



Sustainable nutritional behavior change (SNBC) model: How personal nutritional decisions bring about sustainable change in nutritional behavior

Shoma Berkemeyer^{a,*}, Johanna Wehrmann^{a,b}

^a Osnabrueck University of Applied Sciences, Faculty of Agricultural Sciences and Landscape, Am Krümpel 31, 49090, Osnabrueck, Germany

^b Fachhochschule Muenster, Department of Food Nutrition Facilities, Corrensstrasse 25, 48149, Muenster, Germany

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ABSTRACT

Background: The aim of this qualitative study was to identify a practice level model that could explain a sustained change in nutritional behavior.

Methods: The study used three data inputs from four interviewees, one merged input from a married couple, as narrative interviews. The interviews were analyzed using grounded theory.

Results: Coexistence of a certain suffering and a triggering episode lead to the decision to change nutritional life-style by all interviewed. Maintenance of the self-determined newly learned nutritional behavior was supported by subject-related intrinsic motivation, the ability to reflect, and a low expectation of success from the behavioral change. Environment-related factors were identified as support from life-partner and peers. Subjects reported that the sustained nutritional behavior change impacted their holistic health through subject-perceived improved life quality, increase in the number of social contacts, and a change in personal attitudes and perception. The analysis remains limited, and at best hypothesis generating, in that only three data inputs from four interviewees were used.

Conclusion: In this hypothesis-generating narrative interview study of four study subjects, volition, personal decision making, and long-term motivation (though not external determination) seemed to sustain a change in newly learned nutritional behavior.

1. Introduction

Epidemiological risk factor analysis has been the mainstay in research to understand diseases of civilization [1,2]. Recommendations to reduce the disease burden include improving overnutrition, undernutrition and incorporation of physical activity [1,2]. Genetic studies recommend genetic diagnosis to reduce the burden of the diseases of civilization [3]. Diseases of civilization are typically life-style dependent [3]. Genotype and phenotype determination would contribute to the genetic etiology [3]. Increasingly diet-related epigenetic changes and fetal programming are the additional emerging explanatory factors of diseases [4]. The identification of risk factors of the diseases of civilization [1–4] has though not translated into any appreciable reduction in the burden of the diseases of civilization. WHO reports 71% of the worldwide mortality statistics due to cardiovascular diseases, chronic respiratory disease, cancer and diabetes [5]. WHO attributes that this has bearings not only on health but also on economic and societal domains [6].

Behavioral sciences have postulated that dietary choices in health

behavior were modifiable, both from an individual perspective and within a broader social and political contextual framework [7]. Nutritional environments and socioeconomic characteristics of the individuals and their households were reported as relevant contextual factors, which contributed to differing decisions, views on and the use of local nutritional environments [8]. Supportive environments can promote healthier dietary choices [8]. Strategies used by the food industry to increase food preference and consumption with contextualized value of food, called taste framework, could be used to improve dietary food choices [9].

Conscious and unconscious weighting of accumulated evidence determined peoples' dietary decisions suggesting policy measures and interventions probably require avoiding the dichotomies of "good" and "bad" dietary choices and health behaviors [7]. Instead, focusing on issues that contribute to the weighting of factors that influence dietary decision and behaviors at the time of decision-making and within the choices available could be more useful in practice [9]. The role of environmental changes and their repercussions on individual dietary habits and health behavior could be pertinent. This role though was suggested

* Corresponding author. Osnabrueck University of Applied Sciences, Faculty of Agricultural Sciences and Landscape, Germany.

E-mail address: s.berkemeyer@hs-osnabrueck.de (S. Berkemeyer).

not to label choices made by individuals [7,9] but rather through improving the capability of individuals indirectly by rational weighting of choices [10], towards improving long-term nutritional behavior and choices.

Thus, the aim of this qualitative study was to identify factors, which contribute to sustainable changes in nutritional health behavior, through changes in dietary and life-style decision-making. We, thus, investigated the circumstances, the motives and dietary factors that contributed to a person's decision to change personal dietary behavior and its sustainable maintenance over time. In this way, we aimed to contribute to the understanding of individual dietary behavior change.

2. Methods

We conducted the study between December 2019 and October 2020 at the Applied University of Osnabrueck as a cooperative research study over two affiliated institutions. We reviewed literature to identify existing factors, which influence health behavior. We identified two broad categories: (1) individual and (2) environmental domain behavior [7]. These could be further broken down into elements of (a) social aspects, (b) intrapersonal factors, (c) framework conditions and (d) socio-cultural aspects of behavior. All these elements could function either as obstacles or as motivational, conducive factors for a change in health behavior and its maintenance, with conscious and unconscious effects on dietary choices [7].

After the literature review identification of factors influencing health behavior, we followed it up with the development of a narrative interview guideline. The process of selection of interview subjects was a convenience sampling. We recruited each interviewee actively by word-of-mouth, provided details of the study and obtained informed consents prior to study begin. We conducted three narrative interviews with four subjects, two individual subjects and a married couple, between May and June 2020 (Table 1). For two of the three interviews an additional session of the open-ended narrative interview was conducted. Thus, in total we had five events of narrative interviewing, at each instance for a time-range of 60–120 min. We conducted one interview personally. The remaining interviews were online over Zoom (Zoom Video Communications Inc., 2016), a video-conferencing provider, given Corona virus pandemic contact restrictions.

We did not fix the number of interviewees at the onset of the study but determined them as per theoretical sampling of the grounded theory. This process meant conducting narrative interviews iteratively, i.e. after conducting each interview, we collated and semi-compiled the data with semi-analysis to determine, if an interview with additional input or an additional new subject would be required to augment the data gathered qualitatively. This iterative process of re-evaluation with semi-analysis at each stage facilitated to identify meta-level factors. Data collation entailed documentation of interview text and parsing of information from interviews relating to factors leading to or maintenance of nutritional health behavior. This qualitative analysis thus attempted to gain in-depth information per interview, however, the analysis at best remains hypothesis generating, given only four interviewees with only three data

Table 1
Overview of the selected interview cases^a.

Nr.	Personal details	Motivation for behavioural change	Behavioural change
A	Female, 62 years (y)	Weight reduction, Reduction of health problems	Change of diet, Increase in physical activity
B	Female, 50 y	Weight reduction	Change of diet, Increase in physical activity
C	Married couple: Female, 58 y and Male, 58 y	Health promotion	Change in diet - Raw food diet

^a Three narrative interviews conducted between May and June 2020.

inputs, one merged input from a married couple.

Sustained nutritional behavior was defined in this analysis as a voluntary and individually determined new nutritional behavior (refer Table 1), which was in maintenance by the interviewees for over two years at least. Adherence to the behavior change was elicited in narrative interview questioning of keeping to the change in new nutritional behavior for minimum over the latter two years preceding the interview and in the current phase of living as well.

2.1. Grounded theory

Grounded theory is a style of qualitative-interpretative social research characterized by an open attitude towards new and unexpected findings with resampling for a largely inductive development of a theory or a theoretical construct. For the analysis of the collected data, the three-step coding process of the grounded theory methodology was applied to our data as per the orientation of Strauss and Corbin (1996) [11].

2.2. Open coding, axial coding, selective coding

We used open coding to break down the data into data units, called “concepts”, in order to generate so-called “categories” [12,13]. The interview transcripts were parsed sentence by sentence and analyzed regarding their conceptual content. Results of this open coding were collated in a table with consecutively numbered concepts. We checked these concepts for redundancies. If there were matches on redundancies, we reduced them by combining the two individual concepts into a single concept in a second column of the table of consecutively numbered intermediate concepts. This was followed by abstracting of the concepts into “categories” by bundling of the information in a third column (refer Fig. 1). Literature does not use the terms “codes”, “concepts” and “categories” consistently. In this study, we defined “concepts” as first small-scale analysis of the data content, achieved by data parsing according to the factors identified.

In the next phase of axial coding, the identified categories from open coding were put into relation to each other to process an initial theoretical construct. This initial theoretical construct was iteratively refined using selective coding and relational rearrangements. The aim of selective coding was to uncover the commonalities of the cases under investigation across all the data collected, in our case the three interview cases. The goal was to identify core categories, integrate them into a category network (relational), and thereby formulate a grounded theory [13]. For the final version of the grounded theory, we incorporated a qualitative reliability test and repeated the steps of axial and selective coding. Our study included an internal reliability analysis to test if the factors identified by narrative interviews could be corroborated with study-interview external artefacts.

2.3. Reliability analysis

Table 2 lists the additional data in form of experience reports that we used to test the reliability of the developed categories based on the narrative interviews. In order to generate a wide variety of data concepts, we used different platforms, keywords and types of report. We tested the results of these additional artefacts as open codes, to corroborate the open codes of interviews, arranged and rearranged in the proposed relational aspect, in order to remodel and refine the proposed grounded theory model. (Table 2).

3. Results

Data analysis of narrative interviews offered a range of factors that affected nutritional behavior (refer Table 3). We list them all with referencing from existing literature, which have also identified the factors in context health. Socially conducive aspects included support and encouragement from family, friends or colleagues [14–16], social

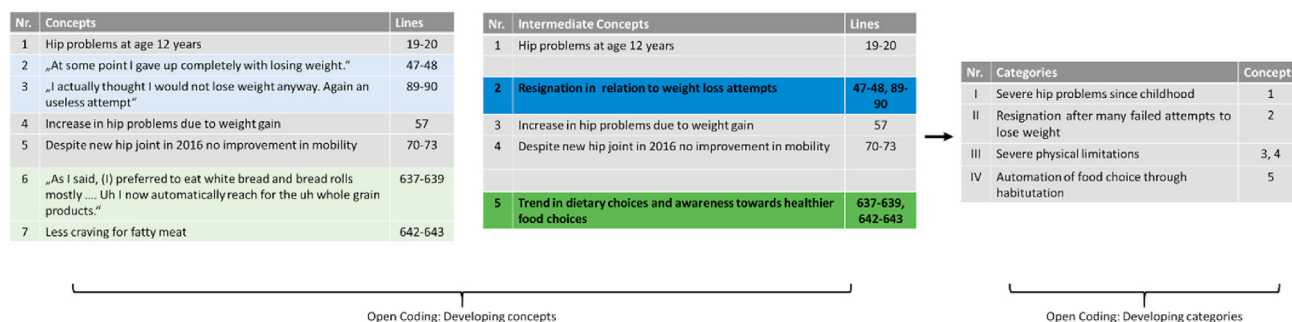


Fig. 1. Illustration of open coding.

Table 2
Overview of the study-interview external artefacts.

Platform	Search keywords	Type of report	Personal details	Link
Google	Change of diet + Raw food + Experience	Blog	Female	https://gruen-roh-bunt.com/3-jahre-mit-rohkost-ein-rueckblick/
Google	Field report + Weight loss	Field report	Male	https://edubil.y.de/tipps/abnehmber-icht-minus-40-kilo/
YouTube	Long term + Weight loss	YouTube Video	Female	https://www.youtube.com/watch?v=f6oRmeE-8kY

inclusion [16,17] (defined as interviewee-assessed feeling of being included and/or being part of the social context of living), and increased physical and/or sexual attractiveness to potential partners [14,17]. The identified social obstacles were unhealthy dietary practices of family and friends or expected consumption of unhealthy foods or alcohol in certain situations [7].

Intrapersonal factors included willpower or the presence of intrinsic motivation as one of the most often mentioned factors for successful behavior change [14,15,18–21]. Other intrapersonal factors included the ability to set goals [20], having a sense of accomplishment [16,20], a desire to improve self-confidence [19], determination, persistence, thought and coping processes, and problem-solving skills [16]. Additionally mentioned factors were the volition to improve in a range of aspects. These were emotional states [15,16], state of health [15,16,18], knowledge and skills [14–16], and general planning, usual activities, and habits [14,15].

Our study identified a range of framework factors, which were also reported in other independent studies. These were the presence and availability of unhealthy foods [14,22], shopping opportunities [15], geographic regions [6], cost and time [14,15]. Framework-based resources were the availability of professional support [16], governmental and nongovernmental food and nutrition programs [6] and the availability of information [15].

A range of sociodemographic factors were identified as well. These were gender [14,15], income [15,19], occupation [23], level of education [19], marital status [19,23], age [15,19] and language and cultural barriers [15]. All these factors were included in development of the grounded theory based sustainable nutritional behavior change (SNBC) model. We grouped and re-related these individual factors at each stage of coding in order to develop a coherent meta-level practice model to understand how a decision to change nutritional behavior came about, how it has been sustained and what impact it brought to daily living.

4. Sustainable nutritional behavior change (SNBC) model

Based on the interview data collected, we developed a model

attempting an explanation of a sustainable health behavior change (Fig. 2). Our model provides a differentiated overview of the personal circumstances, motives and factors that influence a change in dietary and physical activity behavior. The model (Fig. 2) was based on the subjective perspectives of the interview partners and the data reliability testing using study external artefacts.

The health behavior changes identified in the interviews were divided into changes in exercise behavior and changes in dietary behavior. Interview participants A and B had a goal of weight reduction. Both described continuous slow and sustained behavior change. The couple of interview case 3 had the goal to improve their health in general and changed their diet immediately after a three-week experiment. For all subjects, the result was a sustainable change in health habits that the subjects were able to maintain over a long term.

Our model proposes that the decision to change health behavior requires a strong pressure of certain suffering along with a triggering situation. The suffering pressure can be both physical, such as, chronic diseases, overweight, and psychological factors, such as, dissatisfaction, lethargy. All respondents mentioned that the physical suffering and its pressure influenced the psychological factor. The triggering situation was a central moment in which the need for a change in behavior was perceived and the decision to implement the change was volitionally made. In the cases studied these were situations, such as, the conscious perception of being overweight and the associated discomfort or encountering certain new information were identified as triggering situation.

Contextual conditions included context-related aspects that were important for the behavioral change, such as, personal resources, social factors, and biographic experiences. Within personal resources, intrinsic motivation was the uniquely important factor influencing behavioral change. In addition, factors, such as, openness to success achievement, low expectation pressure, and the ability to reflect were important. All interviewees identified these four factors. Additional individually differentiated personal resources were being ambitious, being able to cope with stress, attitude towards nutrition, inquisitiveness, and spiritual belief.

The pertinent social factors were the reaction of the social environment, one's own handling of the reactions to the social environment, and support from the social environment and partnerships as the key factors. Biographical experiences, such as, occupation, family, competitive sports and illnesses, were mentioned which related to the sustainable change in behavior.

The four successful strategies of action towards sustainable nutritional behavior change were the ability to reflect one own's behavior, the ability to use information, an undogmatic approach towards the goal and the establishment of new habits. All these four handling strategies lead to the implementation and maintenance of successful change in nutritional behavior in the long-term.

The consequence of the process of sustainable health behavior change was an increase of the quality of life in general and in various individual aspects of life, an improvement in the self-reported physical and

Table 3
Individual and environmental domains behaviors elicited from interviews.

Domains	References
Social Aspects	
<i>Conducive</i>	
Support and encouragement from family, friends and colleagues	Munt et al., 2016 [14] Kelly et al., 2016 [15] Murray et al., 2013 [16]
Social inclusion ¹	Murray et al., 2013 [16] Ashton et al., 2015 [17]
Increased physical and/or sexual attractiveness to potential partners	Munt et al., 2016 [14] Ashton et al., 2015 [17]
<i>Obstacles</i>	
Unhealthy dietary practices of family and friends	Dover and Lambert, 2016 [7]
Expected consumption of unhealthy foods or alcohol in interpersonal encounters	Dover and Lambert, 2016 [7]
Intrapersonal factors	
<i>Intrinsic motivation</i>	
Intrinsic motivation	Munt et al., 2016 [14] Kelly et al., 2016 [15] Bastin et al., 2018 [18] Holley et al., 2015 [19] Allom and Mullan, 2014 [20] Cluskey and Grobe, 2009 [21]
Ability to set goals	Allom and Mullan, 2014 [20]
Sense of accomplishment	Murray et al., 2013 [16] Allom and Mullan, 2014 [20]
Desire to improve self-confidence	Holley et al., 2015 [19]
Determination, persistence, thought, and coping process	Murray et al., 2013 [16]
Problem solving skills	Murray et al., 2013 [16]
Volition to change – emotional states	Kelly et al., 2016 [15] Murray et al., 2013 [16]
Volition to change - state of health	Kelly et al., 2016 [15] Murray et al., 2013 [16]
Volition to change - knowledge and skills	Bastin et al., 2018 [18] Munt et al., 2016 [14] Kelly et al., 2016 [15] Murray et al., 2013 [16]
Volition to change - general planning, usual activities, and habits	Munt et al., 2016 [14] Kelly et al., 2016 [15]
Framework conditions	
<i>Presence and availability of unhealthy foods</i>	
Presence and availability of unhealthy foods	Munt et al., 2016 [14] Hardcastle et al., 2015 [22]
Shopping opportunities	Kelly et al., 2016 [15]
Geographic regions	WHO, 2018 [6]
Cost and time	Munt et al., 2016 [14] Kelly et al., 2016 [15]
Availability of professional support	Murray et al., 2013 [16]
Government and nongovernmental food and nutrition programs	WHO, 2018 [6]
Availability of relevant information	Kelly et al., 2016 [15]
Sociocultural aspects of behaviors	
<i>Gender</i>	
Gender	Munt et al., 2016 [14] Kelly et al., 2016 [15]
<i>Income</i>	
Income	Kelly et al., 2016 [15] Holley et al., 2015 [19]
<i>Occupation</i>	
Occupation	Welch et al., 2009 [23]
<i>Level of education</i>	
Level of education	Holley et al., 2015 [19]
<i>Marital status</i>	
Marital status	

Table 3 (continued)

Domains	References
Social Aspects	
	Holley et al., 2015 [19] Welch et al., 2009 [23]
Age	Kelly et al., 2016 [15] Holley et al., 2015 [19]
Language and cultural barriers	Kelly et al., 2016 [15]

¹ Social inclusion was defined as interviewee-assessed feeling of being included and/or being part of the social context of living.

psychological health, an increase of social contacts, a change in attitude of the person, and change of perception by the person.

5. Discussion

Our study suggests that within the proposed sustainable nutritional behavior change (SNBC) model, the change occurred slowly and gradually. This slow pace appeared to be noteworthy for maintaining the changed behavior over a longer time. Instead of an immediate radical change, a gradual change of habits with changes effected in small steps seemed to be easier for the participants and led to and fostered the formation of new habits and automatisms. This was usually attributed primarily to intrinsic motivation of the participants with a personal volitional decision for it. Additional factors of successful maintenance of a change in health behavior were the ability to remain open to the success of results, i. e. maintaining a low expectation, along with an undogmatic approach to change in health behavior.

Research data shows that allowing low expectation of results, the feeling of not having to give up options in life, including food consumption options, and the opportunity of latitude in decision-making regarding dietary behavior are important aspects for maintaining the changed behavior [7,24]. Such an approach reduced the fear of change or feeling pressurized due to the change [7,24]. Research also suggests that higher motivation, leading to higher goals of weight reduction, were associated with greater weight loss following higher expectations [25], i.e., setting (early), unrealistic weight loss goals could lead to greater weight loss as well [25]. Corroborating quantitative analyses using directed acyclic graphs or pathway analysis [26] might delineate, if varying individual motivation, and/or individual expectations in setting weight loss targets modulate the success of weight loss per se and, pertinently, weight loss sustained over periods longer than one year. Bays et al. [25] suggested a patient-centered, individualized and multifactorial strategy as probably the key in general practice, where self-determination and self-actualization, i.e., self-ownership, could find support. Thus, an avoidance of dichotomies of “good” and “bad” dietary behavior, i.e., typecasting a normative, idealized behavior from a social and/or environmental context has been reported less beneficial compared to a self-determined healthy behavior that fits an individual [7, 9]. This individual volitional decision-making, instead of external determination, seems critical towards sustained change in nutritional behavior [7,24]. In so far, social and environmental contexts and public policies [8,9] can focus on providing tools that allow individuals to better evaluate and weigh influencing factors.

Our model reported intrinsic motivation as the key factor towards sustained change in nutritional behavior. This stand is supported by various other studies [14,15]. Intrinsic motivation stands out as a significant factor influencing both the change in health behavior and for its long-term maintenance. Possibilities for increasing intrinsic motivation include motivational interviewing [27], and Knecht and Kenning's approach of viewing patients as customers with health as a commodity [28]. Supporting this observation, our study-interviews reported additional individual factors, such as, ability to reflect, ability to use information, undogmatic approach towards the change in behavior, ability to establish a new habit yet though with the leniency of low success

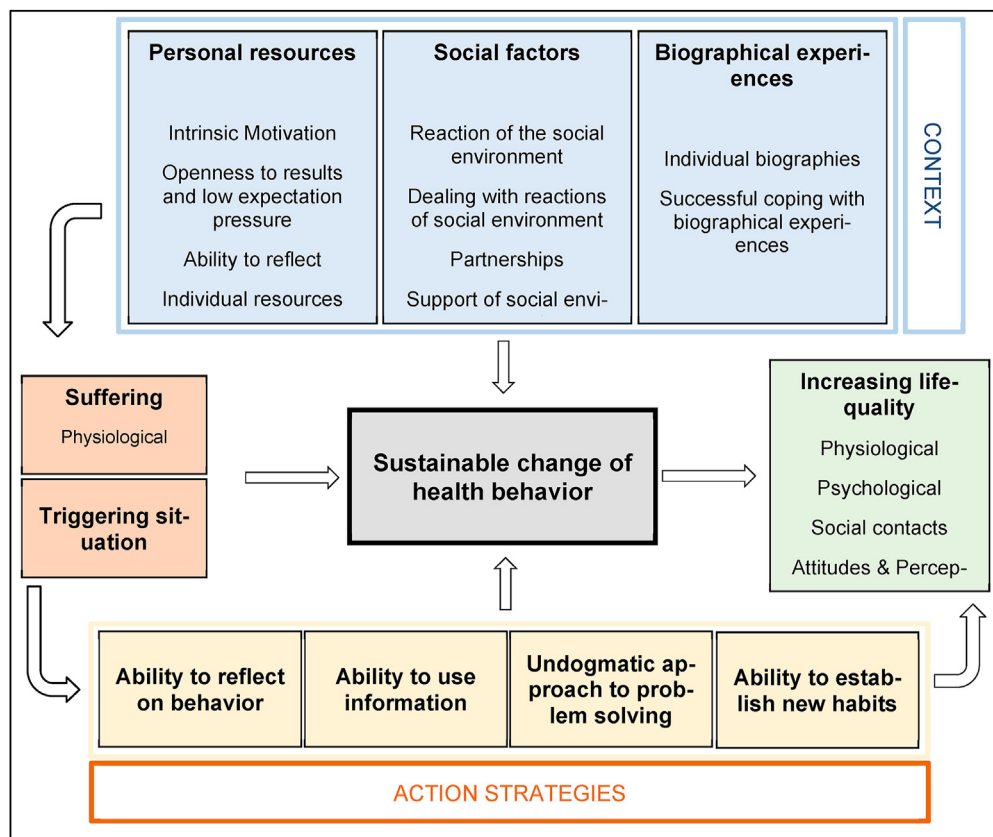


Fig. 2. Model explaining the process of Sustainable Nutritional Behaviour Change (SNBC).

expectation effected long-term, slowly and repetitively the change, which appears as a useful strategy for a sustained dietary behavioral change. In contrast to external determination, it appears that the observed predominance of intrinsic motivation and personal decision-making, as in the SNBC model, might be central in nutritional behaviour change.

Part of the decision-making was also influenced by environmental factors, which is supported by additional studies as well [6,14,15,18–21]. Supportive family, partnerships, environments, i.e. the immediate circle of the individuals, seemed to be important for a sustained dietary behavioral change. Further, our model suggests that the triggering moment desiring a change as well as the ability to use information were probably important means to adjust the decision of a change and maintain the behavioral change. Biographical instances, such as occupation, illness, family along with the personal suffering related to bringing about the volition to want to change.

Grounded theory relates largely to empirical based intermediate theoretical constructs, which are in use in health and social practice [11–13]. Our SNBC model finds some support from the all-encompassing, comprehensive health psychology model, such as, Schwarzer's Health Action Process Approach (HAPA) [29]. While our intermediate practice-based SNBC model does not consider HAPA's predecisional phase, elements of HAPA's postdecisional volition phase, and action phase are somewhat identified in our grounded theory-based SNBC intermediate model. Our theory identifies a certain suffering, which, with a triggering moment as key instance towards the decision of a volitional change in nutritional behavior. Likewise, HAPA's coping, and task efficacy strategies are somewhat reiterated with SNBC's maintenance of low success expectations and improvement in self-efficacy over time, respectively. SNBC also reported reflection on self-efficacy measures, such as, reports on improvement in physical and psychological health, an increase of social contacts, a change in attitude of the person, and change of perception by the person as consequences of change in sustained

nutritional behavior. Thus, our study suggests that intermediate grounded theory-based practice models, such as SNBC, can corroborate generalized models, such as, HAPA. This is supported by other empirical literature [30,31], which as like SNBC, corroborates elements of HAPA to variable extents. SNBC identified individual factors, such as, the ability to reflect, the ability to use information, undogmatic approach, the ability to establish a new habit, all put into practice with the leniency of low success expectation, can be regarded as measures of action self-efficacy and outcome expectancy [31]. Use of HAPA [29] has been reported to allow recovery of self-efficacy [30], which SNBC also identified. Studies have reported on HAPA risk awareness as well [30,31], which SNBC reports marginally and probably indirectly through the instance of a certain suffering combined with a triggering moment, both simultaneously conducive to the volitional decision of change in nutritional behavior.

The possibility of environmental factors, unconscious to the self, can influence personal decision-making. These influencing factors probably include aspects such as transportation, distribution of food, structure and equity in food systems. Our study could not investigate into these aspects and future studies could benefit from inclusion of these aspects, which could also affect dietary behavioral change. We attempted to achieve, within the use of a qualitative study, a higher level of generalizability by selecting different cases with different motivations for dietary and health behavior change, and by subsequently verifying the model through artefacts for reliability check. However, as in all qualitative narrative interview-based analysis, the number of cases analyzed were rather low, i. e. three data inputs, from four interviewees, merged input from a couple living in partnership. Thus, this analysis is at best hypothesis generating. Our study would have benefitted from additional interviews, especially with male subjects, additional age-groups, other motives for dietary behavioral change as well as additional behavioral changes, such as, alcohol consumption and smoking. Finally, our results were based on individual, subjective experiences of mostly female subjects. Our study

strength remains the iterative use of more than one interview to reassess the research question and corroborate data content with external artefacts and the stringent use of the qualitative grounded theory, with iterative note-making, reassessing and reorganizing to complement the body of quantitative epidemiological literature in this research area.

6. Conclusion

SNBC Model indicates that personal decision making triggered by an originally untoward experience might bring about a decision to change nutritional behavior. As per SNBC, achievement and maintaining of the nutritional behavioral change over a longer period is supported by intrinsic motivation, self-determination and self-efficacy, in a supportive, though not externally determining, environment, and with the awareness of the beneficial impacts of the change in behavior. While this analysis remains limited with three data inputs from four interviewees and, thus, hypothesis generating at best, future research remains open to examining the extent to which personal choices relate to and influence health-related choices.

Author contribution

Conceptualization: SB; Methodology: SB, JW; Formal analysis: JW, SB; Writing: JW, SB; Original draft: JW, SB; Writing Review and Editing: SB, JW; Supervision: SB. All contributors reviewed, edited, and approved the final submission and publication.

Declaration of competing interest

The authors declare no conflict of interest and no competing interests were applicable.

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