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A new complementary approach for oral health and diabetes management: health coaching

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ABSTRACT

Background: Health Coaching (HC) is based on " partnering with clients in a thought-provoking and creative process that inspires them to maximize their personal and professional potential" to adopt healthy lifestyles through "building awareness and empowerment". This study`s objective is to assess, for the first time to our knowledge, the effectiveness of HC compared with Health Education (HE) using clinical and subjective measures among DM2 patients, Turkey and Denmark. **Methods:** This stratified random prospective study selected DM2 patients in Turkey (n=186) (TR) (2010-12) and Denmark (n=116) (DK) (2012-2014). Participants were assigned to HC and HE groups. Selected outcomes were HbA1c, periodontal treatment need index (CPI), health behaviours and anthropometric measures. The study duration was 12 months (6-months initiation- maintenance, 6 months follow-up).

Results At baseline, there were no statistically significant differences between the HC and HE groups. Post-intervention, a reduction of HbA1c in the HC groups was observed (TR: 0.8%; DK: 0.4%, $p<0.01$) but not in the HE groups. HC patients had higher reduction in CPI than the HE group ($p<0.01$). Principal component analysis showed that, HbA1c, CPI and "behaviour change" compose one cluster in the HC_{TR} and HE_{TR} groups. Three clusters were formed for the $HC_{DK;}$ respectively HbA1c and CPI, Lean Mass and Body Fat Percentage, "behavior change".

Conclusions: Results indicate that HC has a greater impact on DM management and health outcomes. There is a need for common health promotion strategies with behavioral interventions such as HC for DM2 management that focus on multidisciplinary approaches including oral health.

Introduction

Nearly 400 million people have diabetes globally, and that prevalence will be 600 million by 2035[1]. Moreover 90% of adults living with diabetes have diabetes type 2 (DM2)[2], associated with more unhealthy lifestyles. Diabetes is expected to be the 7th leading cause of death in 2030 [2].

A recent meta-analysis showed that periodontal diseases (PDs) may influence poor metabolic control and its complications[3]. This work amongst others suggests that there is bidirectional association between DM2 and PD; DM2 increases the risk for and severity of PD[4], individuals that have been diagnosed with PD are more likely to have DM2 and/or poor glycemic control[5-7]. Additionally longitudinal observational studies report that severe periodontitis has a significant adverse effect on risk for poor glycaemic control[8,9]. DM2 and PDs share common pathophysiological mechanisms[10-12] that are influenced by lifestyle behaviors such as poor diet, tobacco use and lack of exercise[13,14]. International health organizations such as WHO and International Diabetes Federation emphasise that oral health promotion focusing on behavioural interventions should be integrated in diabetes management programmes. However, integration of oral health information with health behavior interventions has been slow to develop.

Self-management seems to be the cornerstone to improving health outcomes for those living with

DM2 and PDs.[15] However, the evidence suggests that many people with DM2 find it problematic to maintain healthy lifestyles, despite putting themselves at greater risk of disease sequela associated with DM2 and PD[15, 16]. While tailored behavioural interventions are known to have a significant and positive effect upon people's health behaviour[17], exploration and activation of patient-internal resources are keys to adherence to healthy lifestyles and successful management of systemic diseases such as DM2[18]. Training people to strengthen emotional and cognitive capabilities is known to improve health learning capacity[19]. Therefore, there is a need to use an intervention for patients with DM2 which is tailored to their psychosocial characteristics and permits the self-identification of personal resources to enable them to adopt positive self-care practices. One such approach is health coaching (HC) [20]. HC, in this regard, is a new concept for medical practices and includes such practices as collaboration with clients to support thought inspiring self-exploratory journey which facilitates self-management[20, 21].

The objective of the current study was to assess the effectiveness of HC compared to a HE intervention on management of glycemic control and periodontal health, by use of clinical and subjective outcomes among DM2 patients in Turkey and Denmark.

Methods

This project's first phase was finalised in Turkey in 2012 and then the second phase in Denmark between 2012 and 2014. The study includes DM2 adults between age 39 and 79, living in Istanbul, Turkey (n=186), visiting a medical clinic for regular DM2 healthcare, and adults living in Denmark (n=116), visiting dental clinics of the University of Copenhagen, Denmark (*Figure1*).

The eligibility criteria for all participants were: 1. having a clinical diagnosis of DM2, 2. aged 30-70, 3. having at least 4 functional teeth. Patients with severe somatic/mental illness, who were hospitalized, with severe kidney or cardiovascular disease or incurable cancer, were excluded. Those living outside Istanbul or Copenhagen were excluded.

The study has been conducted in full accordance with the World Medical Association Declaration of Helsinki. The Ministry of Health (Turkey) and Regional Ethical Committee (Copenhagen, Denmark) granted the ethical approval and written permission to conduct the study.

The outpatient clinics of two hospitals (Istanbul, Turkey) were used to randomly select the participants with DM2. Sample size calculation and methodology were explained in detail in an earlier publication, 2014[22-24]. Danish participants were recruited from the electronic health records of the School of Dentistry in May, 2012. This research was approved by the Internal Review Board of University of Copenhagen. The sample size calculation was built on the expected difference between pre- and post-coaching HbA1c level (glycated hemoglobin, measured primarily to identify the three-month average plasma glucose concentration), according to our previous study in Turkey[22,23]. With a power of 0.9, $\alpha = 0.05$ and an expected difference in HbA1c of 0.67 % after 6 months, with a SD = 1.2 and a 95% confidence interval, the number of participants can be calculated to 72 (paired *t*- test). With an expected drop-out rate of maximum 25%, a total of 116 participants were recruited. G*power was used to calculate the power and sample size [effect

size, w00.5–0.7, α err prob. 00.05, power (1−β err prob.) 0.95][25].

One researcher was hired for the pre-selection process so that the remaining researchers were blind to the selection process. Eligible patients, based on the screening, received an informative letter about the study, and a pre-paid return envelope including an expression of interest form. Patients not returning the form within two weeks were called to ask about their will/interest to participate to the study. Those returning the forms were invited to the clinics and they were asked to bring their signed informed consent form, self-assessed questionnaires and the latest medical records (HbA1c, LDL, HDL, fasting blood glucose) from the hospital registries. The data was anonymised and de-identified prior to analysis.

For the selection of Danish participants stratified random sampling was used to prevent the imbalance between HC and HE groups for gender and ethnicity which could influence the prognosis or intervention responsiveness, in agreement with Cavender *et a*l.[27], and literature reviews[28, 29]. The present study was based on fully informed consent for the patients, accordingly with the Copenhagen Regional Ethical Committee rules, all participants were fully informed about the intervention groups including their contents. Most of the participants consented to their randomly allocated study groups (HC/HE). However, 43 male patients (23 non-Danish and 20 Danish) strongly preferred to be in the HE group, stating certain barriers to participating in the HC group (work schedule, time, will, no need, etc.). Therefore, a partially randomized patient preference trial (PRPP) design was used, in line with the study of Cooper and his colleagues[30] and Henshaw et al[31]. As discussed in our earlier study[24], this kind of experimental design is preferred when the blinding of the interventions is difficult or impossible and some of the potential participants prefer one or the other of interventions[29, 32]. King *et al*. (2005) suggested in their systematic literature review, when participants declare strong preferences against one particular intervention arm in Randomized Controlled Trials, PRPP design could be used to prevent any bias by reducing or removing preference/motivation effect when evaluating motivation-based studies[33]. In the present study, after the participants were randomized by gender and ethnicity, females were randomly allocated to the HC and the HE groups. Therefore coaching group was a randomised group whereas education group was partially randomized patient preference design group composed of males with strong preference for HE and females with no strong preference for either HE or HC.

Of 186 Turkish and 116 Danish invited participants, respectively 96% (*n*=179) and 94%n=109 consented to participate in the study. At the baseline, the attendance rate at clinical oral examinations was 100% and 90%, respectively among the Turkish (*n*=179) and Danish patients (*n*=98). At post-intervention, 178 Turkish and 104 Danish participants continued the study by returning questionnaires and/or attending clinical examinations. The attendance at the final oral examinations was 178 for the Turkish participants and 98 for the Danish. From baseline to post-intervention, the dropout rates were 1 and 5, respectively for the Turkish and Danish study groups.

INTERVENTION

The two stages of the study (6-months initiation-maintenance phase, then 6 months follow-up), described in detail earlier[22-24], were as follows:

1. Initiation-maintenance Phase

Health Coaching (HC Intervention): The HC approach (*Table 1*) in the present study is a dynamic and collaborative process between coach and the patient to maintain and adopt healthy-lifestyles supported by empowerment of capacity building skills (self-efficacy, diabetes coping skills)[20-24]. HC sessions, conducted by a professional health coach (AB Cinar) in both countries, focused on motivating and supporting the patients for maintenance and improvement of lifestyles with the intent of at least a 0.4-0.8% reduction in HbA1c ($p < 0.05$) in line with the earlier studies[15,34].

The HC approach in the present study originally stems from the internationally accredited coaching framework (International Coaching Community). It uses a blend of specific psychological techniques and some theories including Motivational Interviewing[35], Neurolinguistic Programming[36] and Self-Efficacy Theory[37].

Patients in the HC group received 3-4 face-to-face sessions and 2-3 telephone calls. The timeframe for face-to-face HC sessions ranged between 20–60 minutes, accordingly with the patient's needs, challenges, and progress.

Educational materials (a physical exercise DVD and chi-balls, cooking books for DM2 patients, oral hygiene brochures based on patient motivation principles) were distributed to support the adoption of new positive health behaviour. Personal log-books to screen improvement at achieving personal health goals along with colourful activity charts were given to each patient. At every session, patients were provided with written feedback on progress. Pictorial messages and coaching games were used to prevent any possible attrition.

Health Education (HE) Intervention: HE sessions (Table 4) were conducted by a dental health professional. Participants in the HE group received standard lifestyle advice after baseline examination and were invited for two more face-to-face and 1-2 telephone sessions during the initiation-maintenance period. The timeframe for face-to-face HE sessions ranged between 20–60 minutes, accordingly with the patient's needs, challenges, and progress. The lifestyle advice included the oral hygiene and diabetes management (blood-glucose monitoring, dietary regimes, regular physical exercise, non-smoking, twice daily tooth-brushing). In addition, HE sessions were on phone for 5-8 minutes. Telephone-advice was supported by the educational brochures. HE sessions were explained in detail earlier[22-24].

A "thank you" letter and a brief summary following each assessment were provided to all participants in the HE group in order to minimise attrition over the 12-month study duration.

Participants also received standard, diabetes self-management- and oral health- related education brochures during baseline, 6- and 12-months.

2. Follow-up Phase

The HC and HE group participants received 1-2 face-to-face sessions to screen closely maintenance and improvement of their transformation for positive lifestyles.

Motivational Incentives for all Participants:

Oral health promotion tools such as toothbrushes and toothpastes as motivational incentives were given to all patients during both initiation-maintenance and follow-up phases. Dental scaling (cleanings) were provided at no cost to the participants during initiation-maintenance phase, and certificates of attendance at the cessation of the study were used as other motivational tools. Periodontal cleaning was standard for every participant; thus did not vary according to baseline examination.

Outcome Variables

Clinical Variables

The present data were taken from the routinely collected data [clinical measures and the medical records at baseline and after follow-up (12 months from baseline)]. The latest medical records at the hospitals were used to gather data on HbA1c (3-months average blood glucose level). For further analysis, participants with HbA1c≥8% was recorded as poor glycaemic control and those HbA1c<8% as good glycaemic control, based on the International Diabetes Federation guidelines[23,38].

Participants were invited for periodontal clinical examination [Community Periodontal Need Index (CPI)] and record of anthropometric measures.

Two calibrated clinicians in Turkey (Intraclass and interclass κ value was 0.80 on average, as explained earlier[22]) and one dental hygienist in Denmark[22,24], performed the periodontal examination. CPI was used to monitor the alterations of the periodontal treatment needs over the intervention period. WHO guidelines were followed for the measurement[39, 40]: The index teeth in six sextants (17, 16, 11, 26, 27, 47, 46, 31, 36, 37) were probed; the highest score for each sextant was recorded. If no index teeth/tooth were present in a sextant qualifying for examination, at least two non-index remaining teeth in that sextant were examined and the highest score was recorded. Categorization for CPI was as follows: CPI=0: “healthy gums”, CPI=1: “gingival bleeding on probing but no calculus“; or CPI= 2: “calculus and bleeding”, CPI=3: shallow periodontal pockets (4- 5 millimetres), CPI= 4: “deep periodontal pockets (6 millimetres or more)“, exactly like described by WHO guidelines[39, 40]. For further analysis the mean of maximum score was taken.

Anthropometric measures: Tanita TBF-300-A which utilizes foot-to-foot Bio-Electrical Impedance Analysis to measure the body composition, was used for on-site measurement of Body Mass Index (BMI) and Fat Mass Percentage% (BFP). Lean Mass was calculated by subtracting weight from fat mass.

Behavioural Variables

-*Self-reported ToothBrushing frequency (TBF)* and physical activity were taken from our earlier study[41]. *TBF* was asked as follows: "How often do you brush teeth?" *TBF* recorded on a 5-point Likert Scale ("never=0, once a week or less=1, 2-5 times/week=2, once daily=3, twice or more daily=4"), was re-classified into "once a day or less" and "at least two times a day.

-*Self-reported Physical Activity (PA)* was asked by the question "Please select the activity that fits you best"[41]. There were four options: "1. read, watch TV or other things in a sitting position; 2. walking, active house work at least four hours per week; 3. jogging, running and other kind of running exercises or working hard in a garden 2-3 hours per week; 4. tough training, competition sport more than once a week." For further analysis, dichotomization was used: the last three categories were categorized as "physically active" because the responses to the last two categories were low.

-Behavioural change referring to change at PA and TBF from baseline to post-intervention was coded at four categories:

Code 1: One behaviour reported- negative or no change

Code 2: Both Behaviours reported- negative or no change at both

Code 3: Either one behaviour reported- positive change- or both behaviours reported- one with positive change-

Code 4: Both Behaviours reported- positive change at both

Those who reported 2-3 times daily tooth-brushing both at baseline and post-intervention were coded as either 3 or 4 depending on the change at physical activity. As code 1 was reported only at 5%, "behavioural change" variable was dichotomized as code 1= negative or no change (including code 1 and 2), and code 2= positive change at least at one behaviour (referring to code 3 and 4).

Data Analysis

SPSS (V 17 Chicago Illinois), was used for statistical analyses. Spearman rank correlation and Independent sample *t*-test were, respectively, used to assess the correlation and baseline similarities/differences between HC and HE groups. Paired-sample *t*-tests were utilized for normally distributed data to analyse the change over time for each group alone.

Factor analysis can be used to hypothesize an underlying construct by the principal component analysis (PCA) approach. PCA approach is used to find several combinations of variables that are called components/ clusters, which adequately explain the overall observed variation, thereby reducing the complexity of the data, as described earlier[41]. Factor analysis, in the present study, was applied to the variables by use of PCA and Varimax rotation to analyse not the associations but the interrelationships between HbA1c, periodontal treatment need (CPI), behaviour change and anthropometric measures, thereby to show that these variables share common background factors and underlying dimensions. These variables were allocated to discriminative clusters based on factorial loadings, ranging from highest to lowest values. The loadings equal to or below 0.30

were extracted for ease of communication. The clusters are named according to the variable with the highest loading. Factors were extracted according to meeting the Kaiser criterion of eigenvalue greater than 1. This analysis is used in our earlier studies[24,41] and also extensively in the literature to analyse the interrelationships and common underlying dimensions of health and related behaviours[42-44].

As the Danish coaching and education groups were disproportionately represented, the sampling weighting technique was used to represent the groups equally, in line with the earlier studies and literature[45,46].The proportion of "total sample size: education/coaching sample size" was calculated and 2:3 weighting for the "education: coaching" groups were used. The sampling weighting is commonly used when the stratified random sampling is used[45,46]. For all tests, statistical significance was set at 0.05.

Results

Baseline:

There was no statistical difference between the HC and HE groups in both Turkish and Danish study groups regarding the socio-economic background and clinical parameters (*Table 2*). Majority of the Turkish HC and HE participants reported good control of HbA1c (70% vs. 63%, p≥0.05). It was similar for the DK groups (HC: 75% vs. HE: 80%, p≥0.05).

Turkish Results:

Majority of the Turkish participants reported poor tooth-brushing habits (less than twice daily: HC: 68%, HE: 78%), (p≥0.05). Both the HC and HE groups were physically inactive to a moderate extend (HC: 41% vs. HE: 44%, p≥0.05).

Danish Results:

Among the Danish participants, the percentage of poor tooth-brushing habits were low (HC: 35%, HE: 33%, p≥0.05). Both HC and HE groups reported moderate levels of physical activity (43% vs.47%, p≥0.05).

Post-intervention:

Turkish Results:

In the HC group, HbA1c (0.8%) and periodontal treatment needs (CPI) significantly decreased compared to the HE group (*Table 3*), (p<0.05). The prevalence of good HbA1c control among the HC participants (85%) compared to the HE participants (62%) was significantly higher (p=0.003). Sixty percentage of the HC participants who had poor HbA1c control at baseline were at good control at post- intervention whereas that was 29% for the HE_{TR} group (p=0.001). BMI, LM and BFP in the HC group did not significantly change (p≥0.05). No significant change was observed at BMI also among HE group but there was a dramatic change at LM (mean change:-2.98, SD: ±7.7, p=0.004) and BFP (mean change: 3.11, SD: ±8.4, p=0.003).

The HC group compared to the HE group reported significantly higher rate of "positive change at least at one behaviour" (85% vs. 60%, p=0.001). Eighty one percentage of HC participants

positively changed their tooth-brushing behaviour whereas 53% of the HE reported positive change at tooth-brushing behaviour (p=0.001). Similar improvement observed for the physical activity (HC: 40% vs. HE: 15%, p=0.001). All HC patients who reported brushing 'twice daily' were more likely to be physically active (91%) than 'once a day or less' toothbrushes (69%), (p<0.05).

PCA showed that HbA1c, CPI and "behaviour change" share a common cluster both in the Turkish HC and the HE groups (*Table 4*).

Danish Results:

In the HC group, HbA1c and CPI, as observed in the Turkish group, were also significantly improved compared to the HE group (*Table 3*), (p<0.05). No significant change was observed at the other clinical parameters (BMI, LM and BFP) in both the HC and the HE group participants (p≥0.05).

No significant difference for "positive change at least at one behaviour" was reported between the HC and HE participants (p≥0.05). Specifically, the HC group participants reporting physical inactivity at baseline were more likely to be active (54%) at post intervention compared to those in the HE group (44%), (p=0.042). Likewise the Turkish HC group, all HC patients who reported brushing 'twice daily' were more likely to be physically active (87%) than 'once a day or less' toothbrushes (67%), (p<0.05). Three clusters were formed for the Danish HC group; respectively HbA1c and CPI, LM and BFP, "behavior change" (*Table 4*).

Discussion

The current study evaluates the impact of an individualized HC intervention compared with an HE approach internationally, by integrating patient self-empowerment to adopt healthier lifestyles among the DM2 patients. Significant improvements were observed in HbA1c and periodontal health (CPI) both in Turkey and Denmark. Positive behavioural change was observed in both the HC groups.

HbA1c can be defined as an objective measure for lifestyle behaviour change. Regular monitoring of HbA1c values which is measured at clinical settings is now the principal way to measure and track long-term glycaemic control objectively in diabetes[47]. Knowledge, attitude, and motivation are most important for patients' ability to make behavioral changes to maintain or reduce HbA1c levels[47]. In the present study, the HC groups compared with the HE groups significantly enhanced their lifestyles in line with the significantly higher improvement in HbA1c.

The findings showed that the variable "behaviour change" shared the same cluster with HbA1c and CPI in the Turkish groups; that may suggest that the synergistic interaction between health, oral health and their related behaviours. The HC group compared to the HE group reported significantly higher rate of "positive change at least at one behaviour" and improvement at HbA1c and CPI. All that may be explained as positive health transformation in the HC group by increased self- awareness and empowered self-management skills via HC that could improve health holistically. It is noteworthy that HbA1c and CPI shared the same cluster also in the Danish HC group. Regarding the similar findings in the Turkish HC group, this could

be explained as HC used in the present study enabled the participants to see the whole picture of healthy lifestyle, namely interlink connection between health, oral health and their related behaviours. This may also be an explanation for the higher reduction in periodontal treatment need (CPI) among HC patients in comparison to the HE group; the intervention among the HC participants seems to be more effective in stabilizing the long-term effect of the periodontal cleaning. The HC group participants were motivated and supported to explore and to activate their potential to attain multiple healthy behaviors in their self-management routines, and thus may lead to improvement in periodontal health and glycemic control; that is in line with the earlier studies that showed that taking part in an intervention focusing on empowerment for diabetes self-management had a positive and sustainable impact on management of health behaviours and glycemic control[48,49].

Studies have shown that the coaching groups compared to the control groups significantly reduced the body-weight and fat and coronary heart disease factors including BMI[50, 51]. In line with these studies, the Turkish HC group significantly reduced body fat percentage and improved lean mass. This may be due to that patient empowerment takes precedence and patient explores his/her strengths to adjust healthy lifestyles during coaching sessions. Significant improvement at physical activity and tooth-brushing can enable the improvement at body composition. Our earlier study has shown that tooth-brushing could be a trigger to enhance physical activity, that patients could found it easier to adjust and shorter to see the positive health outcomes such as non-bleeding gums or nice mouth odour[41]. Successful outcome of one behaviour can increase self-confidence which may lead to adjustment of other health behaviours such as physical activity. In the present study, at post-intervention all HC patients who were 'twice daily' toothbrushers, reported physically activity at a higher rate than 'once a day or less' toothbrushes ($p<0.05$). This in line with the studies showing that an individual adopts health behaviours, inclusive of oral health, as separate clusters, either as health-enhancing or health detrimental[42-44].

One of the limitations of the present study is the heterogeneity in the socioeconomic characteristics of the Danish group. HC could work via different pathways and outcomes may differ between different ethnic groups due to cultural and social norms. That may be one explanation for no significant change at body composition and also different pathways of correlation between body composition, health and health behaviours in the Danish groups as all participants were analyzed as one group -Danish- regardless of their ethnical background. However the scope of the present paper was to assess the impact of HC in comparison to HE by use of clinical and subjective variables at an international level, regardless of ethnic or cultural differences. Furthermore, the respective studies in the field are scarce, and to our knowledge there has been neither any international studies assessing HC as an intervention nor any studies exploring the impact of HC compared to HE by clinical and subjective measures. Further studies are required in the field so that HC could be a complementary approach in the clinics to support the clinical interventions for oral health and diabetes management.

Another limitation is that the interaction between HbA1c and CPI has not been assessed further, it may be due to biological and/or behavioural factors. Studies measuring the two-way relationship between periodontal health on HbA1c, and the impact of behavioural interventions on HbA1c and periodontal health, mostly refer to small sample sizes, as discussed earlier[22]. The objective of the current study was to evaluate internationally the impact of a specifically-designed HC intervention on diabetes- and oral health management for participants with DM2. Furthermore, periodontal cleaning can be assessed as a confounding factor; that was a standard for all participants. The rationale for periodontal cleaning is that the cleaning provided a baseline for all participants to evaluate the impact of HC versus HE at stabilizing the long-term effect of the periodontal cleaning in the long-run[22]. Additionally, periodontal cleaning sessions were aimed to be used as an incentive to facilitate patients' understanding what periodontal disease is and how it is interrelated with DM2. This was done by explaining the outcomes of the periodontal examination leading to a standardized knowledge about periodontal disease and DM2, and to an extrinsic motivation so that that It may also seem that the HC patients were encouraged to greater use of dental services. The HC patients were the decision makers to choose which health behaviours they want to work, so the HC patients were neither imposed nor specifically motivated for any particular health behaviour such as use of health care services.

The self-reported measures in the present study can be seen as a limitation, prone to respondent bias. Assessment of the prevalence of health behaviours as part of research is vitally important and that often requires the use of self-report measures. There is an inherent error risk of self-reported measures, however if this error were constant over time, it could still be used as a good comparison criteria among epidemiological studies[16,51]. The present study that could have minimized this limitation; self-reported measures were measured over time and also analysed along with clinical measures. The improvement of both behaviours and relevant clinical measures over time may also minimize the bias.

The fact that data came from two socio-culturally very different settings can be assessed both as a limitation and strength of the study. Individualist cultures such as the Danish cherish individualistic values such as self-reliance, self-autonomy, and self-achievement[52,53] whereas, in the collectivist cultures such as the Turkish, as the opposite of the individualistic, people from birth are integrated into strong and cohesive groups; throughout people's lifetimes they continue to protect them in exchange for unquestioning loyalty[53,]. Coaching focuses on improving all individualistic values which the Turkish HC participants were unfamiliar with, whereas the Danish participants had grown up with. Significant improvement at HbA1c, periodontal health and health behaviors in both the Turkish and the Danish HC groups can underlie that the coaching works effectively with the values of individual, regardless of cultural differences; thereby most probably having a positive impact on self-management of health. However, there is need for further studies to explore the cultural-generalizability of coaching.

The present study, as discussed earlier[22], has strength such as the long follow-up, a structured

and accredited HC framework, specifically trained health coach, multidisciplinary approach and international implementation.

There is a common global consensus on certain factors contributing to successful DM2 management and prevention of further DM2 complications. HC can be an effective approach to achieve these factors under one umbrella. First, primary health-care systems should be inclusive of patient-centred interventions focusing on not only clinical outcomes but also positive lifestyle changes, in order to achieve the long-term positive and sustainable changes at earlier stages before there is a need for costly treatments. Secondly, patients need to be actively engaged in the decision making and they need to feel motivated and responsible to participate in their own health-care. Doing so will lead to the requirement for support by the health professional. Health professionals, thus, who need to improve their competencies and skills about “how” to motivate and encourage the patients to take the lead and active participation in the maintenance and improvement of their health. ”How” can be implied in facilitating the patients to explore and unlock the internal self-resources and then engaging in action and positive lifestyle changes to adopt and maintain health. HC is a person centred approach focusing on facilitating patient engagement and activation towards the self-identified health goals by enabling and supporting the person to explore and use own resources actively in daily life.

In HC, patients are the experts and primary sources for development of personal strategies relevant to oral health- and diabetes-related behaviour and lifestyle changes. That differs substantially from traditional oral health- and diabetes education that the dentist/ physician is the expert who provides usually standardized information for all patients (Table 4). The coach always makes a request before offering advice/information, reflecting and empowering the idea that the patient is in control and also facilitating the patient’s resourcefulness to make decisions and to learn. Moreover, the transfer of knowledge is designed specifically for the patient’s goals; that must be in accordance with the patient’s needs, expectations and daily life. It may be summarized as HC is a personalized, future oriented, self-exploring journey in which patient is guided and motivated by the coach. HE is usually about giving standardized health advice based on external motivation with the patient passively participating. All thus could explain how HC can be more effective than HE.

Dentists and diabetes professionals undergo an extensive training to learn and to practice “what is best” for their patients, however this traditional training mostly focuses on “how” to achieve the “best” in respect to the medical perspective, usually missing the other leg, namely the perspective of the patient-collaborative partner in the medical process. HC can be one of the most effective ways to achieve the “how” completely and thereby to achieve positive outcomes at earlier stages of DM2, before the costly expenses arise both for health-care systems and patients (e.g. financial, severe complications).

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Table 1 Comparison of Health Coaching Approach with Health Education Model

HEALTH COACHING APPROACH	HEALTH EDUCATION MODEL
Focuses on	
• positive health maintenance/improvement • client's whole life and well-being • self-identified health goals and action plans	• disease/problem (disease oriented) • condition-specific factual information about the • specific health condition or health behavior
The agenda is given	
• the client and not by the coach: Client is the expert for his/her own health	• the medical professional: Health professional/educator is the expert for client's
Theme	
• Flexible and the theme can be modified by the coach by using specific framework such as open questions, summaries and reflections	• Mostly standardized for all clients suffering from a specific disease, decided by the health care professional
Motivation and Goals	
• Intrinsic motivation • Addresses internal resources) • Facilitates client engagement and activation towards the self-identified health goals • Coaches elicit ideas and resourcefulness from clients, encouraging them to improve their health by enabling them to see the life from today to future is a personal project that they can build up by exploring and using their own resources	• Extrinsic motivation • Goals/targets are presented by the health professional • Standardized pre-described regimes to improve health for all clients
Communication Pathways and Concepts	
• Asked • Guided • Challenging, determined, ambitious • Doing with, listening • Proactive; focusing on improve positive health from today to the future • Client centred • Informed choice	• Told • Informed • Good client vs. non-compliant • Doing to • Reactive: focusing on how to treat disease/problem • Clinician centred • Options presented

Table 2 Socio-economic and clinical parameters among Turkish and Danish participants at baseline

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Table 3 Change at HbA1c (%) and CPI among Turkish and Danish participants, specified by Health Coaching and Health Education Groups

	Health Coaching Group				Health Education Group				
	Baseline	**Post-intervention**	**Mean change**	**p**	**Baseline**	**Post-intervention**	**Mean change**	**p**	**p** (HC-HE post intervention)
TURKISH									
HbA1c (%)	7.5	6.7	**0.8**	**0.001**	7.8	7.7	**0.01**	NS	**0.001**
CPI	2.3±0.9	0.6±0.9	1.7	0.001	2.4±1.2	1.9±1.5	0.5	0.001	**0.001**
Twice daily toothbrushing (%)	32	70	-	**0.001**	22	25	-	NS	**0.001**
DANISH									
HbA1c (%)	7.4	7.0	**0.44**	**0.001**	7,4	7,4	**0.0**	NS	**0.012**
CPI	2.9±0.6	1.7±0.9	1.2	0.001	2.9±0.7	2.3±1.1	0.6	0.001	0.004
Twice daily toothbrushing (%)	65	71	-	NS	67	72	-	NS	NS

There was statistically no significant difference between HC and HE groups at baseline in terms of HbA1c and CPI

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Table 4 Factor analysis using Varimax rotated solution to assess interrelated clusters of HbA1c at post-intervention, considering the oral health and behavioral factors among Turkish and Danish participants with type 2 diabetes.†

	CLUSTER	
TURKISH HEALTH COACHING GROUP	**Health**	**Body Composition**
HbA1c	.717	.458
CPI	.829	*
Body fat percentage	*	.835
Lean Mass	*	-,831
Behaviour change	-.333	*

The clusters in the study group, in total, accounted for 58.4% of the total variance (composed of component 1 with 32.1% and component 2 with 26.3%).

	CLUSTER	
TURKISH HEALTH EDUCATION GROUP	**Health**	**Body Composition**
HbA1c	,830	*
CPI	.754	*
Body fat percentage	*	.850
Lean Mass	*	-.870
Behaviour change	-.525	*

The clusters in the study group, in total, accounted for 62.1% of the total variance (composed of component 1 with 31.3% and component 2 with 30.8%)

	CLUSTER		
DANISH HEALTH COACHING GROUP	**Health**	**Health Behaviour**	**Body Composition**
HbA1c	.863	*	*
CPI	.811	*	*
Body fat percentage	*	*	.975
Lean Mass	*	.835	*
Behaviour change	*	.847	*

The clusters in the study group, in total, accounted for 78.7% of the total variance (composed of component 1 with 28.2% and component 2 with 29.5%, component 3 with 20.9%).

	CLUSTER		
DANISH HEALTH EDUCATION GROUP	**Health**	**Health Behaviour**	**Body Composition**
HbA1c	**.927**	*	*
CPI	*	**.710**	*
Body fat percentage	.400	*	**.649**
Lean Mass	*	*	**-.786**
Behaviour change	*	**-.762**	*

The clusters in the study group, in total, accounted for 72.0% of the total variance (composed of component 1 with 22.2% and component 2 with 27.9%, component 3 with 21.9%)

†*The clusters are named based on the variable with the highest loading. Loadings below .30 were not shown for ease of communication.*

As BMI was highly correlated with body fat percentage (r_s=.869), it was not included in the analysis

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