Received: 22 September 2019 | Revised: 7 February 2020 | Accepted: 11 February 2020

DOI: 10.1111/idh.12430

ORIGINAL ARTICLE

International Journal of Dental Hygiene | WILEY

Self-regulation in oral hygiene behaviours in adults with gingivitis: The mediating role of coping planning and action control

Mário-Rui Araújo[1,2] | Maria-João Alvarez[1] | Cristina A. Godinho[3] | Tânia Almeida[1] | Cícero R. Pereira[4,5]

[1]Faculdade de Psicologia, CICPSI, Universidade de Lisboa, Lisboa, Portugal

[2]Dental Hygiene Program, Politécnico de Portalegre, Escola Superior de Saúde de Portalegre, Portalegre, Portugal

[3]Instituto Universitário de Lisboa (ISCTE-IUL), Lisboa, Portugal

[4]Universidade Federal da Paraíba, João Pessoa, Brasil

[5]Instituto de Ciências Sociais, Universidade de Lisboa, Lisboa, Portugal

Correspondence
Mário Rui Araújo, Faculdade de Psicologia, CICPSI, Universidade de Lisboa, Rua José Pinto Miranda 6, Parque Belver, 2500 287 Caldas da Rainha, Portugal.
Email: mra@meo.pt

Abstract

Aim: This study investigates the joint role of volitional predictors of oral hygiene behaviours of flossing and brushing in adults with gingivitis, framed by the Health Action Process Approach model (HAPA).

Materials and Methods: In a longitudinal online survey, 201 participants aged 18-75, of which 56.7% were women, completed assessments at baseline(T1), 2 weeks(T2) and 4 months(T3). Oral hygiene behaviours(OH) (brushing and flossing) and social cognitive determinants of behaviour in the HAPA: action and maintenance self-efficacy(ASE & MSE), intention(INT), coping planning(CP) and action control(AC) were evaluated. Structural equation modelling was used to test a series of three nested models. In Model 1, action self-efficacy would determine MSE and INT, and INT would determine OH; in Model 2, INT would determine both CP and AC and the two OH behaviours; and in Model 3, CP and AC would be sequential mediators between INT and OH.

Results: Model 3, predicting a mediating process from intention to behaviour via coping planning and action control, showed the best fit according to the fit indices and explained more of the variance in dental hygiene. The mediating role of coping planning and action control between intention and oral hygiene behaviours was thus confirmed. Importantly, coping planning did not mediate between intention and oral hygiene behaviours, which means that oral hygiene intention influences action control through coping planning, and both sequentially mediate this influence on behaviour.

Conclusions: For individuals who are not yet following the recommendations for specific oral hygiene behaviours, coping planning and action control represent psychological mechanisms by which intentions are put into practice.

KEYWORDS

behavioural science, gingival health, oral hygiene, psychosocial determinants of oral health, self-regulation

1 | INTRODUCTION

Consistent evidence affirms that the main aetiology of periodontal diseases is the formation and persistence of bacterial biofilms on dental surfaces.[1] Collaboration on the part of the patient in the daily disruption of this biofilm and managing gingivitis are critical factors in attaining long-term success with periodontal treatment.[1-3] It is therefore of utmost importance that effective interventions are designed to improve patients' adherence to a type of oral hygiene control capable of promoting gingival health,[4,5] such as brushing habits and interproximal control.[1,6] However, it is a well-known fact that most patients in the long run fail to correctly use means of controlling interdental biofilm and fail to turn up for control appointments.[2]

Gingival health is therefore dependent to a large extent on the individual's oral health behaviour and is not merely a consequence of a clinical intervention in a consultation context.[7,8] Although professionals are generally aware of this issue, their actions towards changing the oral hygiene behaviour of their patients (eg feedback on oral hygiene, explaining the correct use of a toothbrush and interdental cleaning) seem to be restricted primarily to a verbal transmission of information during the consultation.[5,9] However, oral hygiene behaviour change requires not only basic oral health knowledge, but has also been shown to depend on psychological processes.[4,5,9] Hence, theory-based research is sorely needed in order to deepen our understanding of the psychological mechanisms involved in behaviours that impact on gingival health, with a view to developing evidence-based interventions.[4,5,10] The aim of the present study was to investigate the joint role of self-regulatory processes in daily oral hygiene behaviours of adults with gingivitis.

According to the HAPA model, health behaviour is the result of a motivational phase, where individuals form an intention to act, and a volitional, post-intentional phase, where the individuals plan to translate their intentions into action and plan how to maintain their behavioural changes.[11,12] The behavioural intentions are characterized by explicit decisions to act and concentrate on a person's motivation for a certain goal. Although considered a good predictor of behaviour change,[13] intentions are not sufficient by themselves, with other processes being necessary to improve behaviour implementation.[14]

The HAPA model highlights four constructs involved in behavioural enactment: self-efficacy, intention, planning and action control (Figure 1). Action self-efficacy predicts a wide range of health behaviours, including those of oral health; when patients present higher levels of self-efficacy in the use of floss, they also show higher levels of actual usage.[15,16] While action self-efficacy is fundamental to the establishment of intention, maintenance self-efficacy is essential for attaining the self-regulation needed to initiate and maintain the behaviour. There is evidence that maintenance self-efficacy has a predictor role in planning or in the relationship between planning and behaviour,[17,18] meaning that harbouring optimistic self-beliefs increases the value of planning the actions. The same was also found for oral self-care in a study intervention, where participants with higher levels of self-efficacy reported higher levels of planning at follow-up.[16] Planning facilitates the translation of intentions into actions, namely through anticipatory strategies to deal with adversities.[19] Such plans to prevent possible lapses, coping planning, have been shown to be an important psychological determinant in the implementation of behavioural intentions,[20] including in oral hygiene.[19] However, planning alone is not always sufficient for behavioural initiation,[14,18,21,22] with action control, a self-monitoring of behaviour, being an essential element for putting those plans into practice.[19] Planning is believed to function as a more distal volitional predictor, while action control is one that is more proximal to the behaviour.[14] It can be understood as a feedback control that aims to compare one's efforts to one's objectives, seeking to reduce the differences between them.[17] In an intervention to stimulate action control, through the use of a diary to record floss usage, an increase in dental floss was observed.[21] Some studies, not concerning oral hygiene, have gone farther, finding a relation between coping planning and action control sequentially mediating between intention and behaviour.[14,22]

Considering the as-yet limited amount of evidence for the co-action of coping planning and action control in the explanation of oral hygiene behaviours, we aimed to test the mediating role these constructs play between intention and oral hygiene behaviour within the HAPA model, using three measurement points in time, among a sample of adult patients with gingivitis. The interest in these volitional processes resulted from most of the patients attending dental appointments being "intenders," but those intentions often being led astray. The difficulty in implementing intentions regarding oral hygiene behaviours lead us to seek a deeper understanding of these post-intentional mechanisms.

According to the HAPA model,[12] it was hypothesized that:

1. Action self-efficacy would be a determinant of maintenance self-efficacy and oral hygiene behavioural intention. Intention would only indirectly predict oral hygiene behaviours 4 months later;
2. Intention would be a determinant of maintenance self-efficacy, action control and coping planning, with the latter also predicted by maintenance self-efficacy;
3. Coping planning and action control would sequentially mediate the relation between intentions and oral hygiene behaviours.

2 | STUDY POPULATION AND METHODOLOGY

2.1 | Participants

A total of 233 individuals participated in the study. There were several inclusion criteria: participants must have been over 18 years old, with 20 or more teeth (minimum five per quadrant) and the presence of gingivitis.[23] Thirty were not integrated in the final sample due to the exclusion criteria, assessed by the dental hygienist: periodontal pockets >3, smokers, those under orthodontic treatment, pregnant or using removable partial dentures. The final longitudinal sample was composed of 201 individuals

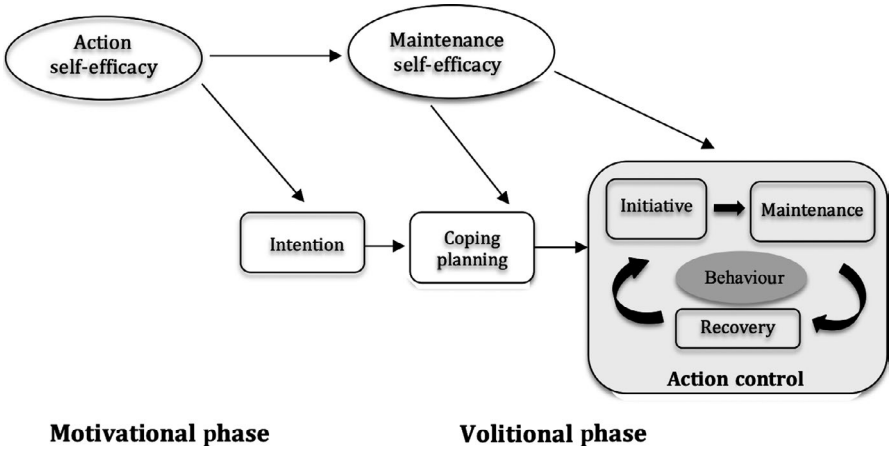


FIGURE 1 The Health Action Process Approach (HAPA; Schwarzer, 2008). Action self-efficacy (eg the belief in one's own personal ability to initiate such changes) is a central motivational mechanism. Taking action and maintaining such changes involves important volitional self-efficacy beliefs, namely the belief in the ability to maintain a recently adopted behaviour and to deal with unexpected obstacles, that is maintenance self-efficacy. Intentions are also transformed by planning, which involves coping planning—the development of strategies to be used should barriers or difficulties arise. Action control is also part of the action phase where it helps translate intention into action, involving awareness of one's standards, self-monitoring to verify whether one's behaviour is meeting what is intended, and effort toward changing one's behaviour in order to reach the target standards

TABLE 1 Descriptive statistics and correlations of the latent variables

	1	2	3	4	5	6	7	Mean	SD
1. Action self-efficacy (T1)	–							5.74	0.94
2. Intention (T1)	0.42**	–						5.95	0.96
3. Coping planning (T2)	0.36**	0.34**	–					5.57	1.19
4. Maintenance self-efficacy (T2)	0.47**	0.33**	0.52**	–				5.72	1.00
5. Action control (T2)	0.30**	0.36**	0.51**	0.43*	–			5.82	0.98
6. Oral hygiene (T1)	0.23**	0.13	0.21**	0.23**	0.27**	–		2.82	0.58
7. Oral hygiene (T3)	0.19**	0.15*	0.18**	0.11	0.29**	0.51**	–	3.40	0.45

*$P < .05$

**$P < .01$.

with gingivitis, as two participants failed to complete the questionnaire four months later.

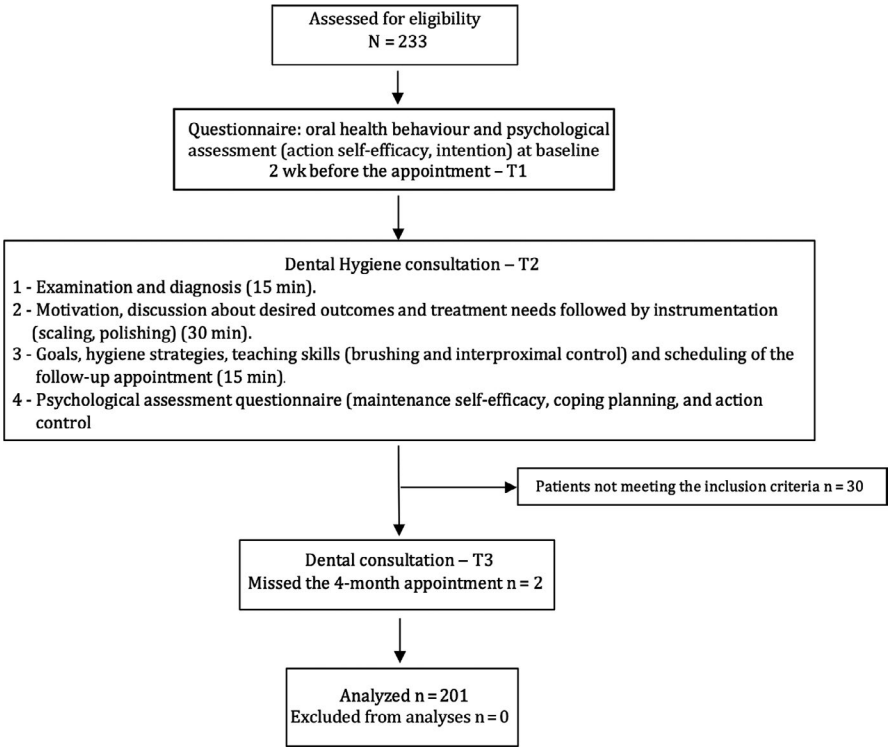
We did not calculate the desired power prior to data collection, but conducted a sensitive power analysis by using the procedures proposed by Schoemann, Boulton and Short (2017)[24] to determine power for simple and sequential mediation models. Using the observed correlation matrix as input (see Table 1) and setting confidence intervals at 95%, our sample size (N = 201) gives an 88% chance of detecting a sequential indirect effect and one of at least 95% for finding a simple mediation effect.

2.2 | Study design and procedure

Individuals were recruited via advertisements in local newspapers, dental clinics and local shops. The study took place in two private dental clinics and was conducted over a span of four months with three assessment points.

Participants received an email explaining the study two weeks prior to the first dental hygiene appointment, and they were directed to read and sign a digital informed-consent form and answer an online questionnaire (Qualtris, Inc, Provo, UT, USA) with measures for action self-efficacy, intention and dental hygiene behaviour (T1). Two weeks later (T2), at the end of the first appointment, data on maintenance self-efficacy, coping planning and action control were collected. Dental hygiene behaviour was evaluated again four months later (T3), in the second appointment (details in Figure 2). The questionnaires were in Portuguese, and the participants had to answer to all the questions. All the excluded participants had access to the first dental hygiene consultation, but their data were not used, and they did not participate in the second appointment. The appointments attended by the participants—carried out by the

FIGURE 2 Study flow chart



first author, a dental hygienist —were provided free of charge. The study was approved by the ethics committees of the institutions involved (Ethics Committee Doc. No. 6/14).

2.3 | Measures

The measures used were adapted to oral health from previous studies with the HAPA model.[11,14] All the HAPA variables were evaluated using a seven-point Likert-type scale, ranging from "totally disagree" (1) to "totally agree" (7), unless otherwise stated.

To assess action self-efficacy, three items were used. The first item was "I believe I will be able to brush and clean between my teeth on a daily basis, even if I have to change my routines." For the other two items, this stem was followed by barriers such as "even if it is difficult" or "even if I need to do some planning" (T1 Cronbach's α =.84).

To measure intention, the question: "For the next two weeks, what is your intention for brushing your teeth twice a day and cleaning between your teeth daily?" was followed by three items used to answer it: "I intend to do it from now on"; "From now on, I intend to do it daily"; and "I intend to do it every day" (T1 Cronbach's α =.93).

To assess maintenance self-efficacy, four items were used. The first item was "I believe I can keep in the habit of brushing my teeth and cleaning between my teeth daily even if… I'm lazy" and for the remaining three items, the stem was followed by barriers such as "I have to start again several times," "I am concerned about other aspects of my life," or "my family (or those who live with me) do not have these oral hygiene habits" (T2 Cronbach's α =.86).

Coping planning was assessed through three items: "I already have concrete plans for when I need to be especially careful to brush and clean between my teeth daily"; "I already have concrete plans on what to do in difficult situations to brush and clean between my teeth daily"; and "I already have concrete plans about how I should act if I stop brushing and cleaning between my teeth daily" (T2, Cronbach's α = .82).

Action control was measured using three items, each of which addressed a different component of action control: "I am currently evaluating my behavior to see if I am brushing and cleaning between my teeth on a daily basis," for self-monitoring; "I always have in mind the intention of brushing and cleaning between my teeth on a daily basis," for awareness of standards; and "I strive to act according to my intentions to brush and clean between my teeth on a daily basis" for self-regulatory effort (T2, Cronbach's α = .83).

In order to assess oral hygiene behaviours, one question about brushing and another about flossing habits were both asked at Time 1 and Time 3: "In the last two weeks/four months how often have you brushed/flossed your teeth? (1 = never; 2 = less than once a day; 3 = once a day; and 4 = more than once a day)." Individual scores for brushing and flossing were calculated and a composite score (a mean) was also computed for both, referred to as oral hygiene (r_{T1} =.14, P = .04; r_{T3} =.16, P = .03).

2.4 | Analytic strategy

First, to evaluate the fit of the proposed measurement model to the factorial structure of the observed variables, a confirmatory

factor analysis was performed. Six factors were specified —action self-efficacy, intention, maintenance self-efficacy, coping planning, action control and oral hygiene (brushing and flossing)—at baseline, Time 2 and/or Time 3, and they were allowed to freely intercorrelate with no correlation between measurement error. Statistical identification of the models was assured by constraining all factors' variances to 1.00. All parameters were calculated using maximum likelihood estimation, and confidence intervals for mediating effects were obtained with bootstrapping procedures with 1000 resamples. Each indicator only loaded on its respective factor.

Structural equation modelling (SEM) with AMOS v. 24 was performed on the variance-covariance matrix of the indicators using the maximum likelihood estimation of the parameters. Confidence intervals for the mediating parameters were subsequently estimated using bootstrapping procedures with 1,000 resamples, a nonparametric procedure recommended for mediation analyses since it does not require normality in the distribution of the sample's indirect effects.[25]

To test the hypotheses of the volitional factors as sequential mediating mechanisms between behavioural intentions and oral hygiene behaviour at Time 3, three nested models were estimated—that is all variables were included in each model. The first one specified the motivational variable (action self-efficacy), measured at Time 1, as a predictor of intention also measured at Time 1 and of maintenance self-efficacy measured at Time 2. Intention at Time 1 was specified as a predictor of maintenance self-efficacy, coping planning and of action control at Time 2, as well as of oral hygiene behaviour at Time 3. In the second model, coping planning and action control (both measured at Time 2) were specified as predictors of oral hygiene at Time 3, and maintenance self-efficacy, measured at Time 2, was added as a predictor of coping planning. Moreover, to test the hypothesized sequential mediation, an additional path from coping planning to action control was specified in Model 3. Past behaviour (ie baseline oral hygiene) was included in all models as a direct predictor of oral hygiene at Time 3. All the predictors were specified as latent variables. Action self-efficacy and past behaviour were allowed to correlate.

The sequence of estimated models ranged from a more parsimonious model, where only intention predicted behaviour (Model 1), to a less parsimonious model, where the volitional predictors were tested as multiple mediators between intention and behaviour (Model 2), to the full proposed model, where the two volitional predictors were specified as sequential mediators between intention and behaviour (Model 3). Paths not used in Models 1 and 2 were constrained to 0. Parameters representing the hypothesized paths were freely estimated. The fit of the different models was assessed by examining the χ^2, χ^2/df, comparative fit index (CFI), the Tucker-Lewis Index (TLI) and the root mean square error of approximation (RMSEA). A satisfactory model fit is indicated by χ^2/df (<2), CFI and TLI (>0.90),[26] and RMSEA (<0.08).[27] The comparison of models also considered the Akaike Information Criteria (AIC), with lower values suggesting a more parsimonious solution,[28,29] and a chi-square difference test.[30] Significance testing was performed at the α =.05 level.

3 | RESULTS

3.1 | Confirmatory factor analysis

The final measurement model showed a good fit to the data, χ^2 (149) = 260.69, χ^2/df = 1.75, CFI = 0.95, TLI = 0.93, RMSEA = 0.06, 90% CI (0.048; 0.073), which indicated that the items measured the proposed six constructs (Figure S1).

3.2 | Descriptive statistics

The final sample was composed of 201 patients, aged 18-75 years (M = 38.6; SD = 12.49) of which 114 (56.7%) were women. The average level of education was a university degree (50.2%), and the majority of the individuals were actively working (78.1%). At baseline, more than 97% of the participants brushed their teeth at least once a day and the majority (74.4%) brushed twice or more. Despite the fact that all admitted to knowing the importance of controlling interproximal area participants reported a low level of control of those areas at baseline, with 80.8% never or barely ever controlling them. Means, standard deviations, and correlations for behavioural and psychological determinants at baseline, two weeks and four months are presented (Table 1). All correlations were positive and ranged from 0.11 to 0.52. Only two of them were not significant: oral hygiene at baseline and intention and oral hygiene at four months and maintenance self-efficacy.

3.3 | Measurement model

The final measurement model presented a good fit: $\chi^2(149) = 260.69$, $P < .001$; $\chi^2/df = 1.75$; CFI = 0.95; TLI = 0.93; RMSEA = 0.061, 90% CI (0.048; 0.073), indicating that the items measured the six proposed constructs. All factor loadings were higher than 0.50, except for the items of flossing in oral hygiene behaviour at Time 1 and Time 3 (0.19).

3.3.1 | Model 1: Intention as a predictor of oral hygiene behaviour

Model 1 had action self-efficacy as a predictor of maintenance self-efficacy and intention, and intention as the only predictor of oral hygiene behaviour at Time 3, besides the level of oral hygiene at Time 1 (ie past behaviour). The model fit was good: $\chi^2(162) = 366.78$, $P < .001$, $\chi^2/df = 2.26$, CFI = 0.90, TLI = 0.89, RMSEA = 0.08, 90% CI (0.068; 0.09), P (RMSEA) < 0.001, AIC = 462.78.

In support of the first hypothesis, action self-efficacy measured at baseline was positively and significantly associated with intention also measured at Time 1, β = .40, $P < .001$, accounting for 16% of the variance in intention, and with maintenance self-efficacy measured at Time 2, β = .43, $P < .001$. Moreover, as stated in the first hypothesis, intention alone was not significantly related

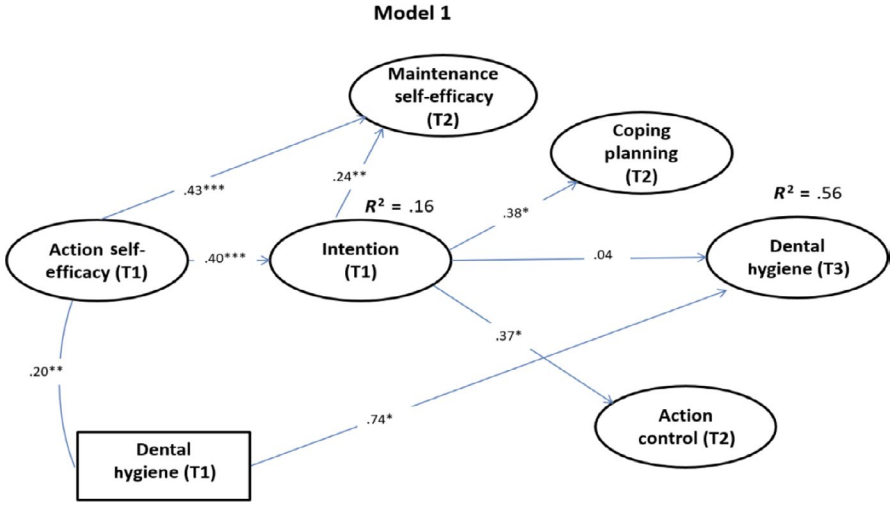


FIGURE 3 Model 1 had action self-efficacy as a predictor of maintenance self-efficacy and intention, and intention as the only predictor of oral hygiene behaviour at Time 3, besides the level of oral hygiene at Time 1 (ie past behaviour). All depicted coefficient estimates are standardized and represent direct effects. Note. *P < .05; **P < .01; ***P < .001

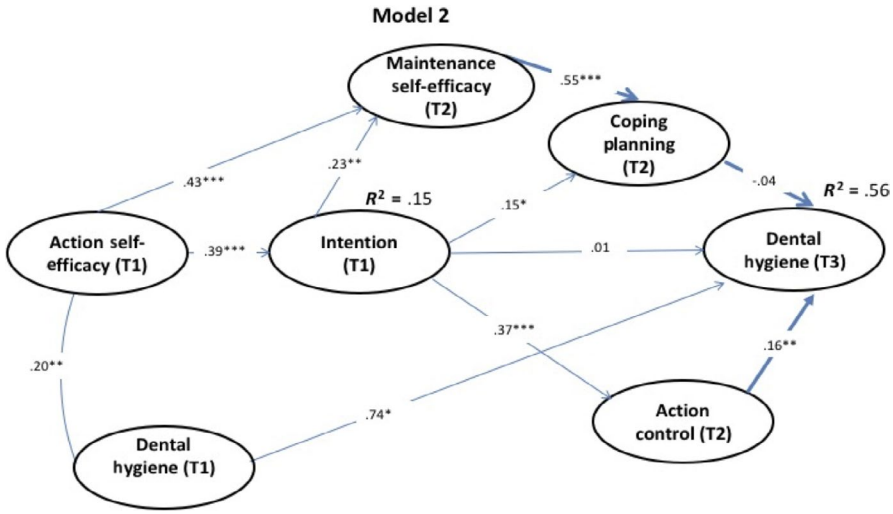


FIGURE 4 In Model 2, the paths between coping planning and behaviour and between action control and behaviour were freely estimated, as was the path between maintenance self-efficacy and coping planning. All depicted coefficient estimates are standardized and represent direct effects. Paths in bold denote the added pathways compared to Model 1. Note. *P < .05; **P < .01; ***P < .001

to oral hygiene at Time 3, β = .04, P = .46. Only the baseline behaviour significantly predicted oral hygiene level at Time 3, β = .74, P = .03, accounting for 56% of the variance in the behaviour (Figure 3).

3.3.2 | Model 2: Coping planning and action control as mediators of the relationship between intention and oral hygiene behaviour

In Model 2, the paths between coping planning and behaviour and between action control and behaviour were freely estimated, as was the path between maintenance self-efficacy and coping planning. The fit of the model proved to be good: $\chi^2(159)$ = 314.77, P < .001, χ^2/df = 1.98, CFI = 0.93, TLI = 0.91, RMSEA = 0.07, 90% CI (0.058; 0.081), P (RMSEA) < 0.001, AIC = 416.77. Intention was a significant predictor of both coping planning, β = 0.15, P = .04, and of action control, β = 0.37, P < .001, and coping planning was also significantly predicted by maintenance self-efficacy, β = .55, P < .001. The second hypothesis was fully confirmed. However, coping planning failed to directly predict oral hygiene at Time 3, β = −.04, P = .53, but action control proved to be a significant predictor of this behaviour, β = .16, P = .01 (Figure 4), which is a precondition for the sequential mediation tested in Model 3.

3.3.3 | Model 3: Coping planning and action control as sequential mediators of the relationship between intention and oral hygiene behaviour

In Model 3, the path from coping planning to action control to behaviour was freely estimated. This model presented a good fit to the data: $\chi^2(158)$ = 275.49, P < .001, χ^2/df = 1.74, CFI = 0.94, TLI = 0.93, RMSEA = 0.06, 90% CI (0.049; 0.072), P (RMSEA) =.017, AIC = 379.49. Intention remained a predictor of coping planning, β = .14, P = .05, and of action control, β = .20, P = .007. Coping planning also predicted action control, β = .51, P < .001, while action control directly predicted oral hygiene at Time 3, β = .20, P = .015, and, together with intention, accounted for 31% of the variance in oral hygiene. Overall, when considering the effect of oral hygiene behaviour at baseline, the model was able to explain 56% of the total variance in the oral hygiene behaviour (Figure 5).

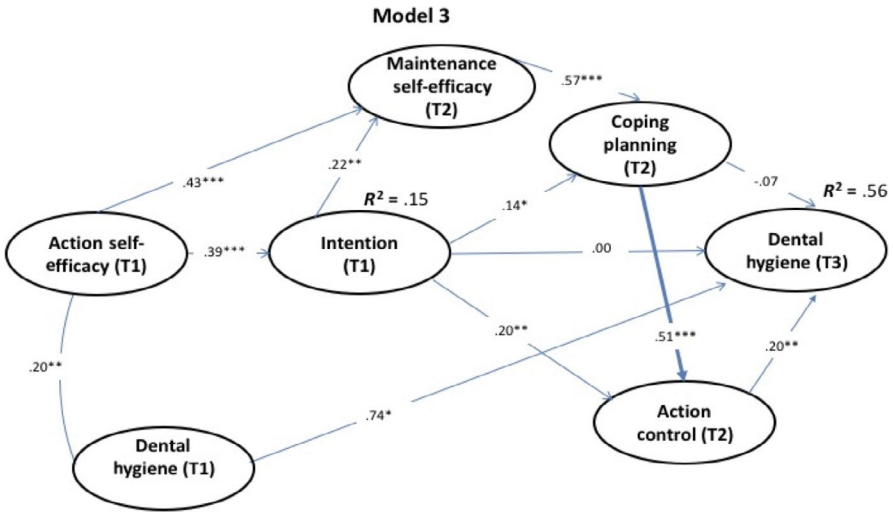


FIGURE 5 Model 3, with coping planning and action control as sequential mediators between intention and oral hygiene behaviours. All depicted coefficient estimates are standardized and represent direct effects. Indirect effects are presented in Table 2. Paths in bold represent the added pathways compared to Model 2. Note. *P < .05; **P < .01; ***P < .001

TABLE 2 Unstandardized indirect effects of model 3, representing the mediating processes from intention at Time 1 to oral hygiene behaviour at Time 3 through coping planning and action control

	Estimated indirect effect	95% CI
Simple mediations		
BI → CP → AC	0.14	0.067-0.26
BI → CP → OHB	0.01	−0.009-0.025
BI → AC → OHB	0.03	0.005-0.076
CP → AC → OHB	0.06	0.01-0.15
Sequential mediation		
BI → CP → AC → OHB	0.03	0.000-0.071

Abbreviations: BI, behavioural intention; CP, coping planning; AC, action control; OHB, oral hygiene behaviour.

Table 2 breaks down the indirect effects estimated in Model 3. As proposed, the sequential mediation was reliable, with the impact of intention at Time 1 on oral hygiene at Time 3 passing in a chain through coping planning and action control. This chain indicates a set of simple mediations that are also significant: coping planning mediates between intention and action control, while action control mediates between coping planning and oral hygiene as well as between intention and oral hygiene behaviour. However, coping planning did not mediate between intention and oral hygiene behaviour, which means that the effect of intention on this behaviour was exerted through action control.

Model 3 showed the lowest AIC, which is indicative of a better fit. Moreover, when contrasting the third model with the first one, there was a significant increase in the model fit, $\Delta\chi^2$ (4) = 83.29, P < .001; the same occurred when comparing Model 3 with Model 2, $\Delta\chi^2$ (1) = 37.28, P < .001, and the latter showed a better fit compared to Model 1, $\Delta\chi^2$ (3) = 46.01, P < .001. Thus, Model 3, where the sequential mediation was considered, was the best among the tested models.

4 | DISCUSSION

This study investigated the psychological mechanisms underlying the oral hygiene behaviours of brushing and flossing. Specifically, we aimed to test the sequential mediating role of coping planning and action control between intention and oral hygiene behaviour within the HAPA model, among a sample of adults with gingivitis.

As predicted, our findings revealed that intentions are not synonymous with change; they need the support of self-regulatory processes—such as self-efficacy, planning and action control—to have an effect on the behaviours. Hypothesis 1 was thereby corroborated; intention alone was not sufficient to predict oral hygiene behaviours, as reported in other studies.[16,31] However, also as predicted, intention proved to be a predictor of coping planning and action control. Intentions impel people to exert control over their behaviour by mobilizing planning and executing actions, which corroborates hypothesis 2.

In this study, when the volitional processes of coping planning and action control were studied sequentially, they proved to be mediators between intention and oral hygiene, with intention acting on the planning of how to handle and overcome obstacles, which in turn had an effect on oral hygiene behaviours through awareness of standards, self-monitoring and effort (ie sequential mediation)—thereby corroborating hypothesis 3. This sequential mediation shows that even when patients make good plans and anticipate difficulties, this in itself is not enough to guarantee the behaviour.

Both planning and action control have been shown to have an effect on altering and maintaining self-care in oral hygiene, improving the efficacy of these behaviours.[16] However, the sequential relationship between these constructs has, to the best of our knowledge, never been explored before in the domain of oral hygiene, despite the mediation through planning and action control having already been investigated and found for other behaviours. For example, Sniehotta et al[17] demonstrated the mediating role of action control between action planning and physical exercise, and later Godinho et al,[14] concerned with fruit and vegetable consumption, showed

that coping planning should be followed by strategies of action control in order to affect behaviour through this sequential mediation. This mediation was also found in another study, where coping planning and action control sequentially mediated the effect of an intervention for hand washing.[22]

Similarly to the studies mentioned, and despite the measurement points in time being different, the results found in the present study suggest the validity of what was hypothesized, with coping planning being a more distal predictor of action and action control being a more proximal predictor of such change in oral hygiene habits. The need to consolidate the planned changes through more constant monitoring therefore appears to be important for achieving therapeutic results.

This study has some limitations, such as that coping planning was evaluated at the same time as action control. Not doing so would have entailed four measurement points in time, a design that would have been very demanding to apply in practice. However, we have followed the recommendation of having different measurement points in time between the independent and the dependent variables.[32] Another limitation is the use of a convenience sample, which might therefore not be indicative of the whole target population. Since participation was voluntary and involved only individuals with gingivitis, participants may have been particularly motivated for the treatment, thus introducing some bias. Given the large body of related research supporting the urgent need to find effective strategies to control gingival diseases, which afflict a significant percentage of individuals,[33] future research would benefit from exploring other mediators, finding additional self-regulatory contributors that could improve oral hygiene behaviours (eg action planning, social norms).

The present study adds support to a general consensus that has been reached regarding the importance of behaviour management in the prevention and control of periodontal diseases.[8] However, despite this consensus, periodontal treatments continue to focus on treating the sequelae of acute episodes, rather than on chronic disease management strategies, where behavioural change and maintenance are fundamental pillars.[9] Meta analyses and systematic reviews,[5,7,34] as well as other studies,[9] are clear in stating that we continue to treat patients as if they were information containers and not actors capable of understanding and managing their behaviours.

It is of fundamental importance that professionals come to understand and manage their clinical interventions through a more relational, psychological and communicational perspective, with increased understanding of how behavioural relationships help to reveal possible individual solutions. Understanding the behaviour of patients is an integral part of the therapeutic process, and this must be brought into focus in order to be more effective in controlling periodontal diseases. This helping relationship, providing patients with not only motivational but also self-regulatory strategies, will not only make them more active agents in their own process of change, but will also enable them to achieve and maintain their desired therapeutic outcomes.

5 | CLINICAL RELEVANCE

This theory-based study provides additional evidence on the psychological mechanisms of oral hygiene behaviours. Behaviour change strategies based on these mechanisms can help individuals be more active in self-regulation, improving their periodontal health.

5.1 | Scientific rationale for the study

Evidence supports the understanding that oral hygiene behaviours require self-regulatory effort. Psychological factors have proven to be important determinants for these behaviours, but there is a need to understand the specific mechanisms that enable an intention to perform oral hygiene behaviours more regularly to be put into practice.

5.2 | Principal findings

The sequential mediating role of coping planning and action control between intention and oral hygiene behaviours was confirmed.

5.3 | Practical implications

Behavioural change interventions aiming to improve gingival health should seek to foster self-regulation processes such as coping planning (anticipation of obstacles and ways to overcome them) and action control (awareness of standards, self-monitoring and effort).

ACKNOWLEDGEMENTS

The authors express their sincere gratitude to Marjolijn Hovius for her comments on this manuscript.

CONFLICT OF INTEREST

The author(s) received no financial support for the research, authorship and/or publication of this article.

AUTHOR CONTRIBUTIONS

Mário-Rui Araújo, Maria-João Alvarez and Cristina A. Godinho involved in conception and design, drafting the article. Mário-Rui Araújo involved in acquisition of data. Mário-Rui Araújo, Maria-João Alvarez, Cristina A. Godinho, Tânia Almeida and Cícero R. Pereira involved in analysis and interpretation of data, final approval of the completed article. Mário-Rui Araújo, Maria-João Alvarez, Cristina A. Godinho and Cícero R. Pereira involved in revising it for intellectual content.

ORCID

Mário-Rui Araújo https://orcid.org/0000-0001-8947-3469
Maria-João Alvarez https://orcid.org/0000-0001-6048-3778
Cristina A. Godinho https://orcid.org/0000-0002-2293-7190
Cícero R. Pereira https://orcid.org/0000-0003-3406-3985

REFERENCES

1. Sanz M, Baumer A, Buduneli N, et al. Effect of professional mechanical plaque removal on secondary prevention of periodontitis and the complications of gingival and periodontal preventive measures: consensus report of group 4 of the 11th European Workshop on Periodontology on effective prevention of periodontal and peri-implant diseases. *J Clin Periodontol*. 2015;42(Suppl. 16):S214-S220.
2. Chapple IL, Van der Weijden F, Doerfer C, et al. Primary prevention of periodontitis: managing gingivitis. *J Clin Periodontol*. 2015;42(Suppl. 16):S71-76.
3. Gurenlian JR. Interproximal biofilm management: lessons learned from the 11th European workshop in periodontology. *Int J Dent Hyg*. 2015;13:237-238.
4. Duane B. Psychological approaches to behaviour for improving plaque control. *Evid Based Dent*. 2017;18(1):3-4.
5. Newton TJ, Asimakopoulou K. Managing oral hygiene as a risk factor for periodontal disease: a systematic review of psychological approaches to behaviour change for improved plaque control in periodontal management. *J Clin Periodontol*. 2015;42(Suppl. 16):S36-S46.
6. Berchier CE, Slot DE, Haps S, Van der Weijden GA. The efficacy of dental floss in addition to a toothbrush on plaque and parameters of gingival inflammation: a systematic review. *Int J Dent Hygiene*. 2008;6:265-279.
7. Renz A, Ide M, Newton T, et al. Psychological interventions to improve adherence to oral hygiene instructions in adults with periodontal diseases. *Cochrane Database Syst Rev*. 2007;2:CD005097.
8. Tonetti MS, Eickholz P, Loos BG, et al. Principles in prevention of periodontal diseases. Consensus report of group 1 of the 11th European Workshop on periodontology on effective prevention of periodontal and peri-implant diseases. *J Clin Periodontol*. 2015;42:S5-S11.
9. Gobat N, Bogle V, Lane C. The challenge of behavior change. In: Ramseier CA, Suvan JE, eds. *Health Behavior Change in the Dental Practice*. Iowa, USA: Blackwell Publishing Inc; 2010:13-32.
10. Scheerman J, Loveren CV, Meijel BV, et al. Psychosocial correlates of oral hygiene behaviour in people aged 9 to 19 - a systematic review with meta-analysis. *Community Dent Oral Epidemiol*. 2016;44(4):331-341.
11. Schwarzer R, Schuz B, Ziegelmann JP, et al. Adoption and maintenance of four health behaviors: theory-guided longitudinal studies on dental flossing, seat belt use, dietary behavior, and physical activity. *Ann Behav Med*. 2007;33(2):156-166.
12. Schwarzer R. Modelling health behaviour change: how to predict and modify the adoption and maintenance of health behaviours. *Appl Psychol*. 2008;57(1):1-29.
13. Armitage CJ, Christian J. From attitudes to behaviour: basic and applied research on the theory of planned behaviour. *Curr Psychol*. 2003;22(17):187-195.
14. Godinho C, Alvarez M, Lima M, et al. Will is not enough: coping planning and action control as mediators in the prediction of fruit and vegetable intake. *Br J Health Psychol*. 2014;19(4):856-870.
15. Scheerman JFM, van Empelen P, van Loveren C, et al. An application of the Health Action Process Approach model to oral hygiene behaviour and dental plaque in adolescents with fixed orthodontic appliances. *Int J Paediatr Dent*. 2017;27(6):486-495.
16. Zhou G, Sun C, Knoll N, et al. Self-efficacy, planning and action control in an oral self-care intervention. *Health Educ Res*. 2015;30(4):671-681.
17. Sniehotta FF, Scholz U, Schwarzer R. Bridging the intention-behavior gap: planning, self-efficacy and action control in the adoption and maintenance of physical exercise. *Psychol Health*. 2005;20(2):143-160.
18. Affendi I, Asiah MN, Normi M, et al. Association between self-efficacy and health behaviour in disease control: a systematic review. *Glob J Health Sci*. 2018;10(1):18-36.
19. Schwarzer R, Schüz B, Ziegelmann J, et al. Adoption and maintenance of four health behaviors: theory-guided longitudinal studies on dental flossing, seat belt use, dietary behavior, and physical activity. *Ann Behav Med*. 2007;33(2):156-166.
20. Craciun C, Schüz N, Lippke S, et al. Facilitating sunscreen use in women by a theory-based online intervention: a randomized controlled trial. *J Health Psychol*. 2011;17(2):207-216.
21. Suresh R, Jones K, Newton J, et al. An exploratory study into whether self-monitoring improves adherence to daily flossing among dental patients. *J Public Health Dent*. 2012;72(1):1-7.
22. Reyes-Fernández B, Knoll N, Hamilton K, et al. Social-cognitive antecedents of hand washing: action control bridges the planning-behaviour gap. *Psychol Health*. 2016;31(8):993-1004.
23. Chapple ILC, Mealey BL, Van Dyke TE, et al. Periodontal health and gingival diseases and conditions on an intact and a reduced periodontium: Consensus report of workgroup 1 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. *J Periodontol*. 2018;89(Suppl 1):S74-S84.
24. Schoemann AM, Boulton AJ, Short SD. Determining power and sample size for simple and complex mediation models. *Soc Psychol Pers Sci*. 2017;8(4):379-386.
25. Hayes AF. Beyond Baron and Kenny: Statistical mediation analysis in the new millennium. *Commun Monogr*. 2009;76(4):408-420.
26. Bentler PM. Comparative fit indexes in structural models. *Psychol Bull*. 1990;107(2):238-246.
27. Hu L, Bentler P. Fit indices in covariance structure modelling: sensitivity to underparameterized model misspecification. *Psychol Methods*. 1998;3(4):424-453.
28. Akaike H. A new look at the statistical model identification. *IEEE Trans Automat Contr*. 1974;19(6):716-723.
29. Kass R, Raftery A. Bayes factors. *J Am Stat Assoc*. 1995;90(430):773-795.
30. Bollen K. *Structural equations with latent variables*. New York, NY: John Wiley & Sons; 1989.
31. Judah G, Gardner B, Aunger R. Forming a flossing habit: an exploratory study of the psychological determinants of habit formation. *Br J Health Psychol*. 2012;18(2):338-353.
32. Cole DA, Maxwell SE. Testing mediational models with longitudinal data: questions and tips in the use of structural equation modelling. *J Abnorm Psychol*. 2003;112(4):558-577.
33. Jepsen S, Blanco J, Buchalla W, et al. Prevention and control of dental caries and periodontal diseases at individual and population level: consensus report of group 3 of joint EFP/ORCA workshop on the boundaries between caries and periodontal diseases. *J Clin Periodontol*. 2017;44(Suppl. 18):S85-S93.
34. Webb T, Sheeran P. Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychol Bull*. 2006;132(2):249-268.

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Araújo M-R, Alvarez M-J, Godinho CA, Almeida T, Pereira CR. Self-regulation in oral hygiene behaviours in adults with gingivitis: The mediating role of coping planning and action control. *Int J Dent Hygiene*. 2020;18:192–200. https://doi.org/10.1111/idh.12430