherence to the implementation strategy was shown for the component "*PT knowledge and attitudes after the workshop towards eight statements on evidence-based OA treatment*". Low adherence was shown for the components "*number of times the PT adjusted their patients' exercise programs*", "*proportion of patients who completed the patient education and exercise period*" and "*proportion of patients who exercised according to dose recommendations from ACSM*".

These results demonstrate that the SAMBA study was successful in terms of recruiting health professionals and providing recommended core treatment to a large number of OA patients in primary care. We believe the good recruitment rates reflect the GPs' and PTs' urge for a more structured treatment approach towards this large patient group[29].

The high proportion of OA patients who received access to physiotherapy and recommended care is in line with the high number of OA patients receiving recommended care through the Swedish BOA and Danish GLA:D projects[11,12,17]. The results from these studies and the added results from the SAMBA project show that the use of workshops as implementation strategy is attractive for health professionals and provides improved access to recommended core treatment for OA patients throughout different health care settings. It is likely that these results will have a positive influence on the primary outcome of the SAMBA study (Box 1).

On the other hand, three of the six fidelity components showed low adherence to the a-priori criteria, among them, the number of patients completing the education and exercise intervention program. The "MOVE" consensus has shown that exercise adherence is an important predictor of outcomes in knee OA[30]. In contrast, other systematic reviews have attempted to summarize reported adherence in exercise RCTs for people with hip and knee OA, but could not conduct analyses on adherence as it was seldom clearly reported[31,32]. Precise knowledge of exercise adherence and effect in patients with OA is still lacking.

Potential barriers of patient adherence to exercise were addressed by the research team when designing the study. Well-known strategies to increase exercise adherence, such as (1) education in the positive effects of exercise; (2) monitoring through physical tests; (3) use of exercise diaries; (4) PT supervision of exercise and (5) use of group-based sessions were actively implemented in the current study[33,34]. However, the results showed that these strategies were not enough to obtain high adherence to the exercise intervention. A survey among PTs in the UK showed that only a very small proportion agreed to the statement that it is the PT's responsibility to make sure the patient continue doing their exercise program[35]. A stronger emphasis, during the workshops, of the PTs role in supporting the patients' exercise adherence might have improved these results. It has also been suggested that focus on the individual patient's barriers and facilitators could improve adherence[36].

In addition, among the subgroup of patients who completed the exercise intervention, only a minority exercised according to the dose recommendations from ACSM. Nor did the PTs perform the desired number of adjustments of the exercise programs as reported by the patients. Hence, the patients' exercise programs may have been under-dosed and received limited progression throughout the period. It is likely that the symptom-related secondary outcomes (Box 1) of the SAMBA study will also be influenced negatively by the poor adherence and low exercise dose. A recent systematic review found that an increase of 30 % in knee extensor strength is necessary for a beneficial effect on pain in knee OA, and gain in muscle strength is shown to be a mediator of symptom relief in knee OA[37,38]. A systematic review on hip OA exercise studies showed that reduction in pain was significantly

Table II
Uptake of recommended OA core treatment modalities in the patient intervention vs the control group at three and 6 months follow-ups combined

Treatment modality	Intervention group ($n = 284$) n (%)	Control group ($n = 109$) n (%)	Crude OR (95 % CI)	P-value	Adjusted OR (95 % CI)*	P-value
Information						
Participated in patient education	199 (70)	6 (5)	40.2 (17.0, 95.1)	<0.001	82.2 (24.6, 274.7)	<0.001
Received information on OA	190 (67)	51 (47)	2.3 (1.5, 3.6)	<0.001	3.5 (1.6, 8.0)	<0.05
Exercise						
Performed resistance exercise	209 (74)	45 (41)	4.0 (2.5, 6.3)	<0.001	5.0 (2.1, 12.3)	<0.001
Performed cardiorespiratory exercise	182 (64)	34 (31)	3.9 (2.4, 6.3)	<0.001	5.7 (2.5, 13.1)	<0.001
Received only passive treatments	1 (0.4)	8 (7)	0.05 (0.01, 0.4)	<0.05		
Weight management	$n = 97$†	$n = 51$†				
Referral to services for support on weight reduction	33 (25)	5 (9)	3.5 (1.3, 9.4)	<0.05		

Analysed with logistic regression in bivariate and multivariate models.
* The adjusted models included the following covariates: age, gender, cluster and time (number of months from study start to completion of the 3 month questionnaire).
† Subsample with self-reported overweight.

Table III
Adherence to content and dose of the implementation strategy and intervention in the SAMBA study among GPs, physiotherapists (PTs) and patient participants

Target group	Component evaluated	Data source	Criteria for "high adherence"	Result	Evaluation
GPs and PTs	Proportion of GPs and PTs attending the workshops	Study records	≥26 (30 %) GPs ≥32 (50 %) PTs from Private Practice 5 (100 %) PTs from Healthy Living Centres	40 (50 %) GPs 32 (50 %) PTs from Private Practice 5 (100 %) PTs from Healthy Living Centres	High adherence
	PT knowledge and attitudes after the workshop towards eight statements on evidence-based OA treatment	PT reported questionnaire (8 items, 5-point Likert scales)	≥90 % answer "agree or strongly agree" or "disagree or strongly disagree" for each item, according to the direction of the scale	For seven of eight statements ≥90 % answered according to the pre-set criteria. For one statement 81 % answered according to the criteria ($n = 37$)	Partly adherence
	Number of times the PT adjusted their patients' exercise programmes	Patient reported exercise diary	≥80 % should receive at least four adjustments over the 8-week exercise period	16 % ($n = 19$) received ≥4 adjustments ($n = 153$ intervention group patients which completed the exercise period and returned exercise diary)	Low adherence
OA patients	Proportion of patients which received physiotherapy	Patient reported questionnaire	≥90 % of the intervention group patients should receive physiotherapy. The proportion should be significantly higher in the intervention group vs the control group	95 % ($n = 271$) intervention group patients received physiotherapy vs 46 % ($n = 48$) control group patients (P=<0.001)*	High adherence
	Proportion of patients which completed the patient education and exercise period	Study records, Patient reported questionnaire and exercise diary	≥80 % of the intervention group patients should complete the patient education and the 8-week exercise period	64 % ($n = 181$) completed the patient education and exercise period. ($n = 284$ intervention group patients)	Low adherence
	Proportion of patients which exercised according to dose recommendations from ACSM†	Patient reported exercise diary (week 4 −8)	≥80 % of the intervention group patients should perform: **Resistance exercise** ≥2 ×/week with intensity 13−17 on Borg RPE scale. AND/OR **Cardiorespiratory exercise** ≥3 ×/week with intensity ≥13 on Borg RPE scale for ≥20 min per session	**Resistance exercise**: 39 % ($n = 72$) performed ≥2 sessions per week. 53 % ($n = 98$) with an intensity of 13−17 on Borg RPE scale. **Cardiorespiratory exercise**: 9 % ($n = 16$) performed ≥3 sessions per week. 51 % ($n = 94$) with an intensity of 13−17 on Borg RPE scale. 62 % ($n = 115$) for ≥20 min per session. ($n = 153$ intervention group patients which completed the exercise period and returned the exercise diary)	Low adherence

* Chi-square test.
† ACSM: American College of Sports Medicine. Garber *et al.* ACSM position stand. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. Med.Sci.Sports Exerc. 2011; 43: 1,334−1,359.

higher in studies compliant to ACSM dose recommendations as compared to incompliant studies[32]. These results highlight the importance of appropriate exercise dose to improve muscle strength and reduce symptoms effectively for patients with hip and knee OA. For future studies implementing OA treatment guidelines in primary care, a strong emphasis on optimal dose and monitoring of exercise dose including progression are important. Such focus might improve the likelihood of obtaining positive results on symptom-related outcomes such as pain and physical function. As suggested in another implementation study on OA treatment guidelines, the lack of effect on pain and physical function might have been due to the application of inappropriate (too low) exercise dose[15]. To achieve improved adherence to exercise, there is limited evidence that digital health interventions, such as text messages might be useful[39].

The investigation of fidelity showed partly adherence to the implementation strategy regarding the component "*PT knowledge and attitudes after the workshop towards eight statements on evidence-based OA treatment*". The PTs answered according to the a-priori criteria for seven of eight statements. The reason one of the statements didn't comply might reflect a problem with the quality of the questionnaire as much as a knowledge deficit among the PTs.

The validity and reliability of the questionnaire should ideally have been assessed prior to the study. The lack of such evaluation might limit the trustworthiness of the data[40].

Strengths and limitations

A major strength of this study was the wide inclusion criteria and the large number of recruited OA patients. Combined with the multi-disciplinary approach targeting and recruiting a large number of both GPs and PTs, the combination provides high credibility of the study towards real-life primary care practice.

For the analyses of uptake of recommended core treatment, we took advantage of the randomised controlled design. This gave us the opportunity to make comparisons to the usual care control group. Other OA management programs are implemented without the opportunity to compare results with a usual care control group, which makes conclusions less powerful[12].

In the evaluation of implementation fidelity only factors concerning adherence to the intervention, emphasizing treatment delivery and receipt were assessed. For a more comprehensive evaluation of fidelity as proposed by Carroll and colleagues the potential effect of moderators should also have been taken into account[20]. Relevant moderators in this study could be quality of delivery of the patient education and exercise, variability in delivery between health professionals and patients' motivation for exercise. Such evaluation would require a more extensive data collection than was possible in the current study. An evaluation of these potential moderators might have provided a better understanding of why four of the six adherence components did not meet the criteria for high adherence. In a previous study, mixed-methods were used to evaluate the fidelity of a complex behaviour change intervention for people with OA and low back pain[41]. In this study, it was reported that the combination of qualitative and quantitative methods provided a more insightful understanding of fidelity and its influencing factors.

A key weakness of the study concerns relying mainly on patient-reported data, as these could have been influenced by recall bias. It is well known that people tend to overestimate normative behaviour such as exercise[42]. When reporting exercise progression it is also possible that patients have been unaware of exercise program adjustments performed by the PT. This may have led to patients underreporting exercise program adjustments. Also, of the 181 patients that completed the entire intervention, only 153 returned the exercise diary. The missing data could influence the results, as we do not know the exercise dose of the patients who did not return their exercise diary.

Conclusion

The current evaluation of uptake and fidelity in the SAMBA study showed that the implementation strategy and the intervention successfully recruited health professionals and improved OA patients' access to physiotherapy and uptake of recommended core treatment. However, it was less effective for providing exercise programs with sufficient dose and progression and in supporting patients' adherence to the exercise program.

Author contributions

All authors took part in the conception, design and analysis of the study. All authors were involved in drafting and revising the article critically for important intellectual content. All authors have approved the final version to be submitted for publication. Tuva Moseng (tuva.moseng@medisin.uio.no) takes responsibility for the integrity of the work as a whole.

Competing interest statement

Tuva Moseng: none.
Hanne Dagfinrud: none.
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Supplementary data

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