# The inter-relationships between self-efficacy, self-management, depression and glycaemic control in Israeli people with type 2 diabetes

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**Evidence from global research has established the important role of glycaemic balance in controlling diabetes, preventing its complications and maintaining quality of life. Research has also identified that self-management, self-efficacy and depression are correlates of long-term glycaemic balance. This article describes a study exploring the inter-relationships between self-efficacy, self-management and depression, and their impact on long-term glycaemic control and symptoms of hyperglycaemia and hypoglycaemia in a community-dwelling population of adult Israelis with type 2 diabetes. The study indicates that nurses and other diabetes professionals need to assess levels of self-efficacy, self-management and mood in individuals with type 2 diabetes.**

**Article points**

1. Maintaining glycaemic control is complex and cognitive, emotional, behavioural, as well as biological factors are involved.

2. This article explores the inter-relationships of self-efficacy, self-management and depression, and their relationships to glycaemic control.

3. Glycaemic control is examined both from a long-term perspective measured by $HbA_{1c}$, and via symptoms of hyperglycaemia and hypoglycaemia.

4. Nurses should include self-efficacy, self-management and mood in their assessments and intervention targets for individuals with type 2 diabetes.

**Key words**

- Depression
- Glycaemic control
- Self-efficacy
- Self-management

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E vidence from research has established the important role of glycaemic balance in controlling diabetes, preventing its complications and maintaining quality of life (American Association of Diabetes Educators, 2011). Self-management, self-efficacy and depression have been identified as correlates of long-term glycaemic balance, typically measured by $HbA_{1c}$ (Glascow et al, 2001).

## Self-management

A positive relationship between self-management and glycaemic control is well established in the literature. In a cross-sectional study of 1000 US veterans, for example, individuals in the 95th percentile for self-management had $HbA_{1c}$ levels 10.9 mmol/mol (1%) lower than those who were only in the 5th percentile (Heisler et al, 2005). Similarly, in a prospective nationwide US study (*n*=809), each positive health behaviour relating to exercise, alcohol, smoking and diet decreased $HbA_{1c}$ by 10.9 mmol/mol (1%), after controlling for demographics, clinical state and treatment modality (Chiu and Wray, 2010).

## Self-efficacy

The relationship of self-efficacy to glycaemic control appears to be more complex. There is substantial support for a positive relationship between self-efficacy and self-management, in line with social cognitive theory (Bandura, 1986). A study of 717 US veterans, for example, demonstrated self-efficacy to be significantly related to management of drug therapy, diet, physical activity and blood glucose monitoring (*P*<0.001; Nelson et al, 2007). Self-efficacy also explained the 31.5% and 34.5% variance in the self-management of a diet and exercise routine respectively, in a sample of 122 Caucasians and African Americans (Temple, 2003). In a Japanese prospective study, the only study variable impacting on self-management 6 and 12 months later was baseline self-efficacy (Nakahara et al, 2006). In a US study (*n*=141), however, self-efficacy emerged as a significant and direct correlate of glycaemic control, without the mediation of self-management (Sousa et al, 2004). Similarly, in an Indian study (*n*=507), self-efficacy was the most important independent contributor of all the study variables to glycaemic

control (odds ratio 2.94, $P<0.001$; Venkataraman et al, 2012). These results point to both a direct relationship between self-efficacy and glycaemic control, as well as an indirect relationship though self-management.

## Depression

The relationship between depression and glycaemic control appears to have several dimensions. A meta-analysis of 47 studies revealed a significant relationship between depression and sub-optimal self-management, with an effect size of 0.21 (confidence interval, 0.17–0.25; Gonzalez et al, 2008). Similarly, in a US prospective study with a nationally representative sample of 866, baseline depression predicted lower levels of self-management, less adherence to drug therapy (odds ratio=2.67) and poorer glycaemic control; unexpectedly, however, adherence and self-management did not predict control (Dirmaier et al, 2010). In a prospective Chinese study ($n=998$) following patterns of self-management and disease control over 5 years, only 13% of the correlation between depression and control was explained via its relationship to management (Chiu et al, 2010). American research examining the relationship between depression and glycaemic control (0.34; $P<0.01$) in males ($n=68$), points to self-efficacy as a mediator, indicating that depression impacts control by diminishing self-efficacy (Cherrington et al, 2010). As a whole, these results indicate that depression has a direct effect on control of glycaemia, but also an indirect effect through self-efficacy and self-management.

Little attention has been given to the correlation of self-management, self-efficacy and depression on episodes of hypoglycaemia or hyperglycaemia, despite their potential impact on the condition and quality of life (Hirsch and Brownlee, 2004; Monnier et al, 2008; Siegelaar et al, 2010).

## Diabetes in Israel

Israel is a developed country, although in parts people maintain traditional lifestyles. Diabetes is the fourth leading cause of death in Israel, responsible for 7% of the country's fatalities and costing 12.4% of its healthcare budget. Approximately 7% of the overall population and 23% of those over 65 years of age have diabetes

(Data on Diabetes, 2010). One half of all Israelis with diabetes have HbA$_{1c}$ levels lower than 53 mmol/mol (7%) and are well controlled (The Knesset, 2014). Over 13% are poorly controlled with HbA$_{1c}$ levels over 75 mmol/mol (9%; Jaffe et al, 2012). This study aims to examine, for the first time, the relationship of self-management, self-efficacy and depression with glycaemic control, in an adult Israeli community-dwelling population with type 2 diabetes. Both long-term control and episodic symptomology of hyperglycaemia and hypoglycaemia are addressed. In addition, the inter-relationships between the independent variables (self-efficacy, self-management and depression) are explored. We hypothesised that:

1) Individuals with high levels of self-management and self-efficacy would have lower levels of HbA$_{1c}$ and would report fewer symptoms of hypoglycaemia and hyperglycaemia.
2) Individuals with higher levels of depression would have higher HbA$_{1c}$ and report more symptoms of hypoglycaemia and hyperglycaemia.
3) Self-efficacy and self-management would be positively correlated, whereas depression would be negatively correlated with the former two variables.

This research was made possible through the cooperation and assistance of the Clalit Health Management Organisation and their primary care clinics in the Jerusalem district.

## Method
### Theoretical framework
The basis of these hypotheses originated from Bandura's Social Cognitive Theory (Bandura, 1986). According to Bandura, thoughts and perceptions (self-efficacy), emotions (for example, depression), behaviours (for example, self-management) and biological events (such as glycaemic levels) are inter-related. Self-efficacious individuals are motivated to engage in positive health behaviours. These enhance well-being, which in turn raises self-efficacy. On the other hand, individuals with low levels of self-efficacy have little expectation of their abilities, which translates into poor self-esteem, depression and less proactive behaviour. Biological processes, such as glycaemic balance, are also affected. Sub-optimal control can lower self-esteem and raise levels of depression, thus

diminishing self-management.

## Design and study sample

All 600 individuals with type 2 diabetes cared for in five primary clinics serving a large, ethnically varied metropolitan area were invited to participate via telephone contact. The clinics are part of the National Clalit Health Services Organisation, which insures 60% of the Israeli population for primary, secondary and tertiary care (Levin-Zamir and Peterburg, 2001) and the study was approved by its Institutional Review Board. Two hundred and fifteen individuals consented to participate (118 men and 97 women).

The study was retrospective and cross-sectional in design. All participants were individually interviewed by trained research assistants, with the use of a structured questionnaire measuring the study variables. Sociodemographic data and their most recent HbA$_{1c}$ result were obtained from Clalit's database; LDL and HDL cholesterol, and body mass index (BMI) measurements were also retrieved.

## Measurements

Self-management was measured via 6 items (Schecter and Walker, 2002). Two items measured periodic activities:

1) Preparation of questions for the health provider prior to clinic visit (0=never, 1=at times, 2=often);
2) Getting an eye exam in the previous 6 months (0=no, 2=yes).

Four additional items measured daily activities:

3) Possessing a blood glucose testing device (0=no, 2=yes);
4) Performing daily glucose monitoring via the device (0=no, 2=yes);
5) Engaging in routine physical activity (0=no, 1=yes, up to an hour, 2=yes, over an hour per week);
6) Taking medication as prescribed (0=never or almost never, 1=at times, 2=often, 3=always or almost always).

As all the subjects reported "always" or "almost always" about adhering to the medication regimen, the item's impact on correlative statistics was neutralised and it was not included in the additive scale of self-management. Scores of the other items were computed on a range of 0–10, with higher scores indicating higher levels of self-management. No measure of internal consistency was computed,

as self-care measures are heterogeneous in nature and are not well correlated (Schecter and Walker, 2002).

Self-efficacy was assessed via the Chronic Disease Self-efficacy 6-item scale and the Diabetes Self-Efficacy Scale (Lorig et al, 2001). The scale items reflect the degree to which an individual is confident in their ability to perform specific management tasks. Two respective examples of items are: "How confident are you that you can keep the fatigue caused by your disease from interfering with the things you want to do?" and "How confident are you that you can choose the right foods to eat when you are hungry (for example, snacks)?"

Alpha Cronbach coefficients were 0.91 and 0.83, respectively. Both scales were translated into Hebrew and translated back for this research. A Likert scale was used with scores ranging from 1 (to a small degree) to 5 (to a very large degree). Alpha Cronbach coefficients for the scales in this study were 0.84 and 0.66 respectively.

Depression was measured by the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977; Radloff and Locke, 2000). The original scale includes 20 items and reflects various aspects of depressed mood, such as appetite and sleep disturbances, fatigue, and feelings of poor self-worth. For each item, the participant is requested to respond: 1=rarely or never, 2=some of the time, 3=a moderate amount of the time, 4=most or all of the time, to illustrate how they have felt over the last week. An example of a scale item is: "You thought your life had been a failure". The scale was translated into Hebrew and one item was omitted ("You were happy") due to difficulty in finding a culturally appropriate accurate translation. Shorter versions of this scale, some of which also omit this item, have been found valid and reliable (Chang and Weng, 2013). The complete score range for the 19 items was 0–57, with higher scores reflecting a greater level depression. Cronbach's alpha in this study reached 0.83.

Symptoms were assessed via Hebrew translations of symptom scales for hyperglycaemia and hypoglycaemia (Piette, 1999). An example of an item reflecting hypoglycaemia is: "In the past week, did you have night sweating?"; and one reflecting hyperglycaemia: "In the past week, have you had to urinate several times during the night?" As no significant correlations are found between

## Table 1. Averages, medians and ranges for the study variables.

| Variable | $n$ | Min | Max | Mean | SD | Median | Range |
|---|---|---|---|---|---|---|---|
| Self-efficacy, diabetes | 213 | 1.75 | 5.00 | 3.6473 | .69227 | 3.6 | 1–5 |
| Self-efficacy, general | 203 | 1.00 | 5.00 | 3.6811 | .89980 | 3.8 | 1–5 |
| Self-management | 210 | 1 | 10 | 7.27 | 2.359 | 8.0 | 1–10 |
| Depression | 204 | 0 | 45 | 12.95 | 9.194 | 10.6 | 0–57 |
| Hypoglycaemic symptoms | 211 | 0 | 7 | 1.35 | 1.463 | 1 | 1–7 |
| Hyperglycaemic symptoms | 211 | 0 | 6 | 1.86 | 1.393 | 2 | 1–7 |
| $HbA_{1c}$ mmol/mol (%) | 193 | 29 (4.8) | 99 (11.20) | 51 (6.804) | 11.75 (1.075) | 49 (6.6) | |

min=minimum; max=maximum; $n$=number; SD=standard deviation

symptoms, that is, having one symptom did not significantly raise the chances of having another (Nathan et al, 2009), the scales were considered additive and no measures of internal consistency were computed.

### Statistical Analysis

SPSS (version 19) was used for data analysis. Frequencies and measures of central tendency were computed. Group differences were measured via $t$-tests. Pearson's $r$ coefficient was used to assess correlations (distributions of study variables were found to be normal), and hierarchical linear regression analyses were performed to ascertain explained variance of the dependent variables.

### Results

#### Sample description

The average age of the sample was 70 years, with over 75% married and an additional 10% living with family members. The majority were not employed, although almost 25% were working

## Table 2. Pearson's $r$ correlations of the study variables.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Age | 1 | .082 | .093 | -.073 | -.136 | -.158 | .050 | .056 | .146 | .049 | .003 |
| Self-efficacy, diabetes | | 1 | ***0.467 | ***0.273 | 0.104 | **-.192 | **0.217 | 0.061 | 0.040 | **0.204 | 0.77 |
| Self-efficacy, general | | | 1 | 0.033 | ***-.399 | ***0.353 | ***0.226 | **0.204 | 0.042 | *0.090 | 0.015 |
| Self-management | | | | 1 | 0.137 | 0.035 | 0.0446 | 0.134 | **0.196 | 0.042 | 0.005 |
| Depression | | | | | 1 | ***.604 | ***.316 | 0.118 | 0.034 | 0.098 | 0.011 |
| Hypoglycaemic symptoms | | | | | | 1 | ***.526 | 0.038 | 0.112 | 0.086 | 0.036 |
| Hyperglycaemic symptoms | | | | | | | 1 | **0.158 | 0.009 | 0.054 | 0.030 |
| $HbA_{1c}$ | | | | | | | | 1 | 0.022 | 0.098 | 0.003 |
| LDL cholesterol | | | | | | | | | 1 | **0.193 | 0.032 |
| HDL cholesterol | | | | | | | | | | 1 | 0.125 |
| Body mass index | | | | | | | | | | | 1 |

*$P<.05$; ** $P<.01$; *** $P<.001$

full-time. Less than 25% had not completed secondary school education. The sample was ethnically diverse, with participants originating from Israel, the US, Western Europe, Eastern Europe and Asia. A statistical comparison of the sample to all patients meeting study inclusion criteria treated in one of the clinics (from which 48% of the study participants originated), showed no significant differences with respect to demographic and base-line medical data.

### Study variables: descriptive statistics

As is apparent from the data presented in *Table 1*, the sample scored high on self-efficacy and self-management and low on depression. Few symptoms of hypoglycaemia or hyperglycemia were reported, with average scores of 1.35 and 1.86, respectively (score range 1–7) and median scores of 1 and 2 symptoms, respectively. The median $HbA_{1c}$ score of 49 mmol/mol (6.6%) in this study is somewhat lower than the national Israeli median score of 53 mmol/mol (7%; The Knesset Department of Research and Information, 2010). With respect to poorly controlled participants (those with $HbA_{1c}$ levels higher than 75 mmol/mol (9%), however, there were substantial differences; only 3.5% of the study sample were poorly controlled, as opposed to 14.2% of the national population (The Knesset, Department of Research and Information, 2010).

### Correlations and study hypotheses

It was hypothesised that individuals with higher levels of self-efficacy and self-management and lower levels of depression would have lower levels of $HbA_{1c}$ and fewer symptoms of hyperglycaemia and hypoglycaemia (hypotheses 1 and 2). The relevant correlations, which are presented in *Table 2*, are all in the direction of the hypotheses. Statistically significant negative correlations emerged between both measures of self-efficacy (chronic illness and diabetes-specific) and symptoms of hyperglycaemia and hypoglycaemia ($r$=-.226, $P$<0.002, $r$=-.217, $P$<0.001, respectively; $r$=-.353, $P$=0.000; $r$=-.192, $P$<0.005). Similarly, statistically significant positive correlations were found between depression and both symptoms measured ($r$=.604, $P$=0.000; $r$=0.316, $P$<0.000, respectively). Chronic illness self-efficacy was also significantly negatively correlated with $HbA_{1c}$ ($r$=-.204, $P$<0.006).

In terms of the inter-correlation of the independent

### Table 3. Regression analysis for hypoglycaemia symptoms.

| Variables | $R^2$ | $R^2$ change | Significance |
|---|---|---|---|
| Age and gender | .096 | .096 | .000 |
| HDL, LDL and BMI | .101 | .005 | .829 |
| Stepwise: Depression | .350 | .249 | .000 |
| Stepwise: Diabetes efficacy | .367 | .017 | .048 |

BMI=Body mass index

### Table 4. Regression analysis for hyperglycaemic symptoms.

| Variables | $R^2$ | $R^2$ change | Significance |
|---|---|---|---|
| Age and gender | .011 | .011 | .416 |
| HDL, LDL and BMI | .027 | .016 | .831 |
| Stepwise: Depression | .107 | .080 | .000 |
| Stepwise: Diabetes efficacy | .155 | .048 | .004 |

BMI=Body mass index

variables (hypothesis 3), diabetes self-efficacy and self-management were positively correlated ($r$=.273, $P$<0.000). Depression was negatively correlated with general self-efficacy (-.399, $P$<0.000) and self-management (-.137, $P$<0.052).

### Regression analysis

In order to assess the extent to which the independent study variables explained the dependent variables of hypoglycaemia and hyperglycaemia, two separate regression analysis were conducted, using three stage hierarchical linear modeling:
- Non-modifiable demographic variables: age and gender.
- Related clinical variables: LDL and HDL cholesterol, and BMI.
- Self-management, self-efficacy and depression, entered stepwise.

Regression results are displayed in *Table 3* and *Table 4*. Of the three variables entered stepwise, depression explained 24.9% of variance for hypoglycaemia, with self-efficacy adding only another 1.7%. With respect to hyperglycaemia, 8% of the variance was explained by depression and an additional 4.8% by self-efficacy.

## Discussion

The main aim of this study was to examine the relationships of three modifiable variables with glycaemic control and symptoms of episodic hyperglycaemia and hypoglycaemia, in a community-dwelling Israeli population. Specifically, the correlations between self-efficacy, self-management and depression with symptoms of hypoglycaemia and hyperglycaemia and levels of HbA$_{1c}$ were analysed. An additional aim was to ascertain the degree of inter-correlation between the independent variables themselves. Significant correlations and inter-correlations (among all the independent variables) emerged in the hypothesised directions.

Regarding the inter-correlations of the independent variables, the findings in this study lend further evidence to the positive relationship between self-efficacy and self-management reported in the literature (Nakahara et al, 2006; Nelson et al, 2007; Sousa et al, 2004; Temple, 2003). Similarly, the negative correlation of depression to self-efficacy and self-management reflect findings of previous studies (Chiu et al 2010; Dirmaier et al, 2010; Mckellar et al, 2004; Zuberi et al, 2011). Depression potentially distorts self-efficacy but the latter can also affect smood. Similarly, depression may deplete energy for self-management and inability to manage could be detrimental to mood (Bandura, 1986). The inter-relationships of the study variables are, according to social cognitive theory, bi-directional. The design of this study precludes establishing the direction of the relationships (and thus causality) for this research. The results do imply, however, that interventions targeted to modify one of the independent variables may indirectly be effective in modifying the others. For example, interventions enhancing self-efficacy may indirectly strengthen self-management and also lower levels of depression.

Regarding the correlations of the independent variables with glycaemic control, depression was strongly and significantly related to symptoms of hypoglycaemia, and somewhat less so to hyperglycaemia. It also explained a substantial amount of variance in the regression analysis. Significant but weaker correlations and less explained variance of symptoms were attributed to self-efficacy. No significant relationship emerged, however, between self-management and symptoms.

It is possible that the index used in this study was not adequately sensitive to capture the specifics of diabetes self-management. Another possibility is that there was an element of social desirability in participants' self-reports.

With respect to HbA$_{1c}$, the dependent variable reflecting glycaemic balance, only one of the three independent variables, diabetes self-efficacy, was a significant correlate ($r$=-.192; $P$<0.005). More robust results were expected, given the correlations of HbA$_{1c}$ with the all the independent variables that emerged in previous studies (Chiu, et al, 2010; Heisler, et al, 2005; Lustman, et al, 2000; Sousa, et al, 2004). The nature of the sample may hold a partial explanation for this. As will be recalled, the profile of this well-educated well-supported, metropolitan sample population is remarkable for its high levels of self-efficacy, self-management and glycaemic control, and its low levels of depression. Perhaps the relatively small variance in the study variables dampened statistical results. Possibly the independent variables are more influential for those with poorly controlled diabetes, which comprised only 3.5% of the sample. Had there been more poorly controlled participants in the study, the relationships between the independent and dependent variables, which were in the right direction, might have been stronger and reached significance. Further research is needed as suggested in the subsequent section.

### Conclusions and areas for further research

Although the study sample was ethnically varied, the Arab and Jewish population of Ethiopian descent were not represented. This is of importance because these sectors tend to be less educated, less proactive with respect to health, and have less access to health care (The Knesset, Department of Research and Information, 2010). It is possible that, for this population, the correlations between the independent and dependent variables would have been stronger. The Knesset (the Israeli legislative body) reports the prevalence of diabetes among the socio-economically disadvantaged to be 14.82%, as opposed to 3.06% in the remainder of the population. Among Ethiopians who have been in Israel 10 years or longer, adopting the Israeli lifestyle and diet, 16% have diabetes. The prevalence of diabetes in the Arab population is 12%, almost

double that of the Jewish population (The Knesset, Department of Research and Information, 2010). These groups should be the focus of further culturally sensitive studies for nurses.

This study has some limitations. The response rate was relatively low and not all segments of the Israeli population were represented. The symptoms of hypoglycaemia and hyperglycaemia are self-reported via scales that have not been clinically validated. There are very few studies that assess the accuracy of self-reported symptoms in predicting blood glucose levels and their results vary (Diamond et al, 1989; Gonder-Frederick and Cox, 1991). It is also possible that symptoms of hypoglycaemia and hyperglycaemia reflect general malaise and are somatic expressions of depression rather than specific for blood glucose fluctuation (Ludman et al, 2004; McKellar et al, 2004; Lin et al, 2010). Lustman et al (1988) actually found that symptoms were better correlated with depression than with blood glucose levels. Another possibility is that individuals with high levels of self-efficacy are less aware of symptoms and therefore tend less to report them, confounding the findings. Research using clinically validated scales will clarify understanding of the relationships between the variables. ■

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