

Advancing the Theory of Planned Behavior within Dietary and Physical Domains among Type 2 Diabetics: A Mixed Methods Approach

D.O. Omondi, M.K. Walingo, G.M. Mbagaya, and L.O.A. Othuon

Abstract—Many studies have applied the Theory of Planned Behavior (TPB) in predicting health behaviors among unique populations. However, a new paradigm is emerging where focus is now directed to modification and expansion of the TPB model rather than utilization of the traditional theory. This review proposes new models modified from the Theory of Planned Behavior and suggest an appropriate study design that can be used to test the models within physical activity and dietary practice domains among Type 2 diabetics in Kenya. The review was conducted by means of literature search in the field of nutrition behavior, health psychology and mixed methods using predetermined key words. The results identify pre-intention and post intention gaps within the TPB model that need to be filled. Additional psychosocial factors are proposed to be included in the TPB model to generate new models and the efficacy of these models tested using mixed methods design.

Keywords—Physical activity, diet, Type 2 diabetes, behavior change theory, model.

I. INTRODUCTION

TYPE 2 diabetes is a Public Health concern worldwide [1] with 3 million affected in Kenya alone. This figure is composed of those who have had their sugar levels tested hence many Kenyans are still unaware of their status [2]. Introducing proper management strategies that include key lifestyle related factors such as physical activity and dietary practices have promising results in reducing the number of individuals affected and also in preventing those already diagnosed from reaching the severe stages of the condition [3]. Long term effect of the Type 2 diabetes can be controlled through dietary and physical activity management [4] hence the need to identify healthful dietary and physical activity promotion strategies. Although dietary and physical activities have been

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used to manage Type 2 diabetes [3] across the world, there is still an increasing prevalence of the disease worldwide including Kenya. It could be that education efforts are not in the appropriate directions or that these patients receive confusing and contradictory advice from a variety of sources for example, health professionals, media and social contacts. Diabetes education at the hospital level fails to include psychosocial aspects such as attitude, subjective norm, perceived behavioural control, perceived susceptibility, perceived benefit, perceived severity, maintenance self efficacy and cues to action when educating patients. On the contrary the education process adopt fact-based approach where the educator counsels patients based on general facts in the management of the disease without considering patients related factors [5]. Diabetic educators should understand eating and physical activity behaviour from the patient's perspective. Physical activity and dietary behaviors need to incorporate the components alongside physical activity and dietary recommendations.

Theoretically based frameworks lay the foundation upon which important factors affecting eating and physical activity behaviors can be drawn, tested and applied in patients' education. The Theory of Planned Behavior (TPB) [6] has proved to be an effective framework within which patients' perceptions and beliefs regarding dietary and physical activity behaviors could be measured and empirically tested. It has also been used to identify patient related factors that can be positively influenced for appropriate behavior change. This theory is limited to concepts including attitude, subjective norm and perceived behavioral control as key predictors of intention that determine behavior. However, this review proposes new models modified from the Theory of Planned Behavior and study design appropriate to be tested within physical activity and dietary practices among Type 2 diabetics in a Kenyan environment.

II. METHOD

A search was performed on Bio Med Central and Pub Med Central databases using keywords, 'Theory of Planned Behavior'; 'physical activity'; 'dietary practice'; 'Type 2 diabetes' and 'mixed methods design' from the start date of each database to September, 2009. Additional searches were performed in the Google and Google scholar. Citations were also identified from the included papers. Experts were consulted for comments and references from published articles

or book chapters in English, describing any of the key words, were included. Articles were excluded if they failed to satisfy the aforementioned criteria. In this review the terms 'model' and 'theory' are used to mean the same thing and the terms 'variable' and 'construct' are also used interchangeably.

III. RESULTS AND DISCUSSION

The Theory of Planned Behavior [6] forms the basis for developing measurable concepts and variables within physical activity and dietary practice domains. According to this theory health related behavior can be predicted by the intention construct. Intention is influenced by attitude, subjective norm and perceived behavioral control towards the behavior (Fig. 1). Attitudes are considered as beliefs about the outcome of the health related behavior weighed by the value of the outcome. Subjective norm is the belief an individual has that key people in his or her life may influence them to behave in a certain way, weighed by the level of compliance to such an influence. Perceived behavioral control is the belief an individual has that certain factors may facilitate or impede action weighed by the perceived control power he or she has on these factors.

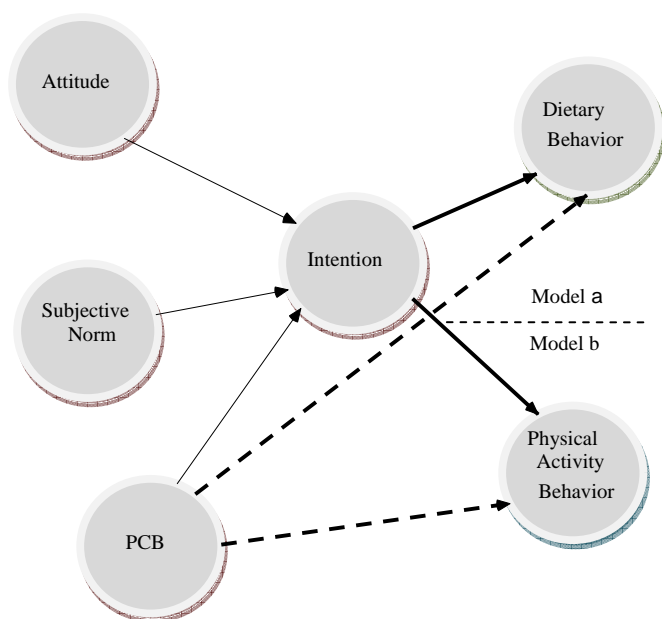


Fig. 1 Theory of Planned Behavior (Adapted from Ajzen, [6])

A. Theory of Planned Behavior Applied to Dietary and Physical Activity Behavior

The Theory of Planned Behavior has been used to predict different kinds of behaviors related to physical exercise and diet. For example, Åström and Okullo [7] validated the usefulness of TPB in predicting intended and self-perceived sugar consumption among adolescents, where major constructs of the theory including attitude and perceived behavioral control predicted intended sugar consumption at Time 1 and Time 2, accounting for 58% ($R^2 = 0.58$) and 19%

($R^2 = 0.19$) respectively. In this study, it appeared that attitude seemed to be a better predictor than perceived behavioral control. In addition, other studies have also reported the efficacy of TPB in predicting health related behavior [8]-[10].

Most studies are now concentrating in the modification and extension of the Theory of Planned Behavior. There appears to be a growing empirical evidence to support addition of variables such as past behavior, self efficacy, moral norms, self-identity, social support and affective beliefs to the TPB [11]. A study that adopted TPB modified to include prior dieting in female undergraduate students in Australia to predict dietary behavior revealed direct attitude as the strongest predictor of intention and prior dieting as a predictor of follow-up attitude [12]. Prior dieting in this case represented the past behavior as additional key component to the TPB. Within this context there are variables that only come in as additional measures to the major constructs of the TPB. For example Ajzen [13] added self-efficacy and controllability items to perceived behavioral control. Self-efficacy is the belief an individual has that he or she can accomplish a specified task, while controllability items are those specific behavior determinants that an individual believe he or she has full control over. Instead of extending or modifying the TPB, Courneya *et al.*, [14] considered replacement of subjective norm with social support based on the results of their study and found social support to be more superior to subjective norm in predicting exercise intention. However, substituting subjective norm with new concepts may not be the best approach toward theoretical advancement since subjective norm is also a better predictor. Including social support as additional moderator to intention could be a step further for the improvement of the model construct.

The suggested attempt is to use the TPB model in understanding dietary and physical activity behavior in addition to the theoretical extension or modification. The approach may be a strong contribution towards the controversy in some situations where certain studies have reported failure of key theoretical constructs to predict behavior. For example, Gardner and Hausenblas [15] noticed a failure of the TPB in predicting exercise adherence, exercise intention and diet intention in a prospective study that targeted women enrolled in a Weight-Loss Program. This study may have reported failure due to the methodological errors caused by participants who dropped out from the study. On the contrary, Blue [16] explored the utility of the TPB in explaining physical activity and healthy eating intentions in persons at risk for diabetes. Major constructs of the theory turned out as good predictors of intention to be active or eat healthy diet. This study concentrated in utilization rather than expansion of the TPB model and suggests that utility of models is also another important area that needs to be explored further.

B. Methodological Advancements: Theoretical Frameworks and Gaps

Psychosocial attributes, particularly the intention construct may have a substantial contribution towards decision-making process among Type 2 diabetes patients within physical activity and dietary practice domains. The decision making process rely on the intention construct from a social cognitive perspective. Intention construct is explained by a number of social cognitive theories as a key factor in predicting behavior [17]-[19]. There is need establish how best factors related to intention can be beefed up and be included in one framework that may be used in behavior change. The Theory of Planned Behavior focuses on the intention as a locus of control [6] and seems to be a powerful model that can allow investigation of additional variables related to intention. This theory has so far drawn attention of most health researchers and is currently being used to study health related behavior.

Despite wide utilization of the Theory of Planned Behavior in studying health behavior, there have been cases when the theory fails to fully explain behavior. Blanchard *et al.*, [20] conducted a study where the Theory of Planned Behavior (TPB) was tested during and after Phase 2 cardiac rehabilitation (CR). Patients completed a TPB questionnaire that included attitudes, subjective norms, perceived behavioral control (PBC), intentions, and previous exercise behavior. Results indicated that attitude, subjective norm, and PBC explained 38% ($R^2=0.38$) of the variance in exercise intention during Phase 2 CR and 51% ($R^2=0.51$) of the variance 6 to 10 weeks after Phase 2 CR. Regression analysis also revealed that intention explained 22 percent of the variance in exercise adherence during and 23 percent after Phase 2 CR. In this study intention construct appeared to be a weaker predictor of exercise behavior after following Ajzen's [6] methodological steps. This may be an indication that a number of factors other than intention may intervene during post-intentional phase to influence behavior on focus as opposed to what the theory postulates. It also demonstrates that post-intentional processes are not yet fully explained and therefore further research on this latter phase of health behavior change is necessary [21], [22]. Some authors suggested the need to include the post-intentional mediators such as action control, action plans and maintenance self-efficacy [23] into the models with intention construct as a locus of control. On the other hand, some

factors may also compete with the intention predictors during the pre-intention phase. In this methodological paradigm, there is need to consider expansion of the TPB model at the pre-intentional (motivational) phase [24]. In this motivational phase attitude, subjective norm and perceived behavioral control are key predictors of intention [6] but it would be appropriate to consider other moderating factors such as perceived susceptibility, perceived severity, perceived benefits, cues to action [25] and knowledge which the model somehow ignored yet could be important in understanding health behavior. Probably an attempt to close the pre-and post intention gaps may improve the value of this theoretical framework.

Limited studies have used the Theory of Planned Behavior in studying health related behaviors in the developing world and particularly in Kenya. Using this theory to understand physical activity and dietary practice among the Type 2 diabetic patients may be a significant contribution made in health behavior research and especially in developing countries. A better approach should go beyond the application of the theory as it is, but in modified versions. Factors that need to be put into consideration during expansion of this theoretical model include knowledge, patients perceptions in relation to susceptibility, severity, benefits and cues to action, action control, action plan and maintenance self-efficacy. All these need to be considered as possible determinants of physical activity and dietary behaviours of Type 2 diabetics. It is on this argument that the review proposes a series of new models with additional concepts into the traditional Theory of Planned Behavior. The first model category (Model 1a) dwells on mediating role of perceived knowledge at the pre-intention phase of the TPB model applied to dietary behaviour while the second model (Model 1b) focuses on perceived knowledge as a mediator during the pre-intention phase of the TPB model applied to physical activity (Fig. 2). As improvement to the TPB model, the proposed models close the gap between psychosocial factors (attitude, subjective norm and perceived al control) and intention. Ajzen [6] considered knowledge as a foundation up on which attitude, subjective norm and perceived behavioral control are built. However, the review proposes that knowledge should mediate these factors with intention in a structural network.

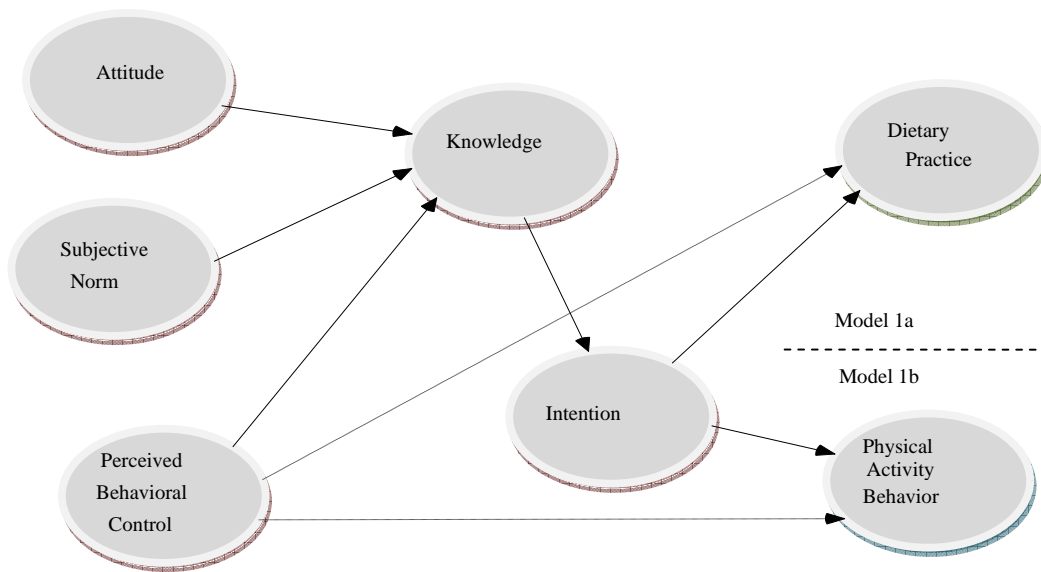


Fig. 2 TPB models (1a&1b) with knowledge as a mediator between psychosocial factors and intention within physical activity and dietary behaviors

In the second model category (Fig. 3) the review consider the role of perceived susceptibility, perceived severity, perceived benefits and cues to action drawn from health belief model [25] as moderators along psychosocial factors (attitude, subjective norm and perceived al control) which are the key predictors of the intention within TPB model applied to dietary behaviour (Model 2a). The second model (Model 2b) also focuses on the role of perceived susceptibility, perceived severity, perceived benefits and cues to action (Table I) as

moderators along psychosocial factors (attitude, subjective norm and perceived al control) that are key predictors of the intention within TPB model applied to physical activity. These model series attempts to improve on the original TPB model by trying to explain that other than attitude, subjective norm and perceived behavioral control, other intervening factors such as perceived susceptibility, perceived severity, perceived benefits and cues to action borrowed from health belief model may have some overall effect on the original model.

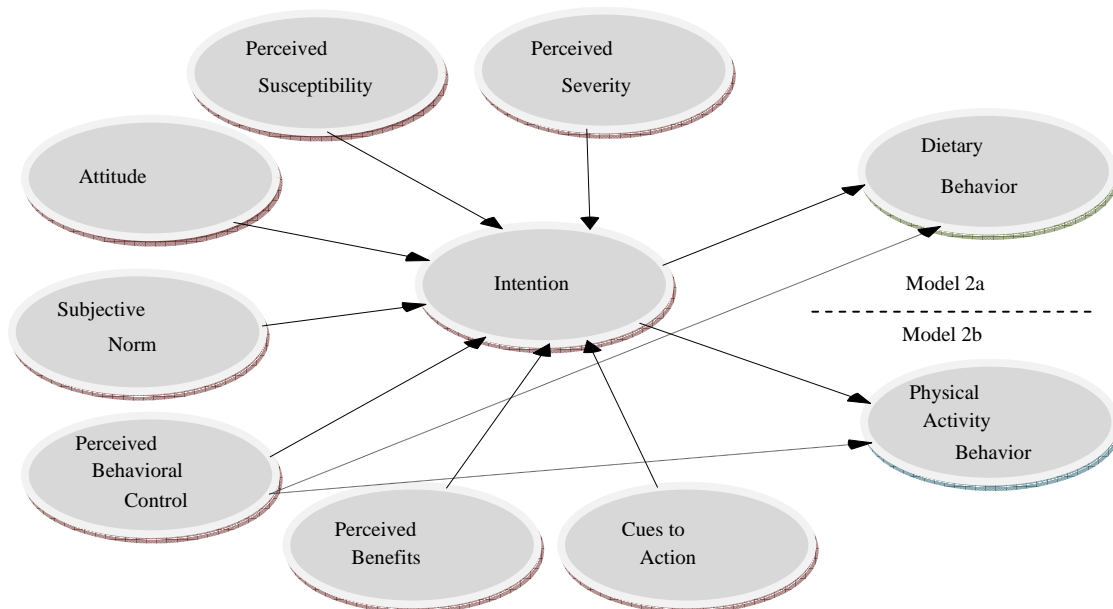


Fig. 3 TPB model (2a&2b) with perceived susceptibility, perceived severity, perceived benefits and cues to action as additional predictor of intention construct applied within dietary and physical activity behaviors

TABLE I
MEASUREMENT AND MEANING OF NEW PRE-INTENTION CONCEPTS INTO THE TPB MODEL

Concepts	Operationalized meaning
Knowledge	Participants are asked to respond to a given set of objective questions testing the understanding of benefits of physical activity and appropriate diet in managing Type 2 diabetes. Statement questions targeting patients knowledge on each of the diet categories e.g. high fat, high sugar and recommended diet are asked to be answered as true/false. Alternatively statement questions targeting patients knowledge on each of the physical activity categories e.g. high level physical activity and sedentary level are asked to be answered as true/false.
Perceived susceptibility:	This measures participants opinion of chances of getting a condition. (e.g. “ If I don’t engage my self in adequate physical activity, my blood sugar will shoot up” or “ If I engage in adequate physical activity, I will maintain my blood sugar levels within normal.” Or “ If I don’t stick to the dietary recommendations, I will be at high risk to increased blood sugar levels” or “If I don’t stick to the dietary recommendations, I will reduce the chances of increasing my blood sugar levels”.
Perceived severity:	This measures the participants belief in the efficacy of the engaging in adequate physical activity. (e.g. “If I don’t engage my self in adequate physical activity, I will not maintain my blood sugar levels within normal and hence I end up in the hospital.” Or “If I don’t stick to the dietary recommendations, I may end up in the hospital” or “If I don’t stick to the dietary recommendations, I may fall a victim of amputation.”
Cues to action:	This measures the participants belief in the presence of strategies to activate. (e.g. “ There are enough reading materials, videos, posters etc. that explain why it is necessary to participate in adequate physical activity” or There are enough reading materials, videos, posters etc. that explain why it is necessary for the diabetic patients to stick to the dietary recommendations

The final and third model series (Fig. 4) propose two models with a focus on the post-intention phase of the TPB model. The first model (Model 3a) dwell on the mediating roles of action plan, action control and maintenance self efficacy between intention and dietary behavior. The second model

(Model 3b) dwell on the mediating roles of action control, action plan and maintenance self efficacy between intention and physical activity behavior (Table II). This series attempt to improve on the original TPB model by closing the gap between intention and behavior.

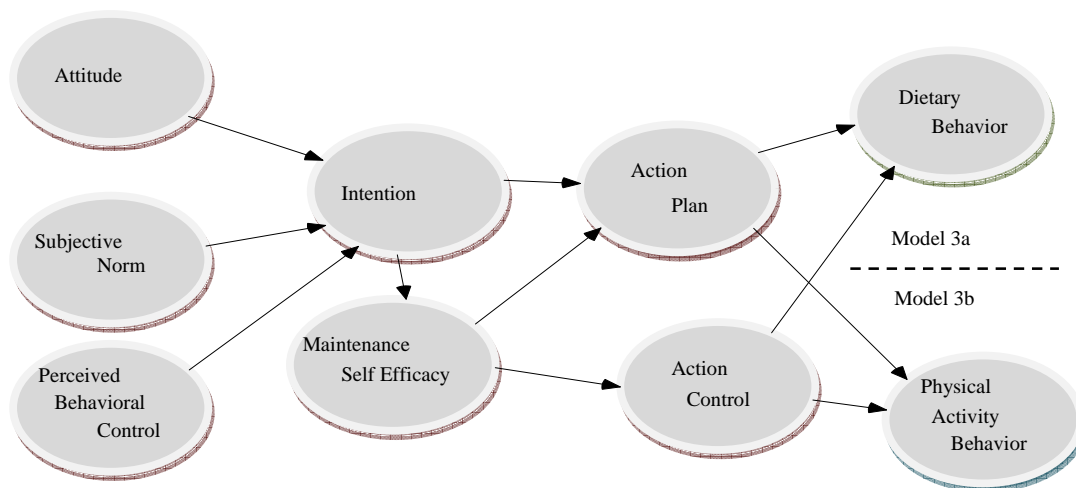


Fig. 4 TPB model (3a&3b) with action control, action plan and maintenance self efficacy as mediators between intention, dietary behaviors and physical activity

TABLE II
MEASUREMENT AND MEANING OF NEW POST-INTENTION CONCEPTS INTO THE TPB MODEL

Concepts	Operationalized meaning
<i>Action plan</i>	This can be assessed using the same techniques adopted by Falko et al, [23]. The item, "I have made a detailed plan regarding..." (a) "...when to do manual work of moderate intensity equivalent," (b)..."where to do the manual work, (c) "...how to do the manual work," and (d) "...how often to do manual work. Two parcels of two items each will be used as indicators for planning. Or "I have made a detailed plan regarding...", (a) "...when to eat the recommended meals," (b)..."where eat the meals (c) "...how to select the meals," and (d) "...how often to consume the meals. Two parcels of two items each will be used as indicators for planning.
This <i>Action control</i>	This can be assessed by an instrument consisting of six items <i>ibid</i> . Two items each should address the different action control facets of comparative self-monitoring, awareness of standards and self-regulatory effort, e.g. "During the last four weeks, I have ..." (a) "...constantly monitored myself whether I do manual work/exercise frequently enough," (b) "...watched carefully that I did manual work/exercise of moderate intensity for at least 30minutes," (c) "...had my manual work/exercise intention often in mind," (d) "...always been aware of my recommended physical activity programme," (e) "...really tried to do manual work/exercise regularly," and (f) "...tried my best to act in accordance to my physical activity standards." Three parcels that consist of two items of different processes each should be used as indicators for action control. Or "During the last four weeks, I have ..." (a) "...constantly monitored myself whether I consume the recommended diet frequently," (b) "...watched carefully that I did eat the diet as recommended by the health care provider," (c) "...had my recommended diet intention often in mind," (d) "...always been aware of my recommended diet," (e) "...really tried to consume recommended diet regularly," and (f) "...tried my best to eat in accordance to my recommended guidelines." Three parcels that consist of two items of different processes each should be used as indicators for action control.
<i>Maintenance self-efficacy</i>	This can be assessed as follows <i>ibid</i> e.g. "After having started engaging in physical activity it is important to maintain this behavior on a long-term basis. How confident are you that you will succeed in doing so?" The item stem, "I am confident to engage in physical activity regularly on a long-term basis, ..." should be followed by four items concerning typical barriers that may hamper the maintenance of the behavior, such as "...even if I cannot see any positive changes immediately," or "...even if I am together with friends and relatives who are not physically active/not doing manual work." Two parcels of two items each should be used as indicators for the maintenance self-efficacy. Or "After having started consuming the recommended diet it is important to maintain this behavior on a long-term basis. How confident are you that you will succeed in doing so?" The item stem, "I am confident to stick to the recommended diet regularly on a long-term basis, ..." should be followed by four items concerning typical barriers that may hamper the maintenance of the behavior, such as "...even if I cannot see any positive changes immediately," or "...even if am together with friends and relatives who are not following the same diet." Two parcels of two items each should be used as indicators for the maintenance self-efficacy.

C. Way forward: Advancing the New Models using Mixed Methods Design

The section above identified gaps that needed to be filled when attempting to advance a new theory built upon the foundation of the Theory of Planned Behavior, in this section, we examined the appropriateness of *sequential exploratory mixed method design* for this type of study. This is one of the mixed methods suggested by Creswell [26] as being relevant for grounded theory investigation. It is a methodology where a study begins with qualitative phase and ends with quantitative phase. The purpose of this strategy is to use quantitative data and results for the interpretation of the qualitative findings. Morgan [27] suggested that this design is appropriate to use when testing elements of an emerging theory resulting from qualitative findings. This category of mixed method uses three-phase approaches where the researcher first gathers qualitative data and analyzes it (Phase1) and then using the analysis to develop an instrument (Phase2) that is subsequently administered to sample of a population (Phase 3) [28]. Based on this method the new models form the framework for qualitative investigation and analysis and confirmation of the qualitative results obtained is done using

quantitative methods. Put in the context of this review, we would begin by conducting Focus Group Discussions (FGDs) or open ended interviews with Type 2 diabetes patients guided by questions measuring the key constructs within the models applied to physical activity and dietary behaviors. These constructs include attitude, subjective norm, perceived behavioral control, perceived susceptibility, perceive severity, perceived benefit, cues to action, action control, action planning and maintenance self efficacy. Data obtained from FGDs or open ended interviews would then be qualitatively analyzed using grounded theory analytical methods to identify important categories for theoretical building. The next phase would be to develop two questionnaires measuring key constructs applied to dietary and physical activity behaviors. These questionnaires would then be used to collect information from the patients to be quantitatively analyzed using structural equation modeling or any other statistical methods which is appropriate for testing new models' fitness.

Many studies may have proposed and supported the application of mixed methods research design in conducting scientific studies in social sciences. In this review we analyzed the content of four articles within the paradigm of mixed methods to support this methodological movement. A study

conducted by Roselyn [29] provides an overview of the mixed methods research and specifically how it is being used in business and management fields and its relationship to the philosophy of pragmatism. Important item drawn from this study indicates that mixed methods has evolved out of the ashes of the paradigm wars to become the third methodological movement. In another study, Johnson [30] attempted to position mixed methods research as the natural complement to traditional qualitative and quantitative research. In this piece of work mixed methods is stronger due to its methodological pluralism which frequently results in superior research. This study also appeared to call for further advancement of the concepts of mixed methods through regular practice. It implies that approval of this new methodology can only be realized when authorities in this field of research are joined by other researchers interested in this methodology. Clarke [31] appeared to agree with the augment of the two authors and provided the usefulness of and appropriateness of mixed method approach to understanding stroke experience. This study pointed out that use of qualitative and quantitative strategies to examine single research questions has received serious criticism and still remains very uncommon practice in the sociology of health and illness. The study concluded that mixed methods provide comprehensive picture of the real phenomena under investigation.

In as much as many of these studies approve mixed methods for current research in social science and related disciplines, Day [32] suggest that synergistic conclusions can add more weight to mixed methods. As revealed in a study where mixed method research team designed and conducted a four-year follow-up that tracked 300 teachers in 100 schools in England over 3-year fieldwork period, he identified the progressive popularity of mixed-methods but pointed out the need to go beyond the use and integration of mixed methods to arrive at more synergistic understandings. However, exhausting the use and integration of the conventional mixed methods suggested by Creswell [26] may be a key step for new researchers interested in mixed methodology since this is a new area of study. The review adopted this method because our focus is directed toward developing new model versions from the Theory of Planned Behavior in a new setting and among specialized population.

IV. CONCLUSION

The study recognized two gaps within the Theory of Planned Behavior that need to be filled in order to come up with new models to use in promoting physical activity and dietary practice of Type 2 diabetics. The two gaps identified include the pre-intention and post intention gaps. The pre-intention gap suggests that additional factors may still compete with attitude, subjective norm and perceived behavioral control in predicting intention. Factors suggested for investigation during this phase include knowledge, perceived susceptibility, perceived severity, perceived benefit

and cues to action. In addition, attitude, subjective norm and perceived behavioral control may be mediated by knowledge of the patients within the context. The post-intentional gap suggests that a number of factors also mediate between the intention and behavior. Such factors include action planning, action control and maintenance self efficacy. Finally we suggest sequential exploratory mixed methods approach as an appropriate method for this theoretical advancement based on evidence.

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