



Original Article

Reduced HbA1c levels in type 2 diabetes patients: An interaction between a pedagogical format for students and psycho-educational intervention for patients

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ABSTRACT

In this prospective study we compared Hemoglobin A1c (HbA1c) levels in T2DM (Type 2 diabetes) patients who received psycho-educational intervention vs. usual care. Intervention was provided by pharmaceuticals students, and accompanied by an academic course. We further examined the effect of the pedagogical format by which students were taught on HbA1c levels of the patients. The format of the academic course varied: the simultaneous format included theoretical, clinical, and practical themes taught within each lesson; whereas in the non-simultaneous format, theoretical themes were taught during the first several lessons, followed by practical skills taught in the following ones.

T2DM patients (n = 171) were recruited through 10 primary care clinics. The inclusion criterion was patients with uncontrolled type 2 diabetes (HbA1c > 7%). Patients were randomly allocated to a training or control group. Pharmaceutical students (n = 85) in their fourth year participated in an academic course and were randomly allocated to a simultaneous vs. non-simultaneous pedagogical format. The interaction effect between intervention type and pedagogical format was significant. Only patients who participated in the training group consisting of students who participated in the simultaneous course format showed improvement on their HbA1c levels. Implications on patients' outcome and suggestions for future studies are discussed.

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1. Introduction

T2DM is a worldwide health concern. In Israel, 8.3% of the population suffers from T2DM [1]. The highest rates of T2DM (15.9%) are reported in Mexico [2]. Patients represent a high risk of cardiovascular disease and mortality [3].

Current knowledge on diabetes management acknowledges the importance of promoting healthy lifestyles and medication adherence. Healthy lifestyles for diabetics are daily physical activity, suitable nutrition, smoking cessation, having a social support system, and practicing stress management [4–7].

Thus, the clinicians' role includes providing medical treatment together with psycho-educational knowledge on diabetes, as well

as teaching lifestyles, and self-management skills [8]. Due to the multiple facets of diabetes, and the complex psycho-medical process, clinicians should enhance their knowledge and clinical skills in order to guide and alter patients' daily care. Results from a previous study have shown that ongoing educational and supportive care provided by dietitians led to long-term metabolic improvement among T2DM patients [9]. Similar improvement was reported when multifaceted caring was provided by nurses [10] and pharmacists [11,12].

However, the impact of psychosocial interventions on T2DM patients' metabolic rates is inconsistent [13]. have shown that psycho-educational and cognitive behavioral interventions enhance self-management skills among T2DM patients, but fail to improve HbA1C levels [14]. showed that T2DM patients who underwent a short-term educational and practical workshop had lower HbA1C values after three months compared with patients who only received education [15].

One possible account for the inconsistency in patient

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improvement may be the format of the pedagogical program that health professionals underwent. Yet, in the literature, the links between teaching methods in health professions and patients' outcome have not been sufficiently explored [16].

Teaching methods that integrated theoretical and practical skills were found as more beneficial than standalone teaching in improving knowledge, skills, attitudes and behaviors among learners, students and health professionals [16,17]; [18–20]. When teaching was comprised of theoretical concepts along with practical skills, students and health professionals reported better practice [16]. Furthermore, in the field of infectious disease [21], identified the need for research to address how knowledge and skills are integrated into the process of educating health professions on all levels of their education. The authors stated that an integrated curriculum of theoretical and clinical skills in the early stage of education is necessary to established habits in the practitioner's career [21].

Thus, we assumed that allowing students to incorporate knowledge and skills into the early stages of their learning process would enable their skill dissemination process to be more accurate as they teach and guide their patients. We examined two formats of an academic course: a simultaneous one, whereby didactics and practice were woven together within each lesson, versus a linear teaching method that began with the introduction of theoretical concepts during the first few lessons, followed by practical skills learned in subsequent ones. We further hypothesized that a teaching format combining both theoretical and clinical skills from the very first lesson would have a more positive effect on improving patients' outcome – reducing HbA1c levels – than a linear teaching method.

Our objective was to examine T2DM patients' outcome as derived from the interactive effect of a psycho-educational intervention, provided by students, and the pedagogical format used to teach them.

2. Method

Ethical approval to conduct the study was granted by the ethic committee of the health science faculty, Ben Gurion university of the Negev. T2DM patients (n = 171) were recruited through 10 primary care clinics in the southern part of Israel. The inclusion criteria consisted of Hebrew-speaking patients with uncontrolled type 2 diabetes (HbA1c > 7%), who were able to walk continuously for at least ten minutes. The exclusion criterion was patients with axis I psychiatric disorders. We randomly allocated T2DM patients from each clinic to either the training group (TG, n = 82) to undergo the psycho-educational intervention, or the control group (CG, n = 89) to receive the usual care. Data on patients' HbA1c levels was taken from their medical files at two measuring points: time 1 (t1): HbA1c level was taken pre-intervention, and time 2 (t2): after one year. Out of 171 patients, completed valid data was taken from 160 patients (93.5%). The sample consisted of 51% men. Participants' mean age was 57 years (SD = 9.5 years).

2.1. The interventions given to T2DM patients

The training group participated in 10 meetings lasting 90 min each: *two meetings* were dedicated to providing patients with knowledge on diabetes, while placing an emphasis on medical and pharmacological aspects. Adherence to medication was also discussed. *Three meetings* focused on physical activities for T2DM patients. Knowledge on physical exercise, and suggestions for simple workouts such as walking, were discussed. *Two meetings* were dedicated to nutrition and diet. Dietary recommendations were followed by adapting patients' daily diets to the recommended one

[22], and *three meetings* focused on stress phenomena and the importance of regulating and managing stress response [22,23].

The control group patients received routine care in their clinics.

2.2. The academic course

Pharmaceutics students (n = 85) in their fourth year participated in a multidisciplinary academic and clinical course for 13 weeks, each lesson lasting 5 h. They were taught the following: theoretical aspects of T2DM management, such as knowledge on diabetes from biochemical, physiological, pathological, and pharmacological perspectives (5 lessons); physical activities for T2DM patients (3 lessons); nutrition and diet (2 lessons); stress and stress management (3 lessons) [24–26]. Within the lessons, students were taught specific techniques, and practiced them. For example, ways of promoting adherence to medication intake, with emphasis on regular sets of blood tests. The students learned stress management skills, such as breathing relaxation and mindfulness. They also practiced physical exercise, such as walking, and were taught ways to adhere to a dietary regime [27].

2.3. Pedagogical format

Students were randomly allocated to a simultaneous vs. non-simultaneous pedagogical format.

1. In the simultaneous format, students were taught theoretical themes followed by practical skills. Thus, 3 h of each lesson were dedicated to a didactic lecture, and the other 2 to skills acquisition, such as practicing ways of adhering to medication.
2. In the non-simultaneous format of teaching, all theoretical concepts were taught within the first 7 lessons, and the final six were dedicated to teaching practical skills. Similar pedagogic principles were reported in medical school [28].

2.4. Measures

HbA1c levels were measured at t1 and t2. Values were taken from the patients' medical files.

Demographic information was also taken from the patients' medical files, and consisted of gender and age. The institutional review board at Soroka University Medical Center, Beer-Sheva, Israel, approved the study. All participants gave their written informed consent for participation in the study, having been told that their participation is voluntary, and they may quit the study at any time.

2.5. Data analysis

Patients in the training and control groups were compared by age and gender using one-way ANOVA and X^2 tests. Patients whose students were taught by different pedagogic formats – simultaneous vs non-simultaneous – were compared with regard to their age and gender using one-way ANOVA and X^2 tests. The decrease in HbA1c values between t1 and t2 was taken as an indicator for patients' improvement according to the HbA1c improvement index: a higher score on the HbA1c improvement index implying greater improvement in patients' HbA1c levels, namely, greater reduction in HbA1c levels from t1 to t2. A univariate ANOVA analysis was conducted with the HbA1c improvement index as the dependent variable, and intervention type (training vs control group) and pedagogical format (simultaneous vs non-simultaneous) as independent fixed factors.

Table 1
Means (SD) of scores on HbA1c improvement index by pedagogical format and intervention type Mean (SD).

		Pedagogical format			
		simultaneous	non- simultaneous	Total	
Intervention type	training	1.06 (0.24)	0.24 (0.16)	0.65 (0.14)	$F_{(1,156)} = 2.35$ NS
	control	0.29 (0.17)	0.42 (0.19)	0.35 (0.13)	
	Total	0.68 (0.15)	0.33 (0.13)		
		$F_{(1,156)} = 3.26$ NS			

3. Results

Patients in the training vs. control groups were compared by age with no significant difference ($F = 1.04$ $df = (1,157)$ $p > 0.05$), and by gender ($X^2 = 0.12$ (1) $p > 0.05$) with no statistical difference. Patients whose students were taught simultaneously vs non-simultaneously were compared as well with regard to age ($F = 0.09$ $df = (1,157)$ $p > 0.05$) and gender ($X^2 = 3.00$ (1) $p > 0.05$). No statistical differences were observed between the groups. Thus patients in the four groups did not differ in their age and gender.

The scores of patients in the 4 groups on the HbA1c improvement index were compared (Table 1).

Table 1 presents means and SD values of scores on the HbA1c improvement index by intervention (training vs control group) and pedagogical format (simultaneous vs non-simultaneous). Both main effects of intervention ($F_{(1,156)} = 2.35$ N.S) and teaching format ($F_{(1,156)} = 3.26$ N.S) were insignificant. Thus, intervention and teaching format did not impact HbA1c improvement index scores. The interaction effect between intervention type and pedagogical teaching format, however, was significant ($F_{(1,156)} = 5.99$ $p = 0.01$). Namely, only patients that participated in the training group, and whose students were taught in a simultaneous format, showed improvement in their HbA1c improvement index scores (mean = 1.06, SD = 0.24), compared to the control group (mean = 0.29, SD = 0.17). See Fig. 1.

4. Discussion

In the present study we examined whether patients' HbA1c levels were affected by the interaction between a psycho-educational intervention, provided by pharmaceuticals students, and the pedagogical format used to teach them. T2DM patients

($n = 160$) received either psycho-educational intervention or usual care. The intervention was provided by pharmaceuticals students who took part in an academic course. We specifically looked into whether patients' HbA1c index values were significantly different when the students who provided their intervention were taught using a simultaneous teaching format, comprised of theoretical, clinical, and practical themes within each lesson, or a non-simultaneous teaching format, where theoretical themes were discussed during the first several lessons, followed by practical skills. Our results showed an improvement in patients' HbA1c index values when patients participated in the psycho-educational training provided by the students who attended the academic course comprising theoretical and clinical concepts within each lesson (simultaneous format). In other words, an improvement in patients' metabolic rate was recorded as a result of the interaction between patients having undergone an intervention group, and their health professionals – pharmaceuticals students – having been taught the theoretical and clinical aspects of T2DM using a simultaneous format. A possible explanation for this finding is that students who received simultaneous pedagogical training started to practice with their patients earlier compared to those who were taught in a non-simultaneous way. Perhaps in the simultaneous format of learning, students could disseminate the practices they had been taught earlier on into their clinical work with their patients, thus presenting their patients with an extensive and recurrent practice [21]. We further suggest that students in the simultaneous group already acquired some practices in early stages of their academic course, allowing them to establish practices that were more precise and thorough in the long run [21].

As for the students who were taught using the non-simultaneous format, and provided the intervention for patients in the study group, perhaps they followed the process of their

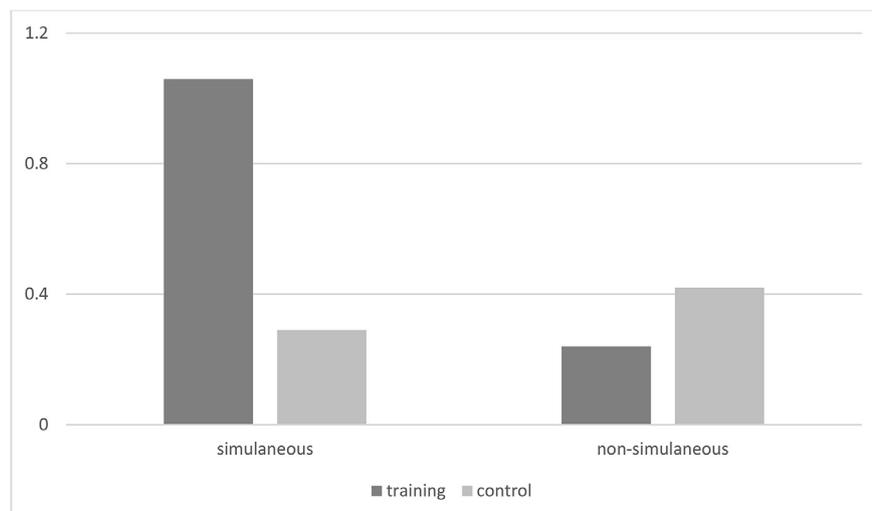


Fig. 1. Interaction effect between intervention type and pedagogical format on HbA1c improvement index scores.

course, teaching their patients theoretical concepts during their first seven meetings, in alignment with the concepts they had been taught during their academic course, and only in later meetings, once they themselves had been taught how to practice, did they integrate their practical skills into their meetings with their patients. Hence, patients whose students were taught using a non-simultaneous format had less practice, negatively influencing their coping with T2DM symptoms.

It therefore seems that both patients and students stand to benefit from early and recurrent practices. However, future studies are called upon to monitor such benefits in a parallel manner. While objective patient' outcome, such as HbA1c levels, is a well-established parameter of improvement, an objective measure for students' improvement must be established as well.

In summary, we believe that a course providing integrative theory and practice in its early stages allows each practitioner, and subsequently patient, to contribute their particular knowledge and skills within the context of a shared plan of care, which may positively contribute to the improvement in patients' outcome [29].

5. Implications

Over the last few decades, pharmacists have been incorporated into multidisciplinary medical teams. Within these teams, they engage in classic pharmaceuticals, as well as ongoing pharmaceutical care (PC) [22,24]. PC consists of activities such as medical management, as well as home visits, and follow-ups on patients with comorbidity who, for example, use anticoagulation. The role of the pharmacist is to provide patients with medical management, teach self-monitoring activities, concepts of food care, and physical activity, in an effort to control weight, and manage high blood pressure, cholesterol, heart disease and other chronic diseases [25–27], as well as stress [14]. Our findings show the potential impact that students learning the field of psycho-education have on patients' metabolic state. It seems that pharmaceuticals students were capable of educating and motivating patients to create changes in their lifestyles, and reach a better metabolic state. The pharmaceuticals students managed to deliver an effective intervention once they were taught their academic course in a simultaneous way that enhanced their confidence and skill practice. We further encourage the examination of other students in the health professions undergoing similar course modes on T2DM patient outcomes.

6. Limitations and future studies

The present study has several limitations that should be acknowledged. First, we did not systematically measure students' skills acquisition and practice in vivo with patients. The students were taught skills and then practiced them in class under supervision. We assumed that simultaneous pedagogical training would have benefits over non-simultaneous pedagogical training, and indeed, the results support our assumption. Yet, future studies conducted among health profession students are called upon to monitor students' ability to integrate their theoretical and clinical knowledge as manifest in their clinical skills. Health professionals such as nurses and physicians are often chaperoned by professionals in their field. Another limitation was that we did not control for students' demographic background. However, other studies in this field did not monitor students' variables either [30,31]. Third, we did not examine students' attitudes and emotional responses to treating their assigned T2DM patients [26]. We did examine students' backgrounds and attitudes; however, patients' demographics and medical statuses were lacking. Future studies should measure the psycho-demographic variables of students and patients, and explore their influence on patients' medical

outcomes. The fourth limitation was that empathic skills of students towards their patients were not controlled for. Empathic skills were previously taught and examined in a short-term course [31]. Future studies are encouraged to incorporate a measurement for empathic responses of health professionals towards T2DM patients.

To conclude, despite its limitations, the current study provides a unique contribution to the field of educating health profession students. Our findings showed that an integrative intervention assisted T2DM patients' outcome when the students themselves were taught in an integrative and more holistic way.

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Conflict of interest

We hereby declare that we have no conflict of interest.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.dsx.2019.05.021>.

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