

Using the Behaviour Change Wheel to develop an oral hygiene self-care intervention for Punjabi immigrant adults: an illustrative example

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ABSTRACT

Background: This article describes the development of an oral hygiene self-care behaviour change intervention (Safeguard Your Smile [SYS]) for Punjabi immigrant adults, using the Behaviour Change Wheel (BCW) theoretical framework. **Methods:** The 3 stages and 8 steps of the BCW were followed to develop the face-to-face SYS intervention. Identification of the problem in behavioural terms was enabled by referring to the results of a qualitative focus group (FG) previously conducted by the research team. Following the BCW method, the sources of behaviour were defined in terms of capability, opportunity, and motivation. Appropriate intervention functions, policy categories, behaviour change techniques (BCTs), and modes of delivery were then identified, selected, and mapped. Concrete strategies were chosen to bring about the desired oral hygiene self-care behavioural change. **Results:** Two main barriers to oral hygiene self-care faced by Punjabi immigrant adults were identified from the original FG: 1) inadequate knowledge and 2) inconsistent daily routine. Oral hygiene self-care behaviour was designated as a target behaviour, detailing frequency, duration, and technique. Five intervention functions (education, training, modelling, environmental restructuring, and enablement) and 2 policy categories (communication and service provision) were identified to influence the capability, opportunity, and motivation related to oral hygiene self-care behaviour. Nine BCTs were selected to influence desired oral hygiene self-care behaviour among adults. **Conclusion:** The development process for this SYS intervention may be employed by researchers to design a behaviour change intervention for other populations. However, additional strategies tailored to each specific context and population must be incorporated.

RÉSUMÉ

Contexte : Cet article décrit le développement d'une intervention de changement de comportement en matière de soins personnels d'hygiène buccodentaire à l'intention des immigrants pendjabis appelée Safeguard Your Smile (SYS), en utilisant le cadre théorique de la « roue de changement de comportement » (RCC). **Méthodologie :** Les 3 stades et les 8 étapes de la RCC ont été suivis pour élaborer l'intervention de SYS en personne. Cibler le problème en matière de comportement a été rendu possible en se référant aux résultats d'un groupe de discussion qualitatif (GD) précédemment mené par l'équipe de recherche. Les sources du comportement ont été définies en matière de capacité, d'opportunité et de motivation, selon la méthode de la RCC. Les rôles d'intervention, les catégories de politiques, les techniques de changement de comportement (TCC) et les modes de prestation appropriés ont ensuite été ciblés, sélectionnés et répertoriés. Des stratégies concrètes ont été choisies pour obtenir le changement de comportement souhaité en matière de soins personnels d'hygiène buccodentaire. **Résultats :** Deux principaux obstacles aux soins buccodentaires personnels auxquels sont confrontés les immigrants pendjabis ont été ciblés dans le GD initial : 1) des connaissances inadéquates et 2) des habitudes quotidiennes incohérentes. Le comportement de soins personnels d'hygiène buccodentaire a été défini comme un comportement cible, détaillant la fréquence, la durée et la technique. Cinq rôles d'intervention (éducation, formation, modelage, restructuration de l'environnement et habilitation) et 2 catégories de politiques (communication et prestation de services) ont été ciblés pour influencer la capacité, l'opportunité et la motivation liées au comportement de soins personnels d'hygiène buccodentaire. Neuf TCC ont été sélectionnés pour influencer le comportement souhaité en matière d'hygiène buccodentaire chez les adultes. **Conclusion :** Le processus de développement de cette intervention SYS peut être utilisé par les chercheurs pour concevoir une intervention de changement de comportement pour d'autres populations. Cependant, des stratégies supplémentaires adaptées à chaque contexte et population spécifiques doivent être incorporées.

Keywords: adults; Behaviour Change Wheel; immigrants; intervention; oral hygiene self-care behaviour

CDHA Research Agenda category: risk assessment and management

INTRODUCTION

Despite overall improvements in the oral health status of Canadians, preventable oral diseases such as dental decay, gingivitis, and periodontitis remain prevalent among vulnerable populations.¹ Preventive interventions are

increasingly a focus of dental public health, with efforts mainly concentrated on behavioural and lifestyle changes. It is widely accepted that positive self-care behaviours play a central role in maintenance of oral health and prevention

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of disease.² Prevention and management of oral diseases are critically dependent upon daily oral hygiene self-care behaviour, healthy dietary intake, tobacco cessation, and regular oral health care visits.³ In general, elementary oral hygiene self-care behaviours, which are a cornerstone of oral disease prevention, are practised inadequately.⁴

Growing evidence suggests that behavioural interventions guided by relevant theory tend to produce effective changes⁵ by targeting underlying mechanisms that facilitate the pathway between intervention and behavioural outcomes⁶. It has been reported that, despite many advantages of using a theory to develop an intervention, behavioural change interventions generally are infrequently theoretically driven.⁷ Indeed, a meta-analysis reported that only 22.5% studies had explicitly used behavioural change theories; the studies that had used a behaviour change theory had applied it suboptimally.⁷ A systematic review by Renz et al.⁸ revealed that only 4 studies were based on behavioural theories, and the suboptimal application of the theory in these studies was underscored. Thus, it was concluded that “there is a need for greater methodological rigour in the design of trials in this area”⁸.

Behavioural change theoretical models

To date, various theory-driven behavioural change models have been developed to guide strategies for promoting healthy behaviours and to facilitate effective coping mechanisms for illness. However, there is a consensus among behavioural theorists that selection of a relevant theory from among the 83 behaviour change theories⁹ can be challenging since many of the constructs used by current health behaviour theories are similar or overlapping but employ different terminologies^{10–13}. Additionally, there is no basis or guidance for determining which theory will predict behaviour or behaviour change most precisely.¹¹ Because the literature on health behaviour theory is full of pros and cons about most of the individual-level theories and lacks of any overall guidance,¹¹ an appropriate theory selection is often daunting for behavioural intervention designers. It has been suggested that effective behavioural change interventions addressing today’s key health issues should be selected based on tested scientific theory, rather than on the investigator’s choice, common sense or intuition.^{14,15}

Behaviour Change Wheel theoretical framework

Michie et al.^{13,16} developed the Behaviour Change Wheel (BCW), an integrative theoretical framework, by synthesizing the common features of 19 theoretical frameworks and linking them in a systematic method to facilitate the development of diverse behavioural change interventions for a wide variety of settings. Components of the BCW can be easily replicated and evaluated.¹⁶

The BCW has 3 layers; its core is based on the “COM-B” model that proposes that people need physical and psychological capability (C), social and physical

opportunity (O), and automatic and reflective motivation (M) to perform a behaviour (B). The COM-B model is supported by the “Theoretical Domains Framework (TDF),” which describes 14 factors from 33 behaviour change theories that fall under the categories of COM. Noteworthy, TDF is viewed as an elaboration of the COM-B model and is sometimes used as an optional substep to gain deeper understanding of the behaviour. The second layer of the wheel comprises 9 intervention functions (education, persuasion, incentivization, coercion, training, enablement, modelling, environmental restructuring, and restrictions). The third layer comprises 7 categories of policy (communication/marketing, guidelines, fiscal measures, regulation, legislation, environmental/social planning, and service provision) that facilitate implementation of the intervention functions.¹⁶ After selecting appropriate intervention functions and policy categories, the next step is to select behaviour change techniques (BCTs) from the taxonomy of behaviour change techniques (BCTTv1).¹⁷

Previously, the BCW has been successfully used in initiatives such as to improve hand hygiene through a national “clean your hands” campaign among hospital staff,¹⁸ to reduce sedentary behaviour in older adults,¹⁹ to increase attendance at stop-smoking services,²⁰ to increase frequency of physical activity among cancer patients,²¹ and to improve medical adherence in adolescent patients²². Asimakopoulou and Newton¹² advocated the introduction of the BCW theoretical framework in dental public health as a means of designing oral-health-related behavioural interventions. Lovell et al.²³ used the BCW in patient education intended to reduce cancer pain. They recommended that the BCW be used to design interventions for people with low health literacy since their limited capability and opportunity factors could be addressed by targeting the enabling and training interventions of the BCW.

Thus, in the context of oral hygiene self-care—a routine behaviour²⁴—this study hypothesized that the BCW, which addresses habit and associative learning factors along with limited capability and opportunity factors, would be appropriate for developing an oral hygiene behavioural change intervention for Punjabi immigrant adults. While acknowledging the importance of a healthy diet and regular oral health care visits for optimal oral health, this study focused on changing oral hygiene self-care behaviour only. The purpose of the present article is to describe the development process of Safeguard Your Smile (SYS), an oral hygiene self-care behavioural change intervention for Punjabi immigrant adults, using the BCW integrative theoretical framework.

METHODS

Stages and steps to developing a behaviour change intervention using BCW

The BCW method comprises 3 stages and 8 steps for developing a behaviour change intervention, such as Safeguard Your Smile (SYS) (Table 1).

Table 1. Stages and steps of the BCW method

Stages of intervention development	Steps of each stage
Stage 1: Understand the behaviour	Define the problem in behavioural terms Select the target behaviour Specify the target behaviour Identify what needs to change
Stage 2: Identify intervention functions and policy categories	Identify intervention functions Identify policy categories
Stage 3: Identify content and implementation options	Identify behaviour change techniques Identify mode of delivery

Stage 1: Understand the behaviour

At the first stage, for understanding the target behaviour and its specifics, the authors referred to the results of a previously conducted qualitative focus group (FG). Ethical approval for that study was obtained from the ethics review board at the Université de Montréal (Comité d'éthique de la recherche en santé [CERES]). Details on the FG were published in 2021.²⁵ In brief, a purposeful sampling technique was used to recruit 5 participants from a community partner organization. A semi-structured interview guide was used to elicit information regarding perceptions, knowledge, needs, barriers, and enablers related to oral hygiene self-care behaviour of Punjabi immigrant adults. The main barriers identified from the FG were inadequate oral hygiene self-care knowledge and inconsistent daily routine.²⁵ Two researchers (NK and DK) discussed the results of the FG, defined the problem, and identified what needed to change in terms of 3 sources of behaviour (i.e., “capability,” “opportunity,” and “motivation”) for oral health outcomes to improve.

Stage 2: Identify the intervention functions and policy categories

At the second stage, the authors identified and mapped intervention and policy categories from the range of options in the BCW. It has been suggested that, while selecting intervention functions, policy categories, and BCTs, the researcher should consider the following question: “Does the intervention function/policy category/BCT meet the APEASE criteria (affordability, practicability, effectiveness/cost-effectiveness, acceptability, side effects/safety, equity)?” As recommended by the BCW, the APEASE criteria were consistently respected while identifying and mapping appropriate intervention functions, policy categories, BCTs, and modes of delivery for the SYS intervention.¹⁷

Stage 3: Identifying content and implementation options of intervention

At the third stage, BCTs and modes of delivery that were likely to be effective in bringing about the desired oral hygiene self-care behavioural change were selected. BCTs linked to the relevant intervention functions were identified from the BCTTv1, which lists 93 BCTs with descriptions and examples of their application.¹⁷

RESULTS**Stage 1: Understand the behaviour**

As shown in Table 2a, based on findings from the FG and discussions between researchers (NK and DK), the target behaviour and the specifics of the behaviour (frequency, duration, and technique) were defined and selected. Table 2b presents the detailed description of the factors identified during the FG as requiring change to improve oral hygiene self-care behaviour among the adults. These factors were classified by the researchers under the appropriate capability, opportunity or motivation component of the BCW.

Stage 2: Identify the intervention functions and policy categories

As shown in Table 3a, of the 9 possible intervention functions, 5 (education, training, modelling, environmental restructuring, and enablement) were identified as meeting the APEASE criteria. Table 3b presents 2 policy categories (communication and service provision) that met the APEASE criteria and were likely to be considered effective in bringing about the desired behavioural change.

The authors then identified 9 BCTs from the BCTTv1 that were considered relevant to overcoming the barriers related to the target behaviour. After these BCTs were selected, the content of the intervention was developed and tailored to the themes of the identified barriers (COM). Table 4 presents details of the 9 BCTs along

Table 2a. BCW stage 1: Understand the behaviour

Step 1: Define the problem	Inadequate oral hygiene self-care-related knowledge & skills, and inconsistent oral hygiene self-care routine among Punjabi immigrants
Step 2: Select the target behaviour	Oral hygiene self-care behaviour (to improve frequency, duration & technique): toothbrushing, flossing, mouth rinsing, and tongue cleaning
Step 3: Specify the target behaviour	1) brushing teeth twice daily for at least 2 minutes, using a soft brush and a fluoridated toothpaste, brushing teeth softly while making small back-and-forth strokes; 2) flossing once daily; 3) tongue cleaning once daily; 4) rinsing twice daily with a mouth rinse

Table 2b. BCW stage 1 (step 4): Identify what needs to change

COM-B component	Behavioural diagnosis	Is there a need to change?
Physical capability	Inconsistent skills for adequately cleaning teeth, interdental areas, and tongue (to improve frequency, duration, and technique)	Yes
Psychological capability	Inconsistent knowledge and awareness of the risks of dental plaque biofilm and consequences of not removing it daily; encouragement to make an action plan	Yes
Physical opportunity	Perception that time is a barrier, finding the time, and providing access to tools and learning opportunities to enable the act	Yes
Social opportunity	Access to culturally and linguistically appropriate intervention(s) provided by expert community members; learning in a group of peers	Yes
Reflective motivation	Promotion of positive attitudes towards the creation of a plan for when, where, and how to perform the desired behaviour in the same situation	Yes
Automatic motivation	Helping participants to select a consistent cue as reminder to help them to enable the act on a regular, routine basis	Yes

Table 3a. BCW stage 2: Identify intervention functions

Intervention function	Does the intervention function meet the APEASE criteria ^a ?
Education	Yes
Persuasion	No
Incentivization	No (not cost-effective)
Coercion	No (not practical or acceptable)
Training	Yes
Restriction	No
Environmental restructuring	Yes
Modelling	Yes
Enablement	Yes

^aAPEASE criteria = affordability, practicability, effectiveness/cost-effectiveness, acceptability, side effects/safety, equity

Table 3b. BCW stage 2: Identify policy categories

Policy category	Does the policy category meet the APEASE criteria ^a ?
Communication	Yes (face-to-face using an educational photonovel developed for this purpose)
Guidelines	No
Fiscal measures	No
Regulation	No
Legislation	No
Environmental/Social planning	No
Service provision	Yes (intervention will be provided to the participants)

^aAPEASE criteria = affordability, practicability, effectiveness/cost-effectiveness, acceptability, side effects/safety, equity

Table 4. BCW stage 3: Identify content and implementation options

Step 7: Identifying BCTs from the taxonomy ^a		
BCTTv1 code ^b	BCT label	Example of how it will be represented in the SYS intervention
5.1	Provide information about health consequences	To explain risk factors of dental plaque biofilm and poor oral hygiene self-care, as well as benefits of action and consequences of inaction on oral and general health using educational material (through photonovel developed)
6.1	Model or demonstrate the behaviour	To demonstrate skills of adequate toothbrushing, flossing, and tongue cleaning methods (frequency, duration, and technique) by using images and "teach-back" approach
12.5	Add objects to the environment	To provide tools (toothbrush, floss, and tongue scraper) to perform the behaviour
1.4	Prompt specific goal setting	To encourage participants to make a concrete plan specifying when, where, and how they will perform daily oral hygiene self-care and a coping plan
7.1	Teach to use prompts/cues	To encourage participants to identify prompts or cues reminding them to perform the behaviour (e.g., at a particular time of day/activity/mobile phone reminder)
2.2	Feedback on behaviour	To follow up and provide feedback on behaviour for reinforcement of behaviour
2.3	Prompt self-monitoring of behaviour	To checkmark and monitor daily progress of oral hygiene self-care behaviour on a weekly calendar
3.3	Social support (emotional)	To provide access to culturally and linguistically appropriate interventions provided by expert community members and to learn in a group of peers
8.1	Behavioural practice/rehearsal	To encourage participants to repeat their oral hygiene self-care routine using a consistent contextual cue to progressively increase its instinctiveness through an associative learning process; helping participants to select a consistent cue as a reminder to act
Step 8: Identifying the mode of intervention delivery		
Intervention will be provided by the principal investigator during in-person meetings to a small group of 4 to 5 participants either at the participant's home or at a mutually agreed upon a suitable place; follow-up will be done over the phone.		

^aBCT = behaviour change technique^bBCTTv1 = behaviour change technique taxonomy

Table 5. Matrix of links between COM-B model, intervention functions, policy categories, BCTs, and SYS intervention components

COM-B components served by intervention functions	Intervention functions	Policy categories	BCTTv1 code	SYS intervention component	Format
Psychological capability	Education	Communication and service provision	5.1	Enhance knowledge using photonovel	Reading material (photonovel)
Physical capability	Training modelling	Communication and service provision	6.1	Demonstrate skills using teach-back technique	Face-to-face demonstration and practice by showing techniques on dentofom
Physical opportunity	Environmental restructuring	Communication and service provision	7.1 and 12.5	Establish a cue/prompt to perform the act and provide tools	Tools (toothbrush, floss, and tongue scraper) and prompts
Social opportunity	Enablement	Communication and service provision	3.3	Provide access to culturally and linguistically appropriate interventions provided by one of their own expert community members; offer learning in a group of peers	Learning offered in a group of peers
Automatic motivation	Enablement	Service provision	2.3 and 8.1	Encourage self monitoring of behavioural practice	Paper calendar provision for self-monitoring of behavioural practice
Reflective motivation	Enablement	Communication and service provision	1.4 and 2.2	Encourage reflection and goal setting for a concrete action plan; follow-up to reinforce behaviour	Verbal persuasion

with the rationale for each intervention. The authors determined that delivering the interventions in a face-to-face setting, coupled with a follow-up to be done on the telephone, would meet the APEASE criteria. Table 5 presents the matrix of links between the COM-B model, intervention functions, policy categories, BCTs, and intervention components of the SYS intervention. The following section describes the SYS intervention.

Safeguard Your Smile intervention

The SYS intervention was designed to be provided by the principal investigator (PI) during in-person meetings with small groups of 4 to 5 participants either at one of the participant's homes or at a mutually agreed upon suitable place; follow-up was undertaken by telephone.

The SYS intervention consists of 5 components as illustrated in Figure 1. The first component involves enhancing the participants' knowledge and understanding of adequate oral hygiene self-care behaviour (BCT 5.1). Using the educational material (SYS photonovel) developed by the community, the goal was to improve the participants' knowledge and understanding of the risk factors for dental plaque biofilm and gingivitis, and the benefits and risks of action or inaction of oral hygiene self-care behaviour on both oral and general health.

Second, the development of adequate oral hygiene self-care skills (frequency, duration, and technique) relied on the "teach back method" (BCT 6.1), which is a way of confirming that participants have understood what the instructor has explained. After explaining the oral health-related information to SYS participants, the PI asked them to repeat the information in their own words. In cases where the participants were unable to remember or accurately repeat what was explained to them, the information was

clarified and participants were given the opportunity to "teach it back" again until they were able to correctly describe in their own words the given information.²⁶ Oral hygiene self-care related tools (toothbrush, floss, and tongue scraper) were provided to all participants (BCT 12.5). Participants received the SYS culturally and linguistically appropriate intervention provided by one of their own expert community members and learned in a group of their peers (BCT 3.3).

Third, an action planning activity was undertaken to encourage participants to create a concrete plan for using what cue, when, and where, and how they would they implement their daily oral hygiene self-care routine and coping plan (BCT 1.4). Furthermore, the PI encouraged participants to identify their preferred environmental prompt or cue to remind them to perform the daily oral hygiene self-care behaviour (e.g., a particular time of day, activity or technologies such as mobile phone alerts) (BCT 7.1).

Fourth, self-monitoring tasks were assigned to track daily progress on the calendar provided on the last page of the SYS photonovel (BCT 2.3).

Finally, 3 monthly telephone follow-up calls were conducted by the PI (BCT 8.1) for the reinforcement of new self-care behaviours (BCT 2.2).

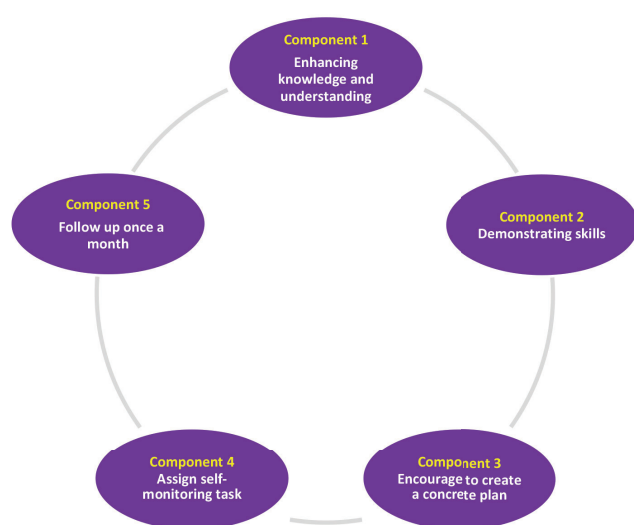
DISCUSSION

This article has illustrated the development process for the SYS, a theory-driven intervention employing the BCW to promote positive oral hygiene self-care behaviour among Punjabi immigrant adults. The BCW provides a systematic method of characterizing interventions that enables their outcomes to be linked to mechanisms of action. Thus, it helps to diagnose why an intervention may fail to achieve its desired goal. In particular, by identifying various barriers, intervention functions, and policy categories, and linking them to specific BCTs and intervention components, the researchers ensured a better understanding of "why and how" the intervention was developed, thereby increasing the opportunity for others to replicate its whole process.

The advantages of the BCW are that it is a systematic method for developing a theoretically grounded and evidence-based behaviour change intervention. Additionally, it details the explicit design and content of the intervention development process. Using the BCW to design the SYS intervention allowed the researchers to target 3 elements (knowledge, skills, and behaviour) through the 5 identified intervention functions (education, training, modelling, environmental restructuring, and enablement). However, it had one disadvantage, namely it systemized the behaviour change science and its application in intervention development, completely neglecting the variability of human behaviour.²⁷

To determine whether the SYS intervention worked and, if so, how well it worked, the researchers conducted a randomized controlled trial (RCT) published previously in this journal²⁸ to evaluate its effectiveness in improving

Figure 1. Components of Safeguard Your Smile intervention



oral hygiene self-care behaviour among Punjabi immigrant adults with low oral health literacy. The main outcomes measured and evaluated were oral hygiene self-care knowledge, oral hygiene self-care behaviour, oral health literacy, plaque index, and gingival index. Outcomes were measured at baseline and in the final evaluation session using questionnaires and oral examination. The findings of this RCT demonstrated that the SYS intervention enhanced positive oral hygiene self-care behaviour among Punjabi immigrant adults with low oral health literacy.²⁸

The SYS intervention differs from other oral hygiene self-care behavioural interventions that did not rely on an explicit theory for their design and development. A study by Mills²⁹ has illustrated that a series of educational sessions can improve oral health knowledge and self-efficacy. However, this study had a very small sample size, and thus the results cannot be generalized. It also lacked evidence of success in effecting sustainable oral health behavioural change.²⁹ Another pre-post study conducted among 67 older primarily Caucasian adults also employed a community-based educational intervention involving multiple interactions to significantly and positively impact oral health literacy and oral hygiene status among older adults.³⁰ However, the theoretical underpinning of the aforementioned intervention was unclear. The SYS intervention, in contrast, employed a pragmatic method.

The strength of the SYS intervention is its application of the BCW, since the BCW provides a wide range of options based on a systematic evaluation of theory and evidence for making the best use of the understanding and resources available to arrive at a strategy. In addition, the researchers used the APEASE criteria that guide an intervention designer to choose options for intervention functions and policy categories that will be locally relevant, likely to be feasible, and capable of implementation as a cohesive intervention.¹⁷ A limitation identified in the original research testing this theory was the small sample size of the focus group (only 5 participants) to identify the barriers and enablers of oral hygiene self-care. Despite this limitation, this article provides an explicit description of the development process of the SYS intervention that is replicable thanks to the use of the BCW method.

CONCLUSION

This article offers an illustrative example of the development process for an oral hygiene self-care behavioural change intervention using the BCW theoretical framework. This model may assist other oral health professionals and researchers in developing interventions to encourage behavioural change in their clients or target populations. However, the authors recommend that future research include additional strategies tailored to specific target behaviour change needs of other communities.

CONFLICTS OF INTEREST

There are no conflicts of interest to declare.

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