

# DWELL

Evaluation Study of the Diabetes and  
WELLbeing 12-week programme



## REPORT 2: Participant Outcomes



Canterbury  
Christ Church  
University



2 Seas Mers Zeeën

DWELL

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# FOREWARD

The DWELL project was funded by the INTERREG 2 Seas Mers Zeeën Programme and ran between 2016 and March 2023. The overall aim of the project was to empower people living with Type 2 Diabetes Mellitus (T2DM) to enhance self-management of illness through a co-produced 12-week educational programme, and to improve targeted aspects of individual health and wellbeing. The project involved partners in the UK, France, Netherlands and Belgium.

Canterbury Christ Church University ('CCCU') led Work Package 4: Evaluation of the DWELL programme, which commenced delivery in 2018. The evaluation comprised four key areas: patient outcomes; system/process benefits of the programme; staff training; cost benefits of the programme.

For Output 4.1 of this Work Package, we present a set of four final project reports which relate to DWELL programme evaluation. These are as follows:

- **REPORT 1:** Evaluation Methodology
- **REPORT 2:** Participant Outcomes
- **REPORT 3:** Process Evaluation
- **REPORT 4:** Workforce training and Cost Effectiveness

Report 2 presents the Participant Outcomes of the DWELL programme. Section one reports on participant demographics, referral to the DWELL programme, diabetes history, medication and comorbidities, and household, work and income. Section two presents the number of participants who were evaluated at each of the four time-points and causes for participant attrition. Section three outlines evidence of efficacy of the DWELL programme. Changes in participant outcomes are compared pre- post-DWELL, and longitudinal data are compared post-DWELL at 6 and 12 months. The COVID-19 pandemic, which commenced in March 2020 while the project was still 'live', had an impact on the programme's delivery and evaluation activities; this impact is discussed where relevant throughout the reports.

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# Executive summary

A total of 593 people with type 2 diabetes took part in the evaluation study of the DWELL programme, across four countries and five sites. Significant positive changes for DWELL programme participants were evidenced from the analysis of participant outcomes of evaluation study. These changes were sustained at 6 and 12 months after the end of the programme. Statistically significant changes in metabolic health and self-reported attitudinal and behavioural benefits are reported as follows:

- Improvements in Metabolic Health
  - Weight Loss of 3.55 kg on average - by the end of programme
  - Waist Circumference reduction of 2.7cm on average - by the end of the programme
  - BMI reduction of 2.62 on average - by the end of the programme
  - HbA1c reduction of 20.5 mmol/mol on average - by the end of the programme
- Enhanced Empowerment and Self-Efficacy
- Improved Diabetes Management
  - Greater perceived personal control and understanding of diabetes
  - Decrease in negative feelings associated with diabetes
  - Increase in optimism for treatment and long-term prognosis of diabetes
  - Decrease in eating in response to emotions and external cues
  - Increase in restrained eating
- Improvements in self-care attitudes and adherence to professional advice
- Improvements in Physical and Mental health
- Improved Health-Related Quality of Life

Improvements were sustained or continued to take place post-DWELL in the medium term (6 months) and long term (12 months). Notably, there was a continued weight loss a year later in the UK and France and continued improvement in participant empowerment and self-efficacy in France. All other outcomes remained improved compared to pre-DWELL levels.

Further exploration of outcome results could shed light to how specific DWELL programme outcomes were sustained in the longer term and could offer greater insight into the associations between participants' physiological and psychological improvements, process characteristics of delivery per site, and external factors such as policy and practice of diabetes care in the wider healthcare system.



# 1. Introduction

Participant outcomes of the DWELL programme were assessed via a range of metabolic health measurements which were taken at DWELL sites at the timepoints of the evaluation study as described in Report 1: Methodology.

## 1.2. DWELL Outcome measures

- **Metabolic Health** outcome measures included weight (in kilograms), Body Mass Index BMI, waist circumference (in centimetres) and glycated haemoglobin (HbA1c). These were measured by a DWELL facilitator according to standard procedures, before and after the DWELL programme, as well as two follow-ups: six-months and 12-months later. HbA1c readings were collected by trained professionals drawing finger-prick blood samples and analysed using the Quo-Test HbA1c Analyzer.
- **Participant Empowerment** was assessed by the Diabetes Empowerment Scale - Short Form (DES-SF) (Anderson et al., 2003). The scale measures overall diabetes-related psychosocial self-efficacy and it had eight items representing eight conceptual dimensions, i.e., assessing the need for change, developing a plan, overcoming barriers, asking for support, supporting oneself, coping with emotion, motivating oneself, and making diabetes care choices appropriate for one's priorities and circumstances.
- **Perceptions of Diabetes** were measured by the 38-item Revised Illness Perceptions Questionnaire (IPQ-R) (Moss-Morris et al., 2002) (the brief version, BIPQ-R, Broadbent et al., 2006, was used in the Netherlands). Illness perceptions are assessed across seven subscales, covering participants' understanding of diabetes, feelings of control over their condition and associated emotions. The seven dimensions are: illness coherence (Coherence), perceived control of treatment (Treatment Control), personal control over illness (Personal Control), perception of negative changes in symptoms across time (Timeline Cyclical), length of time patients anticipate their diabetes would last (Timeline Acute/Chronic), perceived negative life consequences associated with diabetes (Consequences) and reduction in negative emotions associated with diabetes (Emotion). High scores on the consequences, timeline acute/chronic and cyclical subscales represent strongly-held beliefs about the number of symptoms attributed, the negative consequences, and the chronicity and cyclical nature of diabetes. High scores on the personal and treatment control and coherence subscales represent positive beliefs about controllability and a personal understanding of diabetes.
- **Eating Behaviours** were assessed by the 33-item Dutch Eating Behaviour Questionnaire (DEBQ) (Defares et al., 1986). Eating behaviours are measured across three subscales including efforts to control and be aware of eating (Restrained Eating), eating in response to emotions (Emotional Eating) and eating in response to external food cues, such as the look and smell (External Eating).
- Physical and Mental Health were assessed by the 12-Item Short Form Health Survey (SF-12) (Ware, Keller and Kosinski, 1998). It is a multipurpose generic measure of health status and includes one or two items from each of eight health concepts: physical functioning, role limitations due to physical health problems, bodily pain, general health, vitality (energy/fatigue), social functioning, role limitations due to emotional problems, and mental health (psychological distress and psychological wellbeing).
- **Self-Care Behaviours** were measured using elements of the Summary of Diabetes Self-Care Activities Measure (SDSCA) (Toobert, Hampson and Glasgow, 2000) changes in participants recollection of healthcare advice and diet, footcare and medication adherence.
- **Physical Activity** was measured by the International Physical Activity Questionnaire (IPAQ). Metabolic equivalent minutes (MET) per week are calculated for vigorous, moderate, walking and total activity, according to the authors' instructions (IPAQ, 2005) and research tool for automatic scoring using (Zhou et al., 2016). MET minutes represent the amount of energy expended carrying out physical activity. A MET is a multiple of estimated resting energy expenditure. One MET is what you expend when you are at rest. Therefore 2 METS is twice what you expend at rest.
- **Health-related Quality of Life** was measured using the visual analogue scale (EQ VAS) from the European Quality of Life 5 Dimensions 3 Level Version questionnaire (EQ-5D-3L) (EuroQol Group 2009). It records participants' self-rating of health on a visual scale where the endpoints are labelled 'Best imaginable health state' and 'Worst imaginable health state'. The VAS can be used as a quantitative measure to assess changes in the person's perception of their own health over time.

## 2. Sample of Participants

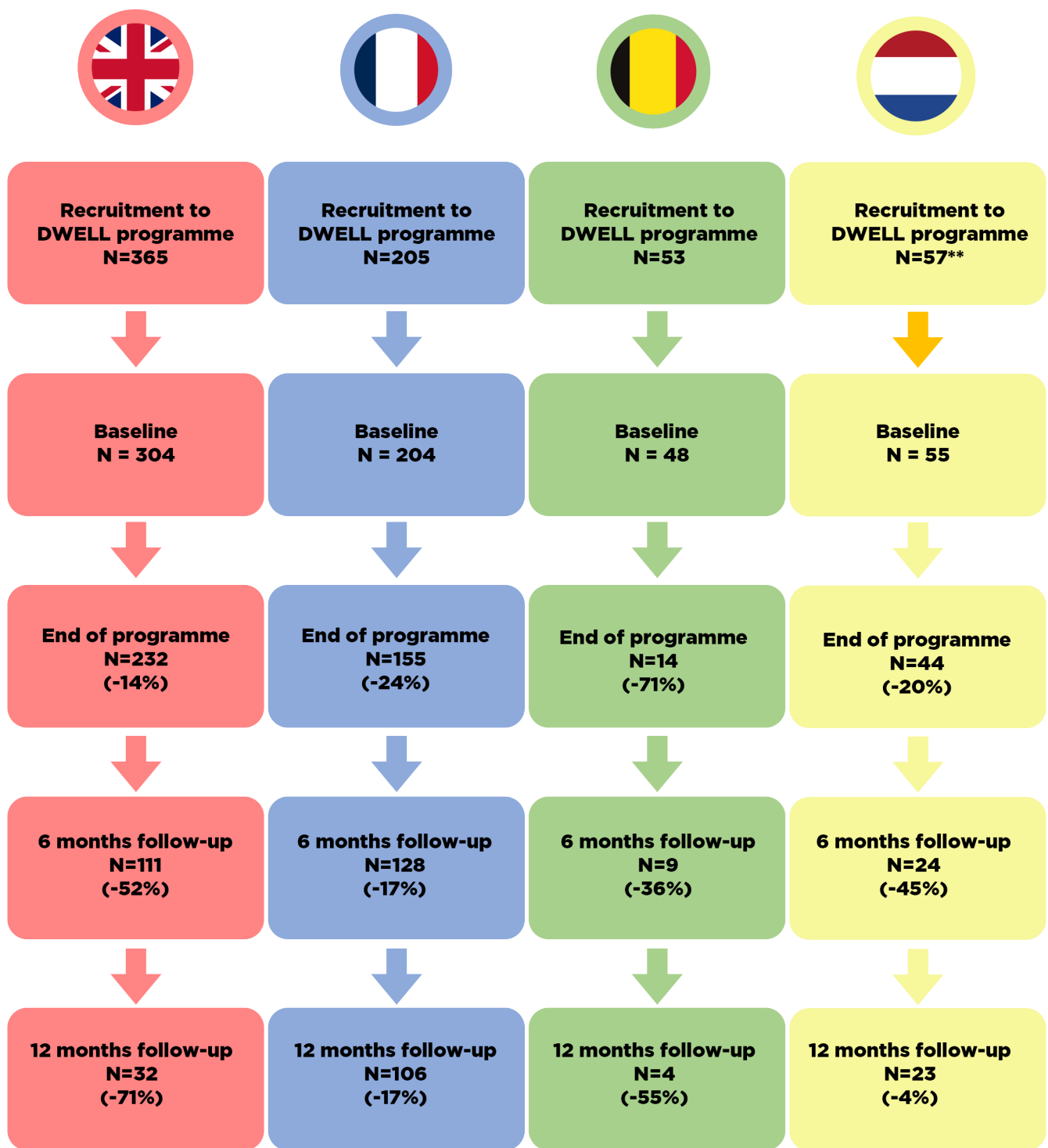
### Participant Numbers and Attrition

Overall, the evaluation targets were aligned to those of the programme delivery recruitment. Figure 1 presents the targets per country as well as the actual samples per timepoint. The overall target of the study was 680 participants, which was the number of people recruited to the DWELL programme. 611 participants took part in the evaluation at baseline (T0, pre-DWELL), of whom 445 completed the end of programme evaluation (T1), 272 completed the 6-month follow up (T2) and 165 completed the 12-month follow up (T3).

The attrition rates between timepoints were within anticipated levels, common in longitudinal evaluations studies with a year or more after the end of the intervention. In particular, there was average attrition of 19% at the UK, France and Netherlands sites and 71% at the Belgium site between T0 and T1; average attrition of 37.5% between T1 and T2; and, 37% between T2 and T3. Specific contextual factors related to the delivery of the programme per site could be useful for understanding levels of attrition. Natural drop out over the 6-month and 12-month follow up points accounts for much of the overall study attrition. The number of responses in each measure at each timepoint also varied as participants could omit answering questions they did not feel comfortable to answer. As psychometric scales had exclusion criteria and instructions for scoring calculations, including missing cases, the number of valid cases for each outcome may differ, and this is noted as needed.

Attrition was also undoubtedly exacerbated by the COVID-19 pandemic which affected a few cohorts and participants across countries in the last period of the project after March 2020. The COVID period broadly began in March 2020 and the impact on the DWELL delivery and evaluation differed across countries, depending on lockdown policies and timeline per country. Certain DWELL cohorts could not begin their programme at all because of the pandemic, other cohorts completed the programme and the pre-DWELL evaluation but could not complete post-DWELL evaluation, or the follow up evaluations. Further, although delivery sites tried to collect evaluation data once the lockdown measures were lifted, this proved more difficult than pre-COVID as for example metabolic data was difficult to obtain. Overall, the COVID-19 pandemic was a significant reason for high levels of attrition at the later period of the evaluation study.





\*Percentages refer to attrition from previous time-point

\*\* This number does not include 56 Pre-DWELL/pilot participants who used activity monitor only

Figure 1 Participant numbers and levels of attrition for each timepoint across countries

## 3. Demographic Data

### 3.1 Participant Demographics

Across all programme sites, most participants were aged between 50 and 79 years (n=506, 87%), with a mean average age of 62.4 years. There were slightly more females than males participating in the programme (Females = 313, 52.8%, Males = 280, 47.2%). Most of the sample were of white ethnic background across all countries (n=539, 92%), with some representation from other ethnic backgrounds, mainly Asian (n=21, 3.6%), Black/African/Caribbean (n=15, 2.5%), mixed ethnic group (n=8, 1.4%) and other (n=3, .5%). Detailed participant demographics per country are presented in Table 1.

Table 1 Participant Demographics per country

Participant Demographics					
	UK (n=289)	France (n=204)	Belgium (n=45)	Netherlands (n=55)	Total (n=593)
<b>Age (years)*</b>					
Mean (SD)	60.97 (13.28)	63.60 (8.13)	64.24 (8.36)	60.40 (11.06)	62.38 (10.20)
≤ 19	4 (1.4%)	-	-	-	4 (0.7%)
20-29	2 (.7%)	-	-	-	2 (0.3%)
30-39	7 (2.5%)	1 (.5%)	-	3 (5.5%)	11 (1.9%)
40-49	31 (11%)	10 (4.9%)	1 (2.1%)	4 (7.3%)	46 (7.8%)
50-59	67 (23.8%)	48 (23.4%)	15 (31.3%)	16 (29.1%)	146 (24.6%)
60-69	96 (34.2%)	98 (47.8%)	17 (35.4%)	23 (41.8%)	234 (39.5%)
70-79	66 (23.5%)	41 (20%)	10 (20.8%)	9 (16.4%)	126 (21.2%)
> =80	8 (2.8%)	6 (2.9%)	2 (4.2%)	-	16 (2.7%)
Missing	8	-	-	-	8 (1.3%)
<b>Gender</b>					
Male	120 (41.5%)	104 (50.7%)	20 (41.7%)	36 (65.5%)	280 (47.2%)
Female	169 (58.5%)	100 (48.8%)	25 (52.1%)	19 (34.5%)	313 (52.8%)
<b>Ethnicity</b>					
White	253 (89.7%)	194 (95.1%)	42 (93.3%)	50 (91%)	539 (91%)
Asian	18 (6.4%)	-	2 (4.4%)	1 (1.8%)	21 (3.5%)
Black/African / Caribbean	10 (3.5%)	4 (2%)	1 (2.3%)	-	15 (2.5%)
Mixed ethnic group	-	6 (2.9%)	-	2 (3.6%)	8 (1.3%)
Other ethnic group	1 (0.4%)	-	-	2 (3.6%)	3 (0.5%)
Missing	7	-	-	-	7 (1.2%)

Participants were referred to the DWELL programme via several routes. Almost all participants in the Netherlands were recruited via their partner hospital, as the DWELL programme was delivered in hospitals, accounting for this high percentage of recruitment from this area. Self-referral was a popular route in the UK and Belgium, as participants contacted the programme after seeing leaflets at delivery sites, pharmacies, or other health facilities. The last route to the programme was the “other” which referred to recruitment done directly by site partners through their networks and other services they were providing, mainly indicated by French, UK and Belgian participants (Table 2).

Table 2 Participant Referral to the DWELL programme per country

	Country				Total (n=570)
	UK (n = 269)	France (n = 202)	Belgium (n = 44)	Netherlands (n= 55)	
GP Surgery	47 (17.5%)	13 (6.3%)	-	-	60 (10.5%)
Hospital	1 (.4%)	61 (29.8%)	-	54 (98.2%)	116 (20.4%)
Self-referral	121 (45%)	11 (5.4%)	26 (54.2%)	1 (1.8%)	159 (27.9%)
Other	100 (37.2%)	117 (57.1%)	18 (37.2%)	-	235 (41.2%)

### 3.2 Participant Diabetes History, Medication and Comorbidities

Data collection about the participants' diabetes history, medication and comorbidities, was not collected at all or not fully collected across all sites; Belgium did not collect this information and Netherlands did not collect family history data.

Nonetheless, available data suggested most participants had diabetes for more than 10 years (overall mean in years = 11.60) and family history of diabetes (only collected in UK and France) varied with most UK participants reporting no family history (66%) while French participants who answered this question, indicated they had family history (83%). However, low response rates in this question may indicate that those unsure of their family history left this question blank, while those with a history of diabetes in the family were more likely to know and report on it.

Across sites, the majority reported taking diabetes (n = 473, 93%) and other medication (n = 429, 89%) and having one or more comorbidities (n = 430, 88%). Common comorbidities included high blood pressure and high cholesterol.

Table 3 Participant Diabetes History, Medication and Comorbidities per country

	Country			
	UK	France	Netherlands	Total
<b>Time since diagnosis of diabetes</b>				
	n = 205	n = 185	n = 54	n = 444
Mean (years)	9.05	9.32	16.40	11.60
<b>Family history of diabetes</b>				
	n = 217	n = 59	n/a	n = 276
Yes	74 (34%)	49 (83%)	n/a	123 (44.6%)
No	143 (66%)	10 (17%)	n/a	153 (55.4%)
<b>Diabetes medication</b>				
	n = 254	n = 203	n = 54	n = 511
Yes	231 (90.9%)	189 (93.1%)	53 (96.4%)	473 (92.6%)
No	23 (9.1%)	14 (6.9%)	1 (1.8%)	38 (7.4%)
<b>Other medications</b>				
	n = 174	n = 200	n = 55	n = 429
Yes	161 (92.5%)	179 (89.5%)	41 (74.5%)	381 (88.8%)
No	13 (7.5%)	21 (10.5%)	14 (25.5%)	48 (11.2%)
<b>Comorbidities</b>				
	n = 230	n = 204	n = 55	n = 489
Yes	181 (78.7%)	194 (95.1%)	55 (100%)	430 (87.9%)
No	49 (21.3%)	10 (4.9%)	-	59 (12.1%)

### 3.3 Participant Household, Education, Employment Status and Income

Participant household composition, education, employment status and income were collected at baseline to contextualise programme participation and benefits and understand better the profile of those who took part in the DWELL.

Across sites, most participants lived with others and, in the majority, it was with a partner (n=372, 65%), however, a fourth of participants lived alone (n=140, 24%). There were no particular differences between countries (Table 4).

Table 4 Participant Household composition per country

	Country				
	UK (n=273)	France (n=204)	Belgium (n=44)	Netherlands (n=55)	Total (n=576)
Lives Alone	77 (28.2%)	51 (24.9%)	12 (25%)	-	140 (24.3%)
Lives with a Partner	167 (61.2%)	135 (65.9%)	30 (62.5%)	40 (72.7%)	372 (64.6%)
Lives with Children	69 (25.3%)	50 (24.4%)	7 (14.6%)	16 (29.1%)	142 (24.7%)
Lives with Parent	4 (1.5%)	6 (2.9%)	1 (2.1%)	-	11 (1.9%)
Lives with Housemate	4 (1.5%)	2 (1%)	-	1 (1.8%)	7 (1.2%)
Lives with Other	15 (5.5%)	5 (2.4%)	2 (4.2%)	3 (5.5%)	25 (4.3%)

Most participants were educated up to secondary school level (n = 365, 62%), with Belgium having a relatively higher percentage of participants educated to degree level (n = 23, 48%) (Table 5).

Table 5 Participant Education per country

	Country				
	UK n = 283	France n= 204	Belgium n = 47	Netherlands n= 51	Total n = 585
Cannot read / write	3 (1%)	1 (0.5%)	-	-	4 (0.7%)
Below primary ed	1 (0.4%)	3 (1.5%)	-	-	4 (0.7%)
Primary ed or similar	5 (1.8%)	27 (13.2%)	4 (8.3%)	2 (3.6%)	38 (6.5%)
Secondary ed	185 (65.4%)	126 (61.5%)	19 (39.6%)	35 (63.6%)	365 (62.4%)
University or similar	80 (28.3%)	39 (19%)	23 (47.9%)	2 (3.6%)	144 (24.6%)
Other	9 (3.2%)	8 (3.9%)	1 (2.1%)	-	18 (3.1%)

In terms of employment status, most participants across sites were not in paid employment at the start of the DWELL programme (n = 389, 67%) or never worked (n = 10, 2%). There were some differences per country; in the Netherlands, there were slightly more participants in paid work (n = 30, 54.5%) than not (n = 24, 44%), whereas in France and Belgium only a fifth of participants was in paid work.

Those who were in paid employment reported the number of sick days they took in the past year; responses were very varied per country with UK and Netherlands having the fewer reported sick days (UK - mean = 6.20; Netherlands – mean = 11.45) and France the most reported sick days (mean = 97.47), followed by Belgium (mean = 65.36) These differences could be attributed to particular outlier participants and the different sickness absence policies per country.

Information about the participants' occupation (current or previous) was collected according to the International Standard Classification of Occupations (ISCO-08) and divides jobs in 10 groups. Overall, there was a diversity of occupational groups, mostly concentrating around plant and machinery (n = 105, 18%), other (n = 16%), professional (n = 87, 15%), and managerial (n = 83, 14%). There were differences between the countries. For example, in the UK, there were more participants from professional, other and managerial backgrounds; in France, more plant and machinery

and managerial; in Belgium, more professional and managerial; and, in Netherlands, more other, professional and managerial backgrounds. Details of participant employment status information per country can be found in Table 6.

Table 6 Participant Employment Status per country

	Country				
	UK	France	Belgium	Netherlands	Total
<b>Employment status</b>					
	n = 281	n = 204	n = 45	n = 54	n = 584
In paid work	105 (37.37%)	39 (19 %)	10 (20.8%)	30 (54.5%)	184 (31.5%)
No paid work	173 (61.57%)	157 (76.6%)	35 (72.9%)	24 (43.6%)	389 (66.6%)
Never worked	3 (1.07%)	7 (3.4%)	-	-	10 (1.7%)
<b>Sick Days *</b>					
	n = 103	n = 32	n = 10	n = 29	n = 175
Mean	6.20	97.47	65.36	11.45	45.12
SD	18.40	149.06	128.17	26.15	80.44
<b>Occupation (Current or previous)</b>					
	n = 279	n = 204	n = 47	n = 53	n = 583
Manager	42 (15.1%)	27 (13.2%)	6 (12.5%)	8 (14.5%)	83 (14.2%)
Professional	55 (19.7%)	12 (5.9%)	10 (20.8%)	10 (18.2%)	87 (14.9%)
Technician/assoc. prof	14 (5.0%)	15 (7.3%)	1 (2.1%)	2 (3.6%)	32 (5.5%)
Clerical support	37 (13.3%)	4 (2%)	3 (6.3%)	1 (1.8%)	45 (7.7%)
Services and sales	10 (3.6%)	18 (8.8%)	1 (2.1%)	-	29 (5%)
Agriculture, forestry & fishing	2 (0.7%)	3 (1.5%)	-	2 (3.6%)	7 (1.2%)
Craft & related	16 (5.7%)	1 (.5%)	-	1 (1.8%)	18 (3.1%)
Plant & machinery	7 (2.5%)	92 (44.9%)	2 (4.2%)	4 (7.3%)	105 (18%)
Low skilled job	19 (6.8%)	10 (4.9%)	3 (6.3%)	2 (3.6%)	34 (5.8%)
Home maker	11 (3.9%)	13 (6.3%)	2 (4.2%)	-	26 (4.5%)
Armed forces	2 (0.7%)	1 (.5%)	2 (4.2%)	1 (1.8%)	6 (1%)
Student	2 (0.7%)	-	-	-	2 (0.3%)
Other	54 (19.4%)	2 (1%)	17 (35.4%)	22 (40%)	95 (16.3%)
Not applicable	8 (2.9%)	6 (2.9%)	-	-	14 (2.4%)

\*Relates only to those who reported doing paid work

When asked about their main source of income, most participants were receiving state pension (n = 230, 40%) with a third receiving income from work (n = 150, 26%), reflecting answers given about their employment status. Across all countries, more than half participants reported having money worries either sometimes (n = 258, 44%) or always (n = 95, 16%). There were some differences between countries with most participants in France indicating money worries (n = 142, 69%) whereas participants in Belgium having the lowest level of money worries (n = 17, 35.5%) (Table 7).

Table 7 Participant Income per country

	Country				
	UK	France	Belgium	Netherlands	Total
<b>Main Source of Income</b>					
	n = 284	n = 184	n = 48	n = 54	n = 570
Work	88 (31%)	27 (13.2%)	8 (16.7%)	27 (49.1%)	150 (26.3%)
Early retirement pension	36 (12.7%)	7 (3.4%)	2 (4.2%)	-	45 (7.9%)
Disability pension	10 (3.5%)	8 (3.9%)	1 (2.1%)	-	19 (3.3%)
State pension	94 (33.1%)	98 (47.8%)	26 (52.2%)	12 (21.8%)	230 (40.4%)
Sick leave benefits	2 (0.7%)	3 (1.5%)	7 (14.6%)	1 (1.8%)	13 (2.3%)
Unemployment benefits	16 (5.6%)	7 (3.4%)	2 (4.2%)	8 (14.5%)	33 (5.7%)
Social benefits	8 (2.8%)	17 (8.3%)	-	-	25 (4.4%)
Widow(er) pension	3 (1.1%)	5 (2.4%)	-	-	8 (1.4%)
Private income	7 (2.5%)	1 (0.5%)	-	2 (3.6%)	10 (1.8%)
No financial support	4 (1.4%)	1 (0.5%)	-	1 (1.8%)	6 (1.1%)
Other	16 (5.6%)	10 (4.9%)	1 (2.1%)	3 (5.5%)	30 (5.3%)
<b>Worries about money</b>					
	n = 284	n = 204	n = 48	n = 55	n = 591
Never	117 (41.2%)	62 (30.2%)	31 (64.6%)	28 (50.9%)	238 (40.3%)
Sometimes	119 (41.9%)	100 (48.8%)	14 (29.2%)	25 (45.5%)	258 (43.7%)
Always	48 (16.9%)	42 (20.5%)	3 (6.3%)	2 (3.6%)	95 (16.1%)

## 4. Efficacy of the DWELL programme

To investigate the efficacy of the DWELL programme, metabolic and validated psychometric scales were used to compare baseline and end-of-programme outcomes across all countries. Non-parametric statistical tests (Wilcoxon signed-rank tests) were undertaken on all outcome measures to demonstrate change and assess statistical significance and Cronbach alpha coefficient tests were conducted to assess the scales' internal consistency. Where there is statistically significant difference there is a note indicating this; levels of significance are: \*  $p \leq 0.05$ , \*\*  $p \leq 0.01$ , \*\*\*  $p \leq 0.001$ , and, where 'NS  $p > 0.05$ ' is indicated, it means that the result was not statistically significant (NS).

Results are presented in terms of pre-post DWELL programme comparisons per country and long-term changes 12 months after the end of the programme delivery across sites.

### 4.1 Participant Outcomes at the end of the DWELL Programme

#### 4.1.1 United Kingdom (UK)

##### Metabolic Health

The evaluation study hypothesis was that participation in the DWELL programme would improve participant metabolic health outcomes. In support of this hypothesis, non-parametric statistical analysis, comparing pre-post measures, showed that there were statistically significant reductions in all metabolic health areas for the UK participants (Figure 2):

- Weight loss of 4.05 kg ( $z = -9.798$ ,  $p < .001$ )
- BMI reduction by 0.9 ( $z = -9.249$ ,  $p < .001$ ),
- Waist Circumference reduction of 3cm ( $z = -8.657$ ,  $p < .001$ )
- HbA1c reduction by 4 points ( $z = -6.855$ ,  $p < .001$ )

These findings support an important beneficial impact of the DWELL programme on metabolic indicators of health.

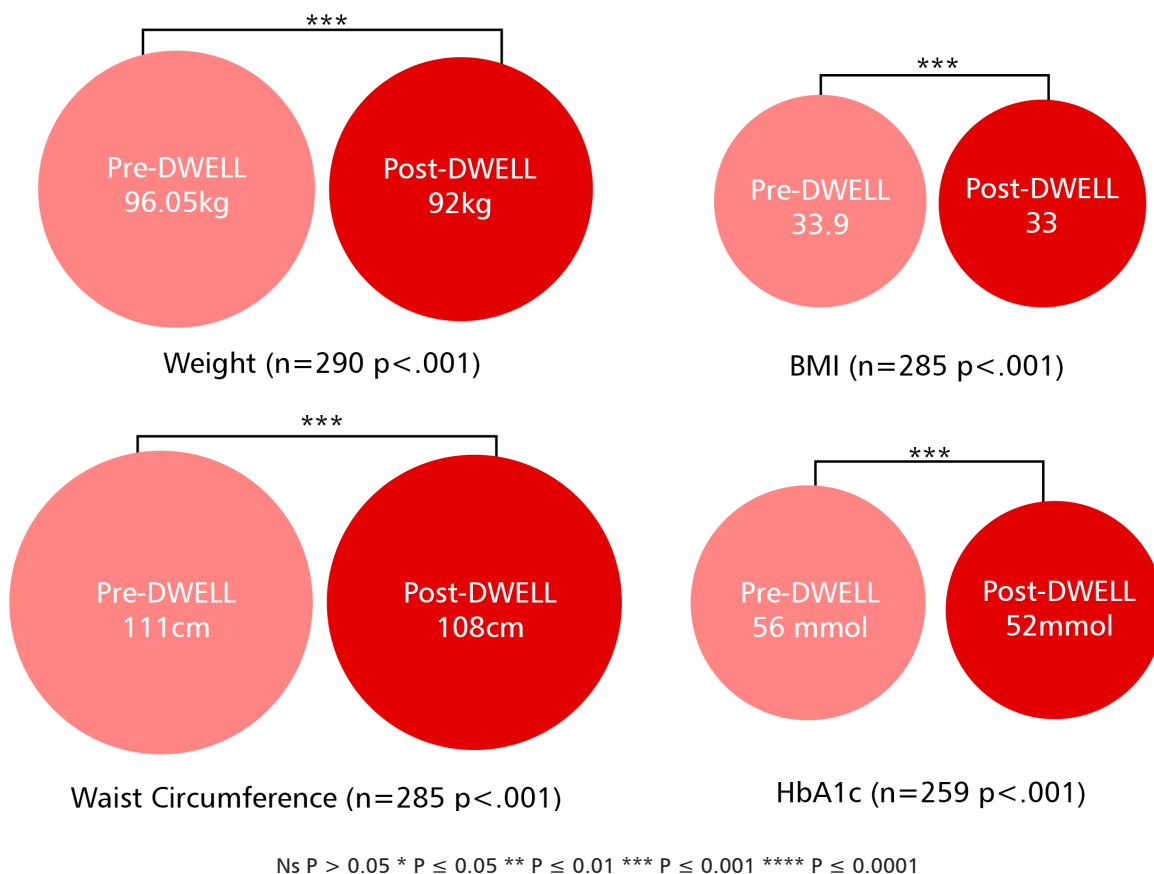


Figure 2 Comparison of Metabolic Health Outcomes pre-post DWELL - UK participants

## Participant Empowerment

A key aim of the DWELL programme was to empower people with type 2 diabetes to improve self-management of their condition. To assess whether the DWELL programme had increased feelings of diabetes-related self-efficacy, DES-SF scores were compared pre-post DWELL. The scale had good internal consistency (Cronbach's  $\alpha$  coefficient = .817).

In support of the study hypothesis, participation in the DWELL programme resulted in an increase in DES-SF scores and the results were statistically significant ( $z = -9.402, p < .001$ ) (Figure 3). This suggests that DWELL met one of its key aims in improving diabetes-related self-efficacy of participants.

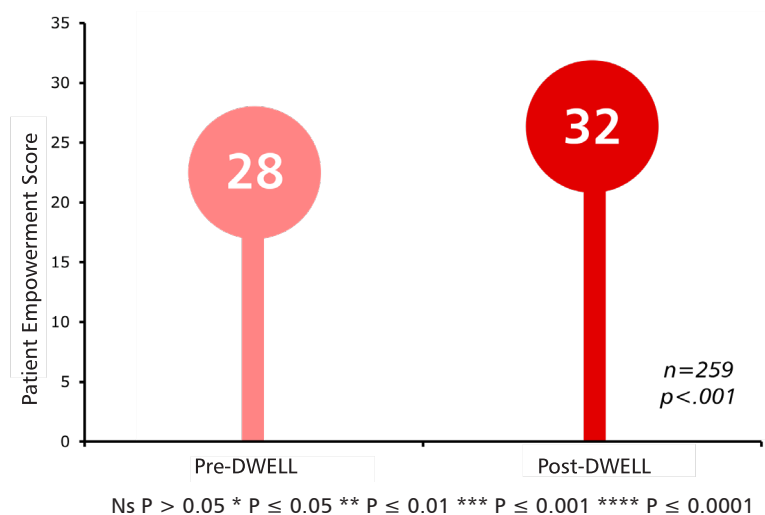


Figure 3 Comparison of Participant Empowerment scores pre-post DWELL - UK participants

## Illness Perceptions

The study hypothesis was that diabetes education, one of the key elements of the DWELL programme, would increase participants' illness coherence, personal control over diabetes, and perceived treatment control. The IPQ-R scale and its sub-scales had good internal consistency (Cronbach's  $\alpha$  coefficient ranging from .80 to .96), with the exception of the treatment control subscale (Cronbach's  $\alpha$  coefficient = .58).

Findings confirmed that there were statistically significant improvements in illness perceptions of UK participants as follows:

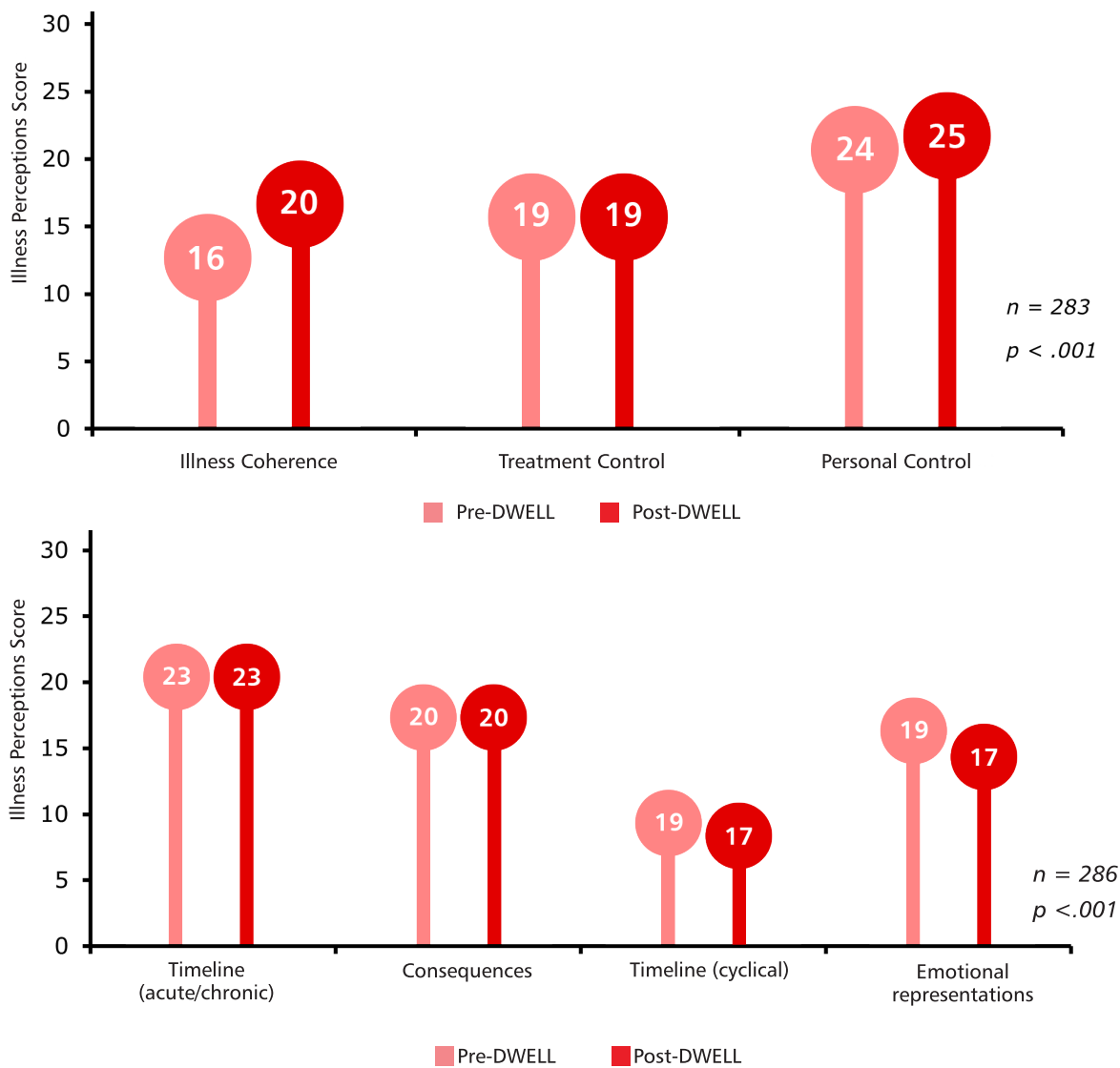
- Illness Coherence increased from 16 to 20 ( $z = -10.099, p < .001$ )
- Personal Control increased from 24 to 25 ( $z = -4.316, p < .001$ )
- Treatment Control remained the same at 19 ( $z = -2.725, p = .006$ )

In addition, due to the wellbeing focus of the DWELL philosophy, it was anticipated that participation in the programme would have a positive emotional impact on participants' emotions towards diabetes, as measured by IPQ-R. In support of this hypothesis, there were improvements as follows:

- Negative Emotions associated with diabetes reduced from 19 to 17 ( $z = -6.650, p < .001$ )
- Negative fluctuation of symptoms of diabetes (timeline cyclical) reduced from 12 to 11 ( $z = -2.023, p = .043$ )
- Length of time that participants anticipated their diabetes would last (timeline acute/chronic) remained the same at 23 ( $z = -2.15, p = .044$ ).

These findings suggest the DWELL programme had a beneficial effect in educating participants to have better understanding about their diabetes and improving their personal control over their condition. UK participants also reported improved positive outlook on their diabetes following the DWELL programme and an improved understanding of the cyclical nature of type 2 diabetes.





Ns *P* > 0.05 \* *P* ≤ 0.05 \*\* *P* ≤ 0.01 \*\*\* *P* ≤ 0.001 \*\*\*\* *P* ≤ 0.0001

Figure 4 Comparison of Illness Perception scores pre-post DWELL – UK participants

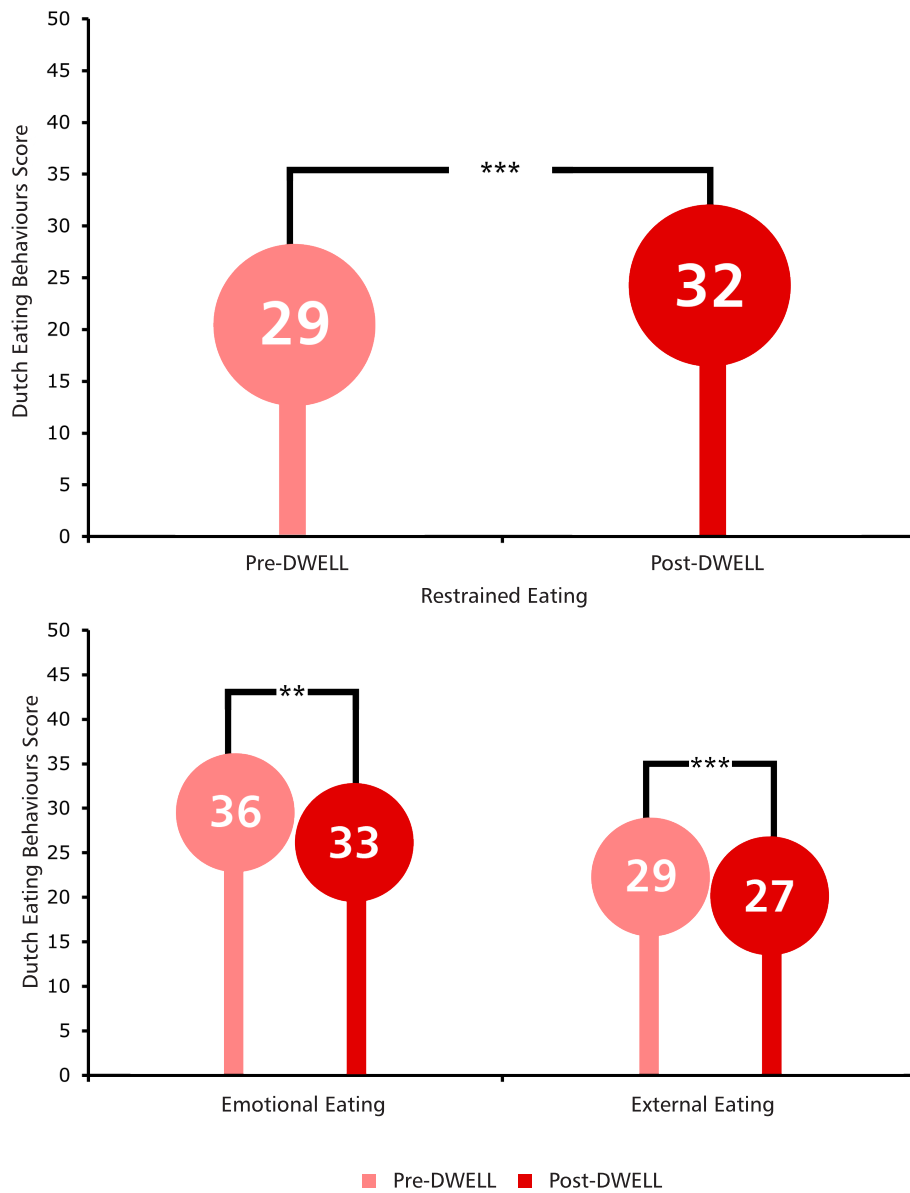
### Eating Behaviours

Following nutrition and education components of the DWELL programme, it was hypothesised that participants' efforts to be aware of and in control of consumption of food (Restrained Eating), would increase, while eating in response to emotions (Emotional Eating) and eating in response to external food cues (External Eating) would decrease. Internal consistency, as measured using Cronbach's alpha, was high across all subscales (Cronbach's  $\alpha$  coefficient ranging from .86 to .95).

In support of this hypothesis, improvements were found as follows:

- Restrained Eating increased from 29 to 32 ( $z = -6.582, p < .001$ )
- Emotional Eating decreased from 36 to 32, ( $z = -3.094, p = .002$ )
- External Eating decreased from 29 to 27 ( $z = -4.830, p < .001$ )

Taken together, these findings demonstrate beneficial effects of the DWELL programme on eating behaviours, with UK participants reporting more in control of their eating, and less influenced by emotional and external food cues.



Ns  $P > 0.05$  \*  $P \leq 0.05$  \*\*  $P \leq 0.01$  \*\*\*  $P \leq 0.001$  \*\*\*\*  $P \leq 0.0001$

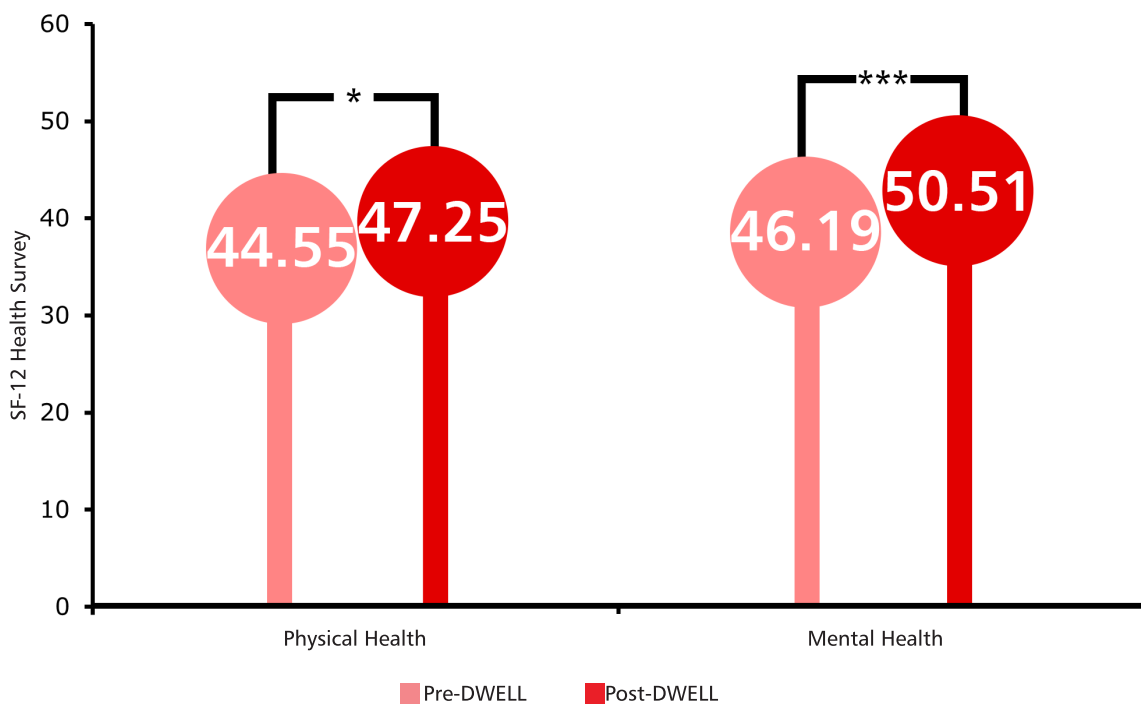
Figure 5 Comparison of Eating Behaviours scores pre-post DWELL – UK participants

### Physical and Mental Health

It was hypothesised that participant physical and mental health would improve following participation in the DWELL programme. Internal consistency for the SF-12 scale was good (Cronbach's  $\alpha$  coefficient Physical Health = .82, Mental Health = .76).

Findings support the study hypothesis by confirming statistically significant changes as follows (Figure 6):

- Physical health increased from 44.55 to 47.25, ( $z = -2.240$ ,  $p = .025$ )
- Mental health increased from 46.19 to 50.51 ( $z = -3.648$ ,  $p = <.001$ )



Ns P > 0.05 \* P ≤ 0.05 \*\* P ≤ 0.01 \*\*\* P ≤ 0.001

Figure 6 Comparison of Physical and Mental Health scores pre-post DWELL – UK participants

### Self-care Behaviours

To assess diabetes-related self-care behaviours, participants reported the advice they recalled receiving from their health team on diet, exercise, monitoring blood sugars and medication pre-post DWELL. These findings are presented in Figures 7, 8, 9, 10 and 11. Participants with missing items were removed (pre-DWELL sample = 295, post-DWELL sample = 221)<sup>1</sup>.

Dietary advice given by healthcare teams to participant was varied, however, there was an increase in each area when pre-post DWELL responses were compared. As expected for people with diabetes, “Eat lots of fruit and vegetables” was the most common advice pre-DWELL (43.9%) and post-DWELL (57.5%), while “Other” had the lowest response pre-DWELL (10.7%) and post-DWELL (12.2%). The only time this was not the case was the identification of “no dietary advice given” item. Although this may suggest that health professionals were giving more specific advice, this could also suggest that participants were more engaged with healthcare teams or more broadly that as participants learnt more about their disease, could better identify specific approaches to diet and were better able to grasp complex information regarding their illness, they had a better ability to recall discussing these subjects with their healthcare team.

<sup>1</sup> No measure of statistical significance was carried out on these comparisons.

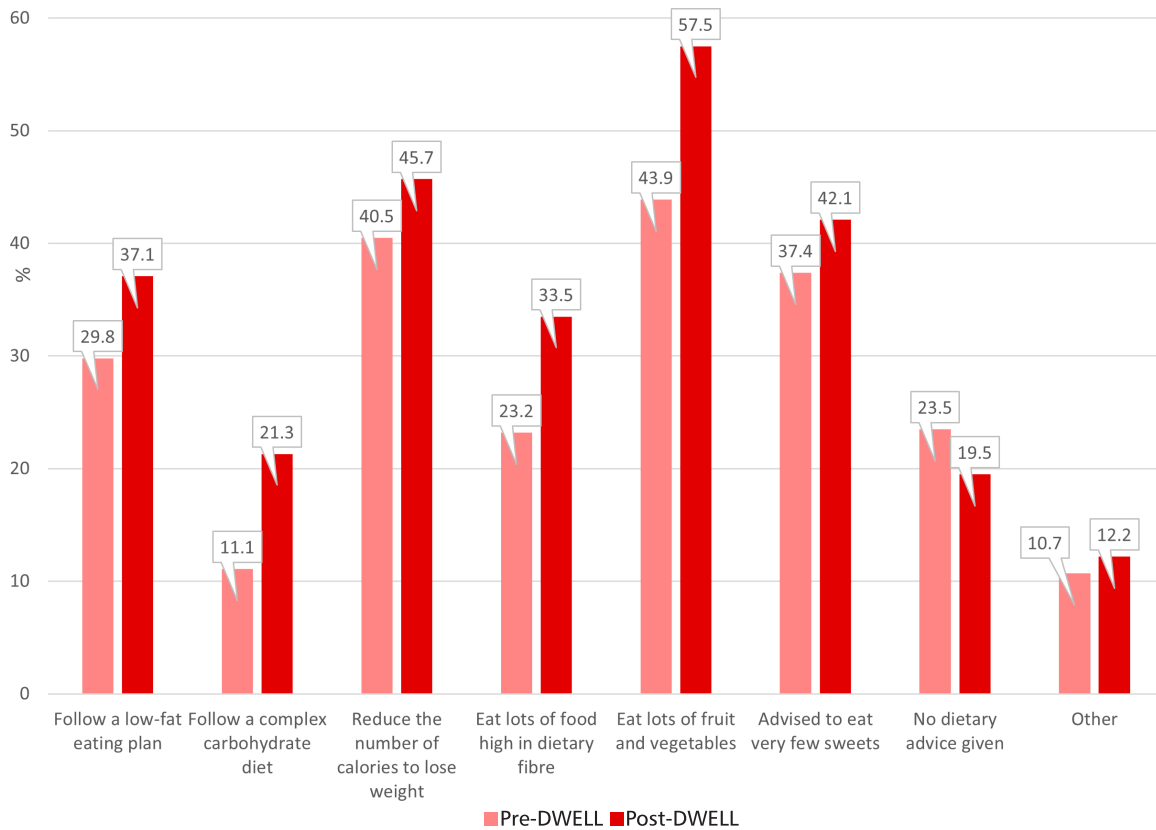


Figure 7 Reported dietary advice from healthcare team pre-post DWELL – UK participants

This pattern of increased reporting at the end of the programme continued with exercise advice. This supports the previous suggestion that participants increased their understanding and their ability to take on advice.

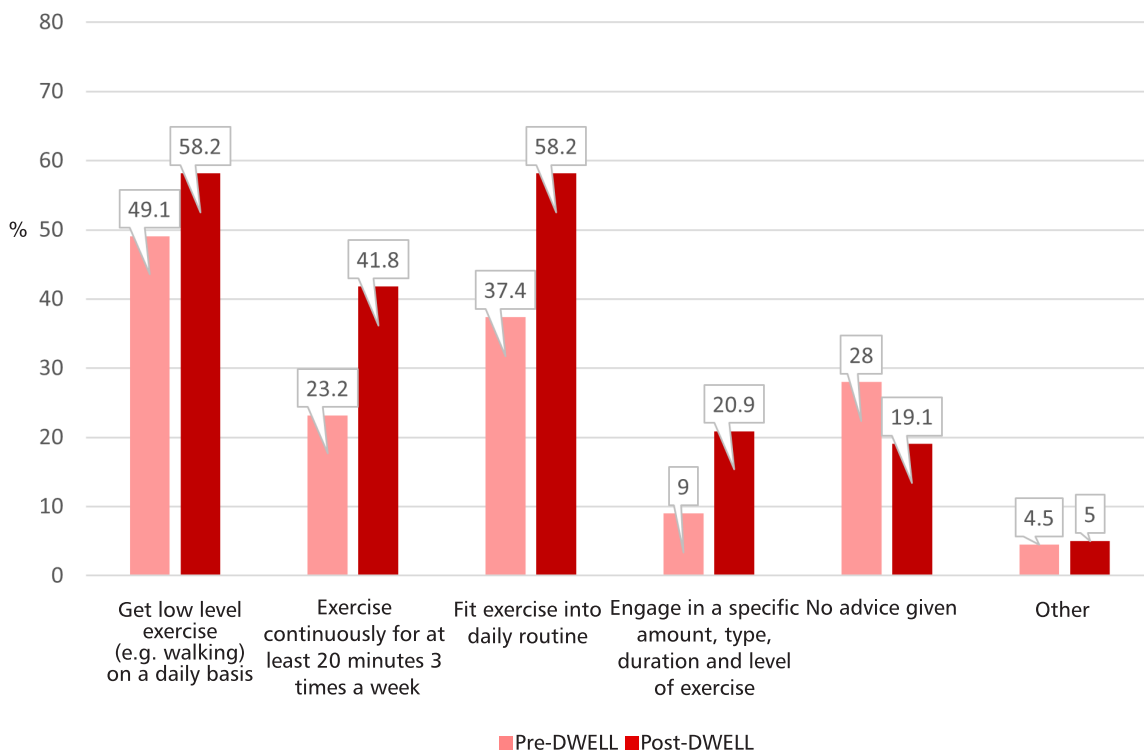


Figure 8 Reported exercise advice from healthcare team pre-post DWELL – UK participants

In terms of reported blood sugar testing advice, responses remained consistent pre-post DWELL. This might be expected with such specific advice likely to be key part of routine diabetes care regime by professionals, therefore attendance in a psychoeducational programme would not affect it much.

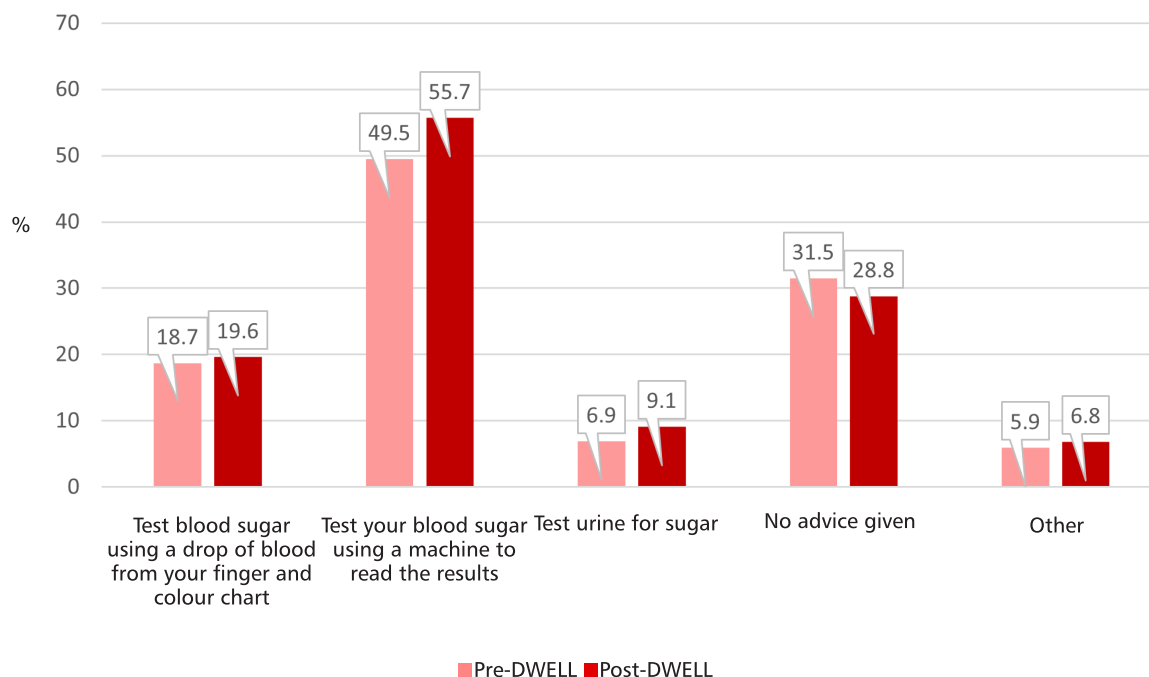


Figure 9 Reported blood sugar measurement advice from healthcare team pre-post DWELL – UK participants

Participant recollection of medication advice remained very consistent pre-DWELL and immediately post-DWELL. This is likely to be because the specificity of the advice, the regularity of taking medication, the importance medication plays for management of diabetes and the straightforward relationship between medication adherence and health improvement, mean medication advice remains in the forefront of participants’ minds. This may mean that participant education during the DWELL programme has less impact on participant medication adherence than other areas of advice such as diet or exercise.

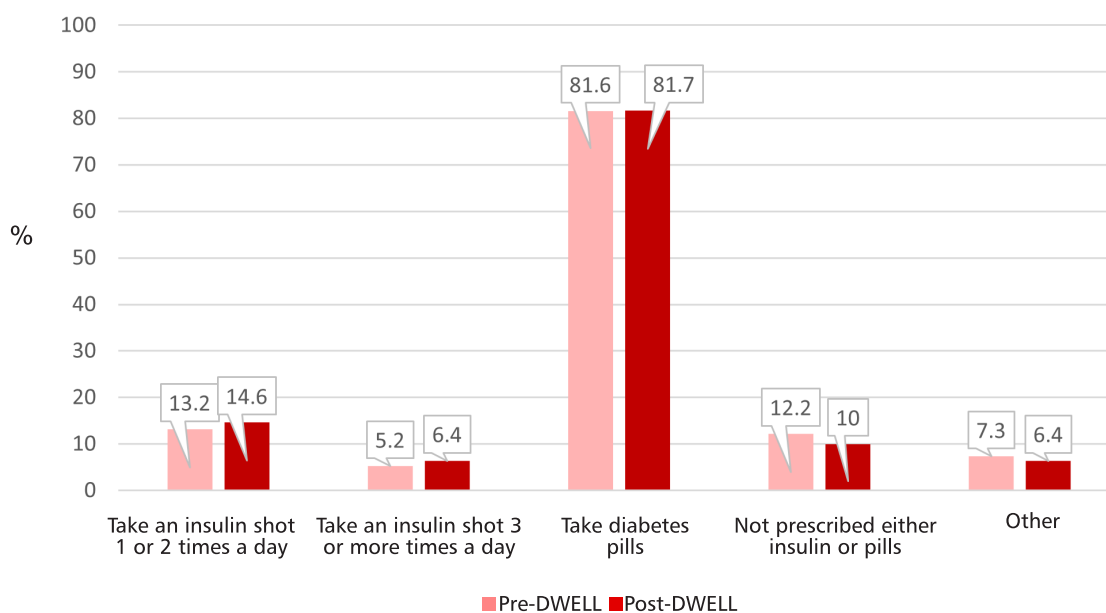


Figure 10 Reported medication prescription from healthcare team pre-post DWELL – UK participants

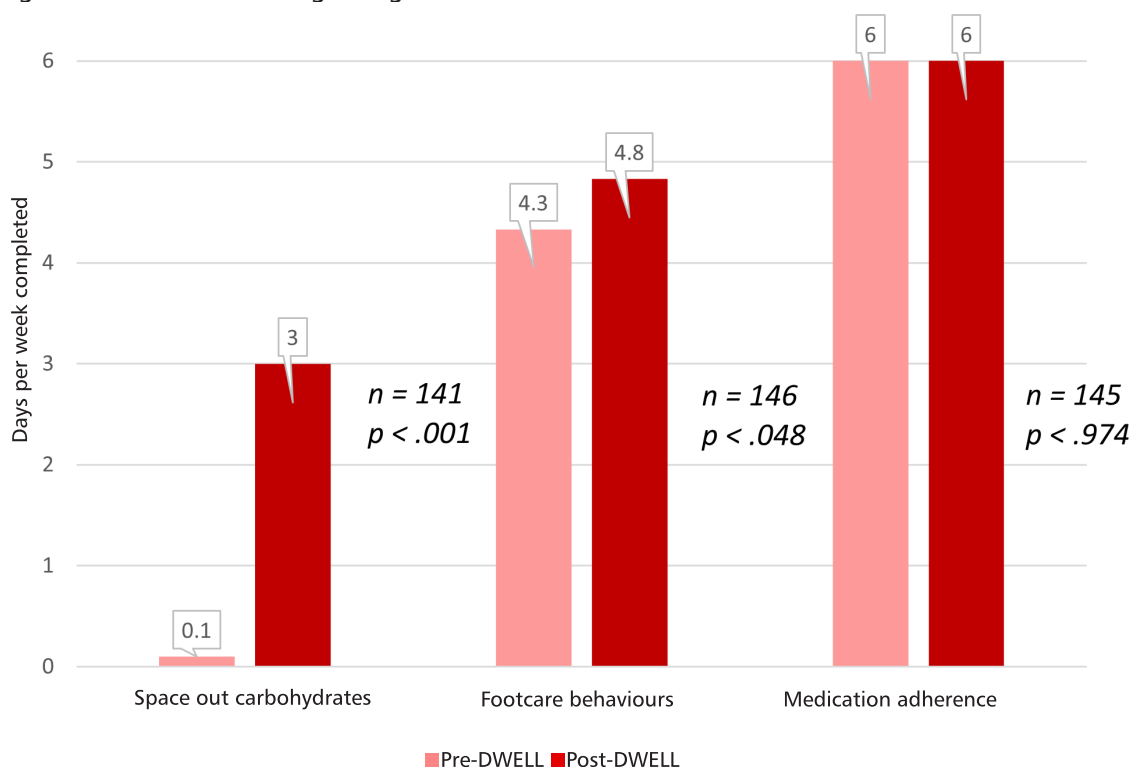
Also, statistical comparison tests pre-post DWELL were conducted in relation to median number of days per week that participants engaged in diet, footcare and medication adherence self-care behaviours (Figure 11).

Adherence to taking prescribed medications did not improve following DWELL remaining at 6 ( $z = -.033, p = .974$ ). Almost all participants took their medication every day, suggesting regularity, therefore no particular improvements would be expected when participants were already consistently adhering to medication advice.

The above increased reporting on dietary advice was also reflected in reported adherence to diet self-care behaviours, with a marked improvement in participants reporting the spacing out carbohydrates. This rose from a median average of much less than one day a week pre-DWELL to three days post-DWELL ( $z = -4.209, p < .001$ ). This suggests that participants appeared to have learnt more about nutrition and could better identify specific approaches to diet, were better able to grasp complex information regarding dietary habits and take more care over their diet once they had completed the DWELL programme.

Footcare adherence scores were calculated from an average number of days participants followed recommendations of washing their feet, drying between their toes and not soaking feet. Following DWELL, footcare behaviours were improved to an average half a day more relative to baseline ( $z = -1.974, p = .048$ ).

Findings demonstrate that following participation in the DWELL programme, participants were more regularly undertaking self-care behaviours regarding diet and footcare.



Ns P > 0.05 \* P ≤ 0.05 \*\* P ≤ 0.01 \*\*\* P ≤ 0.001 \*\*\*\* P ≤ 0.0001

Figure 11 Comparison of diet, footcare and medication adherence self-care behaviours pre-post DWELL – UK participants

### Physical Activity

To assess levels of physical activity, participants completed the International Physical Activity Questionnaire (IPAQ). In line with the scale's instructions, participants who presented as outliers, had missing data, or who reported they did not know how much time they spent on exercise were removed from the analysis. This resulted in reduced sample for analysis consisting of 95 participants. Pre-post DWELL comparisons of median MET minutes per week for vigorous, moderate, walking and total activity were calculated and are presented in Figure 12.

As physical activity was a core part of the DWELL programme, it was hypothesised that there would be an increase post-DWELL. In support of this hypothesis, findings suggest the following improvements:

- Total MET-minutes per week increased from 1386 to 2040 MET-minutes ( $z = -2.821, p = .005$ )
- Moderate activity increased in 0.1 - 120 ( $z = -1.302, p = .193$ ); however, the difference was non-statistically significant
- Vigorous activity remained the same 0.1 – 0.1 ( $z = 2.942, p = .003$ )
- Walking activity increased from 693 to 732 ( $z = -676., p = .499$ ); however, the difference was non-statistically significant

These results indicate that the total physical activity levels improved for UK DWELL participants. In relation to particular types of activity, although they showed some positive changes, analysis did not support any statistically significant results.

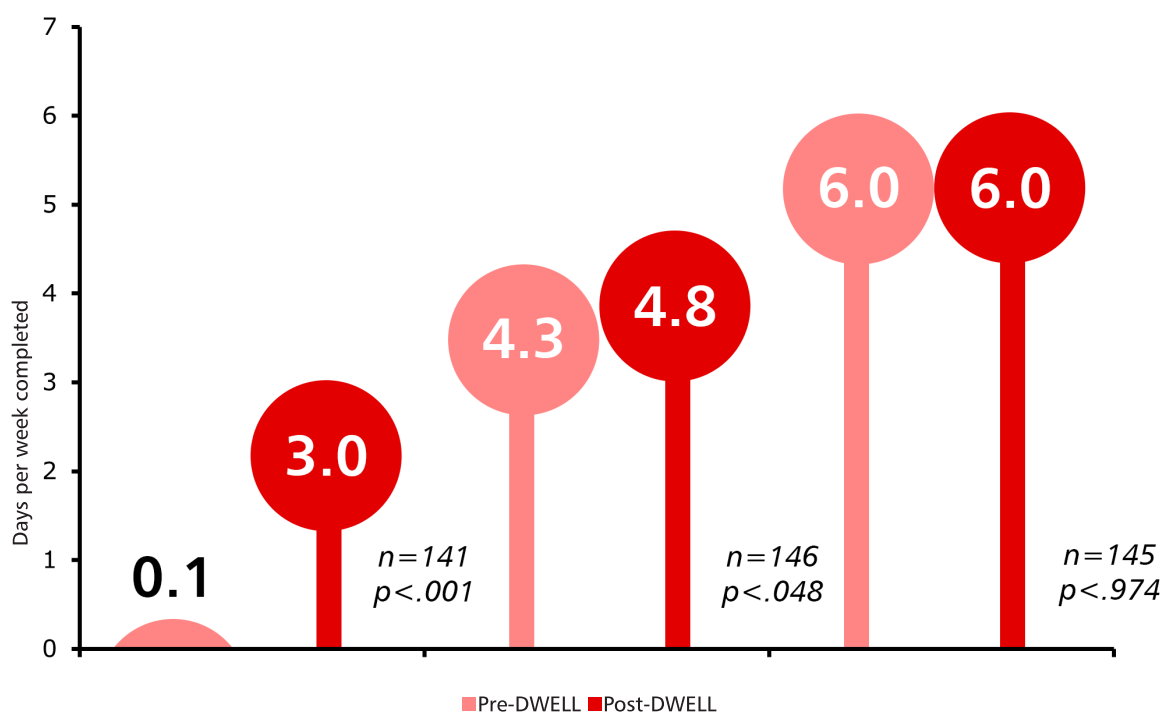


Figure 12 Median MET-minutes per week spent on vigorous, moderate, walking and total physical activity pre-post DWELL – UK participants

### Health-related Quality of Life

Health-related Quality of life was measured by the European Quality of Life - 5 Dimensions - 3 Level Version questionnaire (EQ-5D-3L) (EuroQol Group 2009). EQ-5D-3L is a generic tool for Patient Reported Outcomes (PRO) that assesses patients' quality of life, irrespective of the disease. The visual analogue scale (EQ VAS) from this measure was used to record participant's self-rating of health on a visual scale, expressed as 0 (the worst health imaginable) to 100 (the best health imaginable).

There was a clear improvement in participants' health when measured on this visual scale when pre-post DWELL results were compared from 60 to 75 ( $z = -4.925, p = <.001$ ).

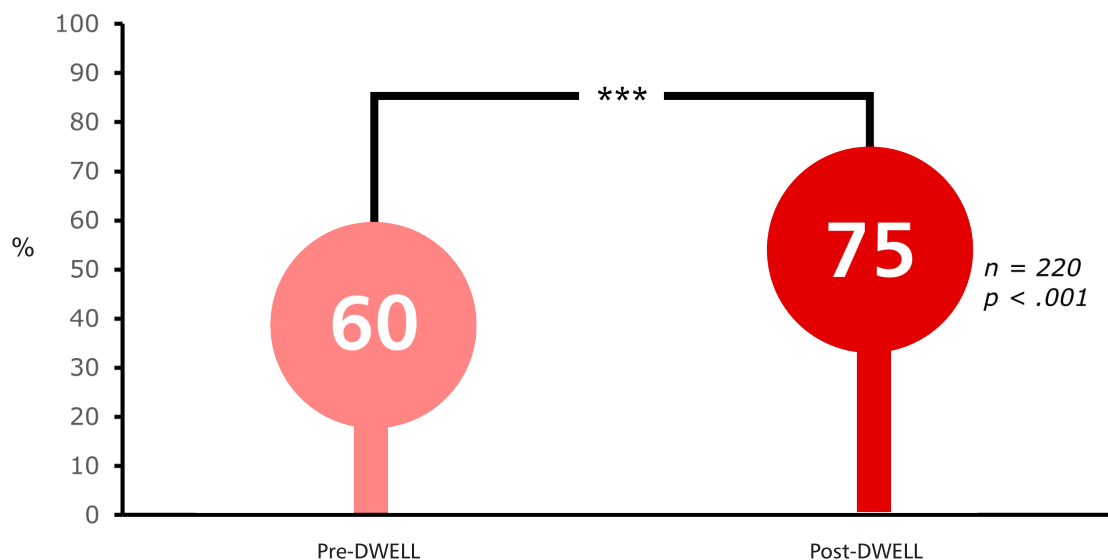


Figure 13 Health-related Quality of Life scores pre-post DWELL – UK participants





## 4.1.2 France

### Metabolic Health

Analysis of metabolic health outcomes for French DWELL participants showed significant improvements:

- Weight reduction of 2.7 kg ( $z = 4.645, p = <.000$ )
- Waist circumference reduction of 3cm ( $z = 5.321, p = <.000$ )
- HbA1c reduction of 5.6 mmol/mol ( $z = 3.813, p = <.000$ )

These findings support a beneficial impact of the DWELL programme on metabolic health outcomes. However, BMI remained consistent post-DWELL – pre - 33.6 – post - 33.7 ( $z = 4.006, p = <.000$ ).

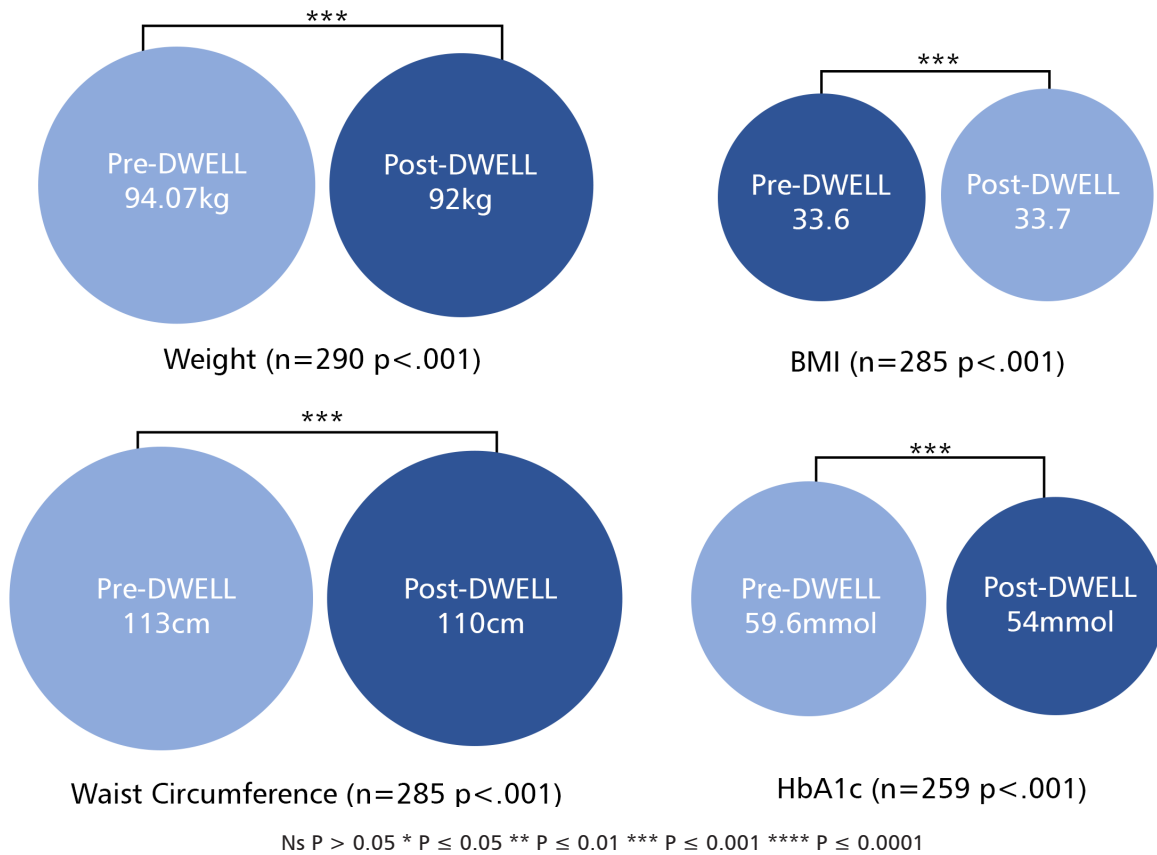


Figure 14 Comparison of metabolic health outcomes pre-post DWELL - French participants

### Participant Empowerment

In France, participation in the DWELL programme resulted in a statistically significant increase in median DES-SF participant scores from 27 to 31 ( $z = 7.721, p = <.001$ ). These results support DWELL's impact on participants' empowerment and self-efficacy levels, a key aim of the DWELL programme.

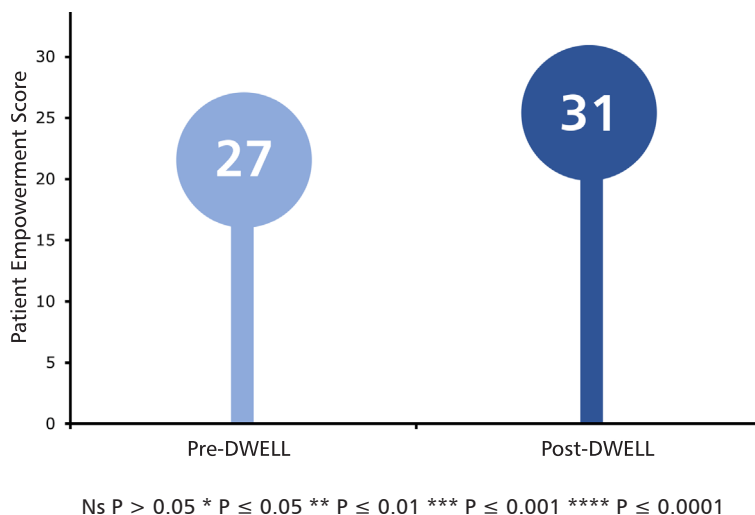


Figure 15 Comparison of Participant Empowerment scores pre-post DWELL – French participants

## Illness Perceptions

Results from the French participants broadly match those of the UK:

- Illness Coherence improved from 17 to 19 ( $z = -6.290$ ,  $p < .001$ )
- Personal Control improved from 23 to 24 ( $z = -3.104$ ,  $p < .002$ )
- Negative Emotions associated with diabetes reduced from 18 to 16 ( $z = -.204$ ,  $p < .001$ )
- Treatment Control scores remained the same at 19 ( $z = -1.803$ ,  $p = .071$ )
- Length of Time anticipated diabetes would last (timeline acute/chronic), remained the same at 24 - 25 ( $z = -.850$ ,  $p = .395$ )
- Negative life consequences of diabetes remained the same at 18 ( $z = -1.908$ ,  $p = .056$ )

Findings suggest that the DWELL programme in France had a beneficial effect in educating participants about their diabetes, changing positively attitudes towards diabetes and improving their personal control over their condition.

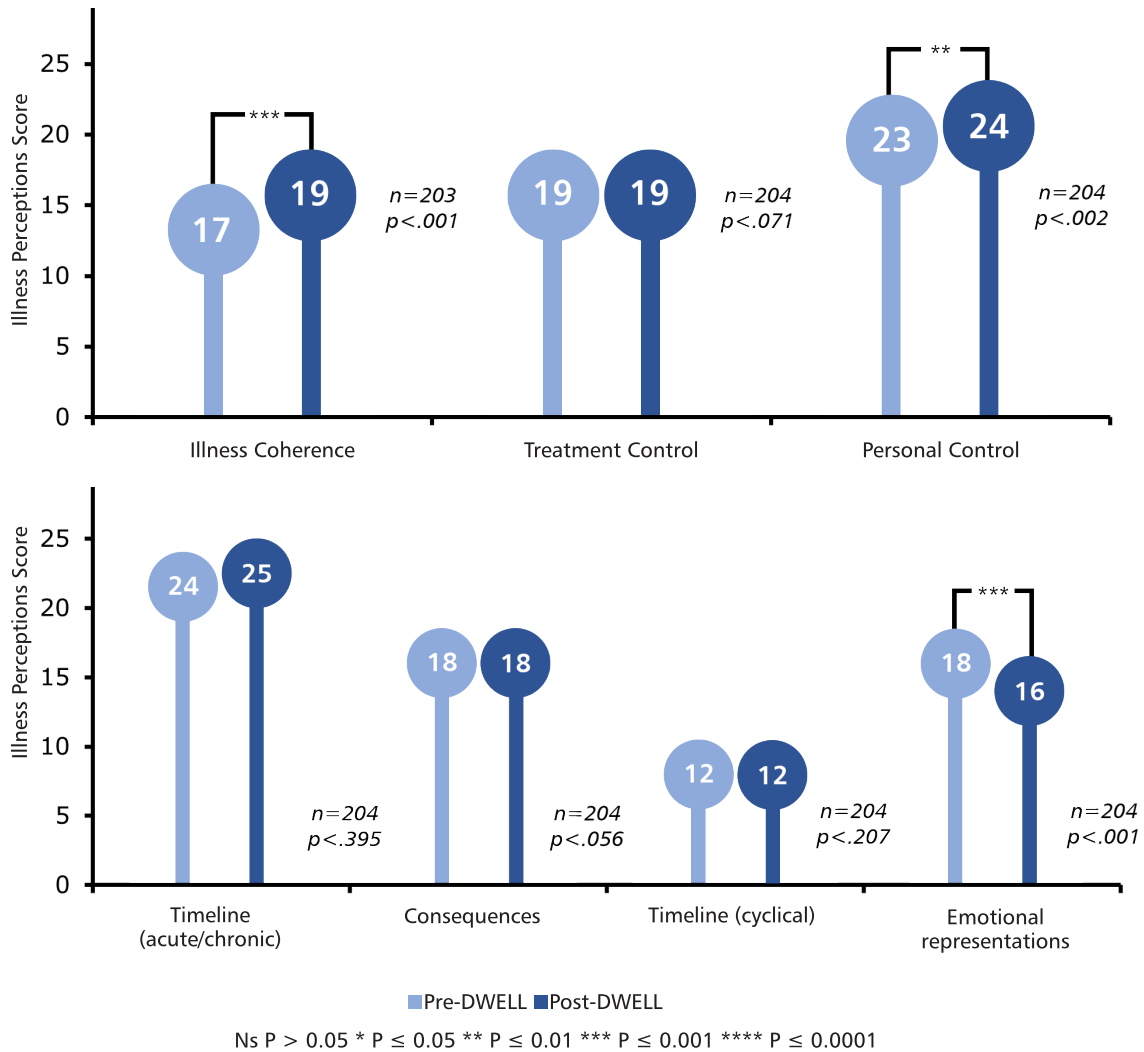


Figure 16 Comparison of Illness Perception scores pre-post DWELL – French participants

## Eating Behaviours

In terms of eating behaviours, French participants reported positive changes similar to the UK:

- Emotional Eating was reduced from 27 to 26 ( $z = -2.677$ ,  $p = .007$ )
- External Eating was reduced from 23 to 21 ( $z = -4.049$ ,  $p < .001$ )

These findings demonstrate beneficial effects of the DWELL programme on participants' psychological responses to food, with participants less influenced by emotional and external food cues. Restraint eating remained the same at 30 ( $z = -1.891$ ,  $p < .059$ ).

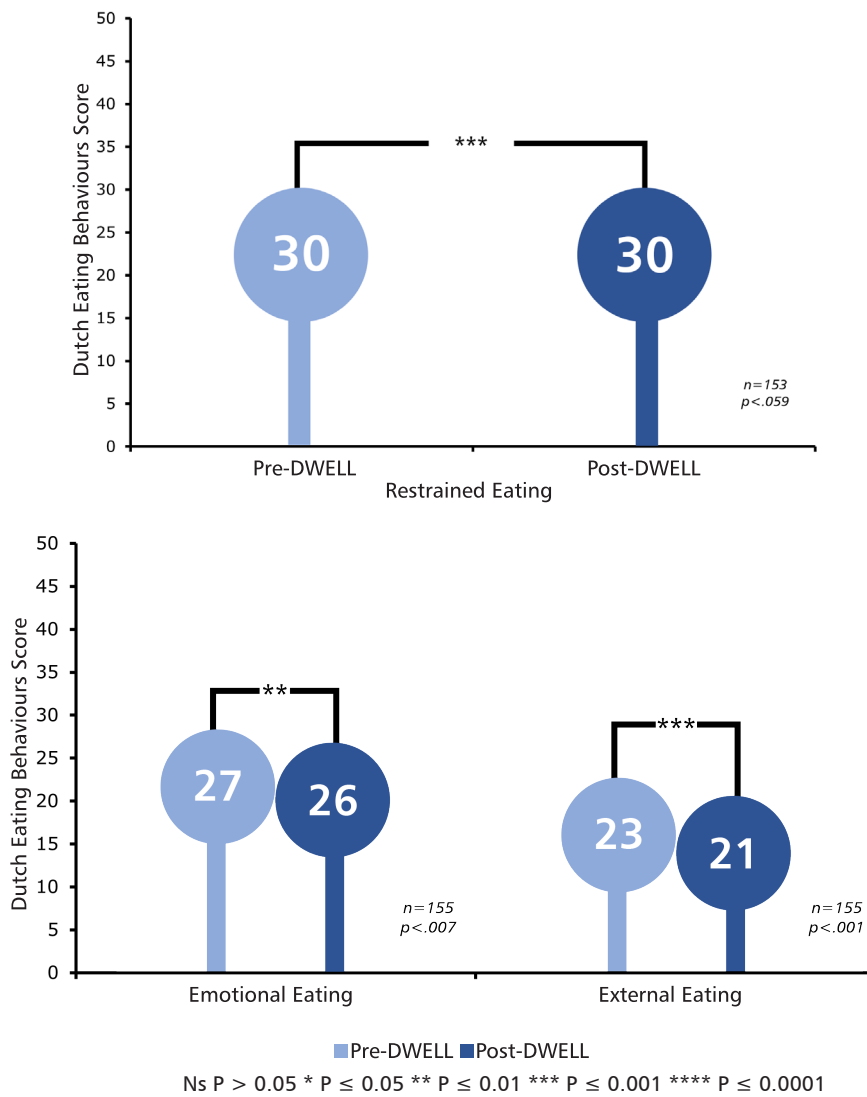


Figure 17 Comparison of Eating Behaviours scores pre-post DWELL – French participants

### Physical and Mental Health

Like the UK, positive change in perceived physical and mental health confirmed the study hypothesis:

- Improved Physical Health 41.7 – 45.8 (z = -3.768, p < .001)
- Improved Mental health, 42.7 – 46 (z = -2.749, p = .006).

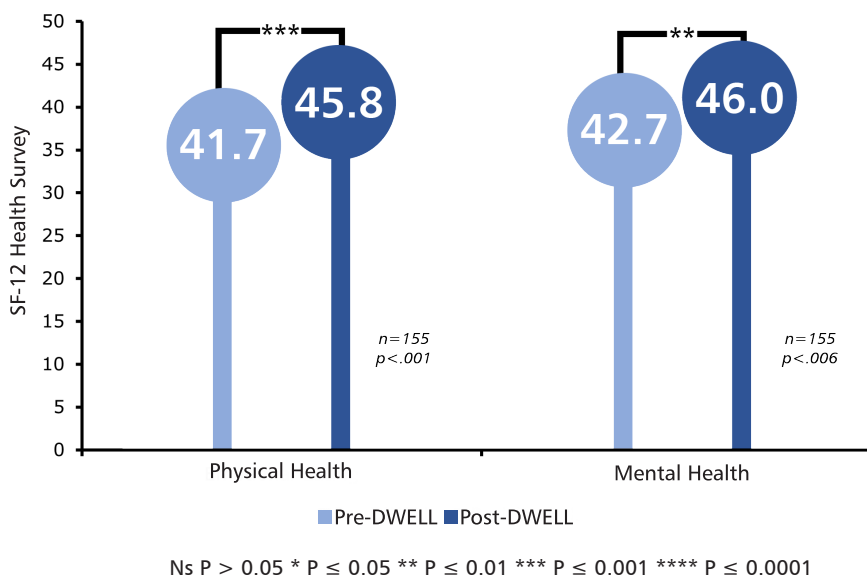


Figure 18 Comparison of Physical and Mental Health scores pre-post DWELL – French participants

## Self-care Behaviours

Relative to the UK, much fewer participants in France reported receiving “no dietary advice”, with only 6.4% pre-DWELL compared to 23.5% in the UK and immediately post-DWELL 2.6% compared to 19.5% in the UK. Moreover, unlike the UK dietary advice, pre-post DWELL dietary advice remained relatively stable. This difference between countries is likely to be due to broader cultural and social focus on food, which has traditionally been associated with France. Advice relating to “hunger and satiety” and “no foods off limits” appears to increase at the end of the DWELL programme which could be a result of particular education on nutrition during the programme.

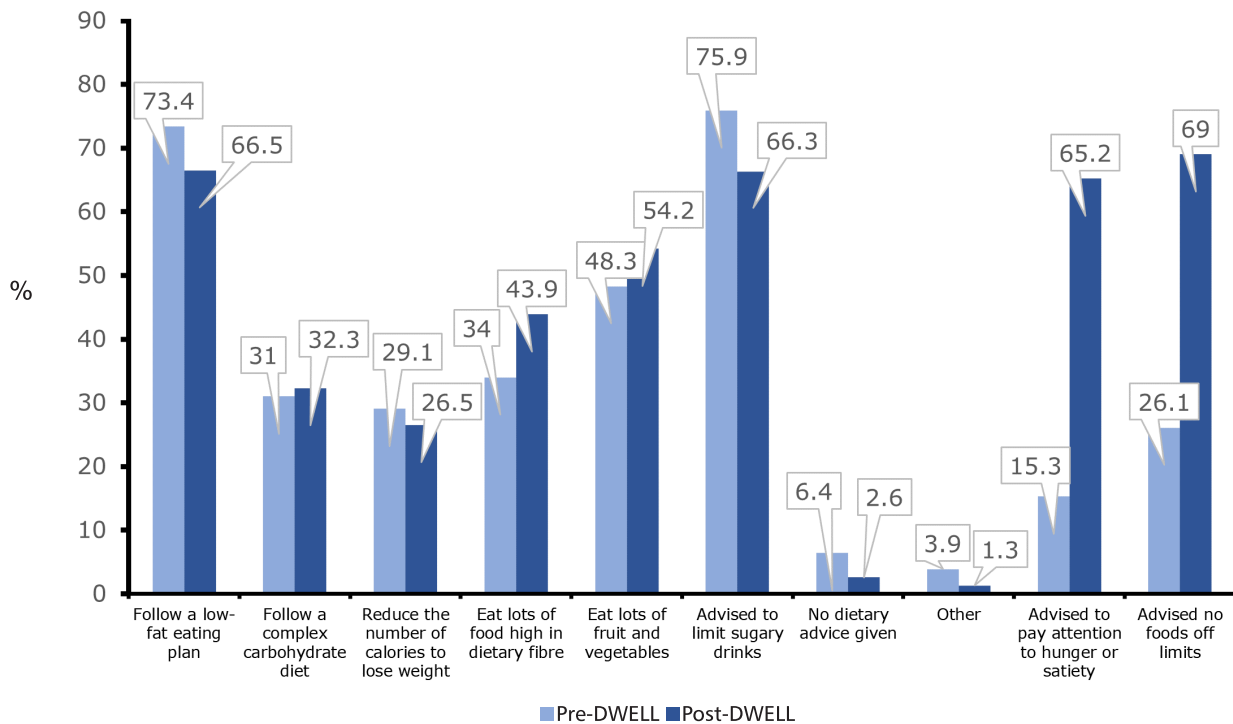


Figure 19 Reported dietary advice from healthcare team pre-post DWELL – French participants

Other than the “no advice” option, there was an increase in the exercise advice participants recalled being given by their healthcare teams when pre- and immediately post-DWELL were compared. These results reflect those of the UK much more closely and therefore suggest that again participants either received more advice, were more engaged in their treatment or more able to recall healthcare advice once they had completed the DWELL programme.

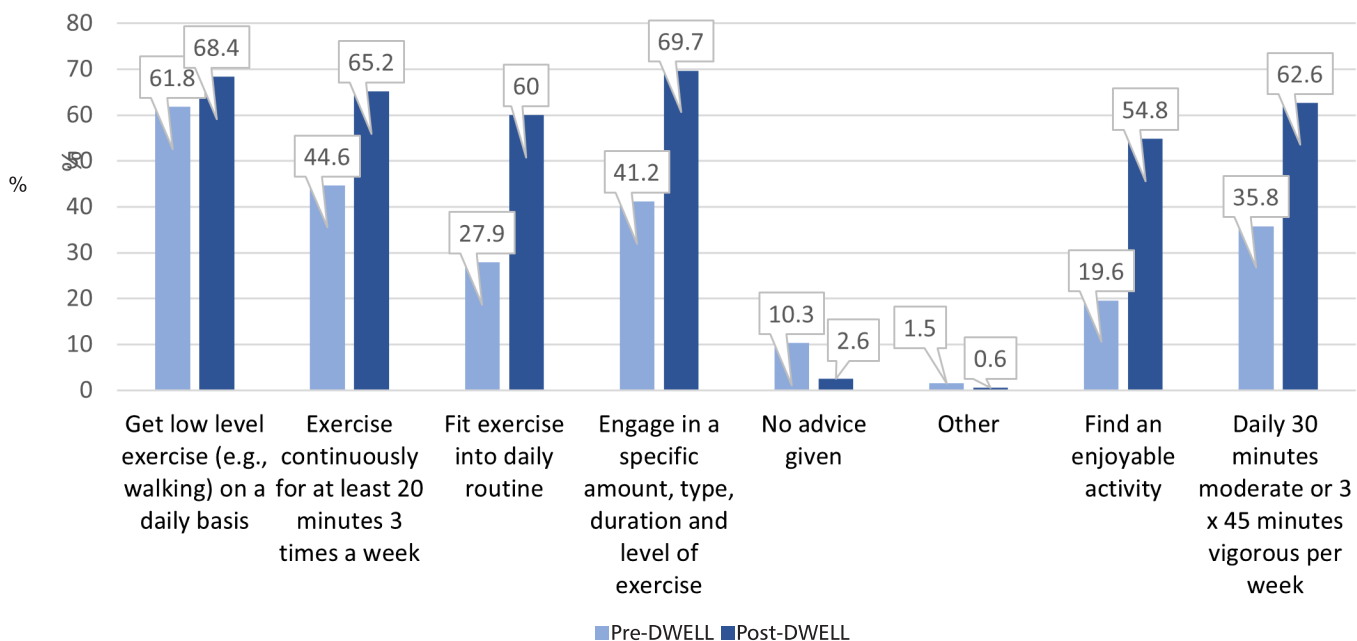


Figure 20 Reported exercise advice from healthcare team pre-post DWELL – French participants

France had very similar results to the UK in participant recollection of blood sugar measurement advice, which remained same pre-post DWELL. This could mean that the DWELL programme has less of a significant impact on whether participant's recollect blood sugar measurement advice compared to other areas of advice such as diet or exercise.

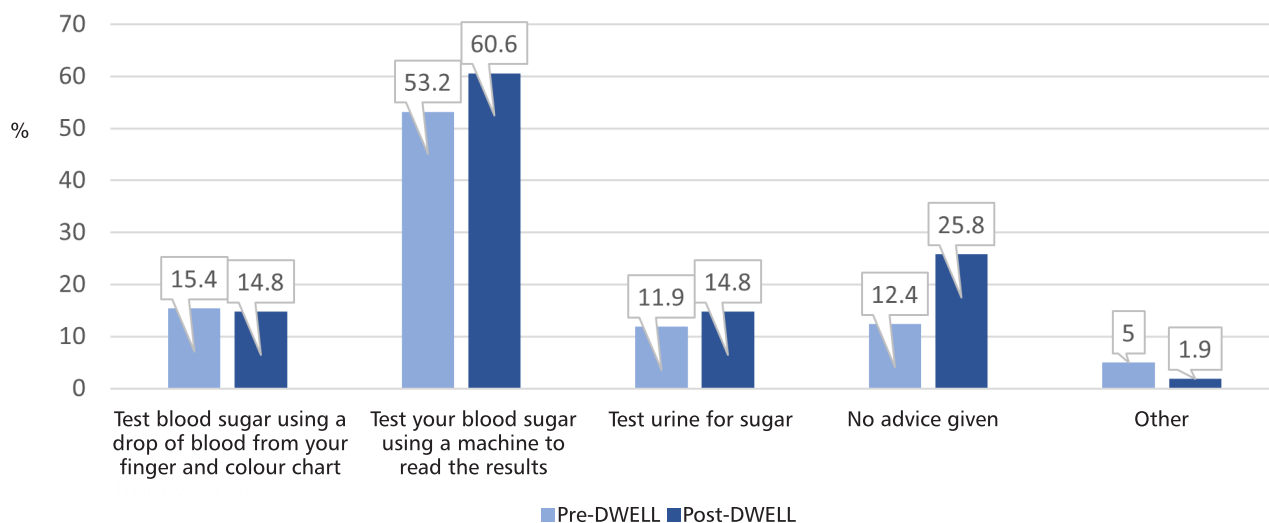


Figure 21 Reported blood sugar measurement advice from healthcare team pre-post DWELL – French participants

Similar to UK, participants' recollection of advice about medication prescription remained stable pre-post DWELL, confirming the straightforward relationship between medication adherence and health improvement, which means medication advice was both a focus of healthcare teams and remained in the forefront of participants' minds.

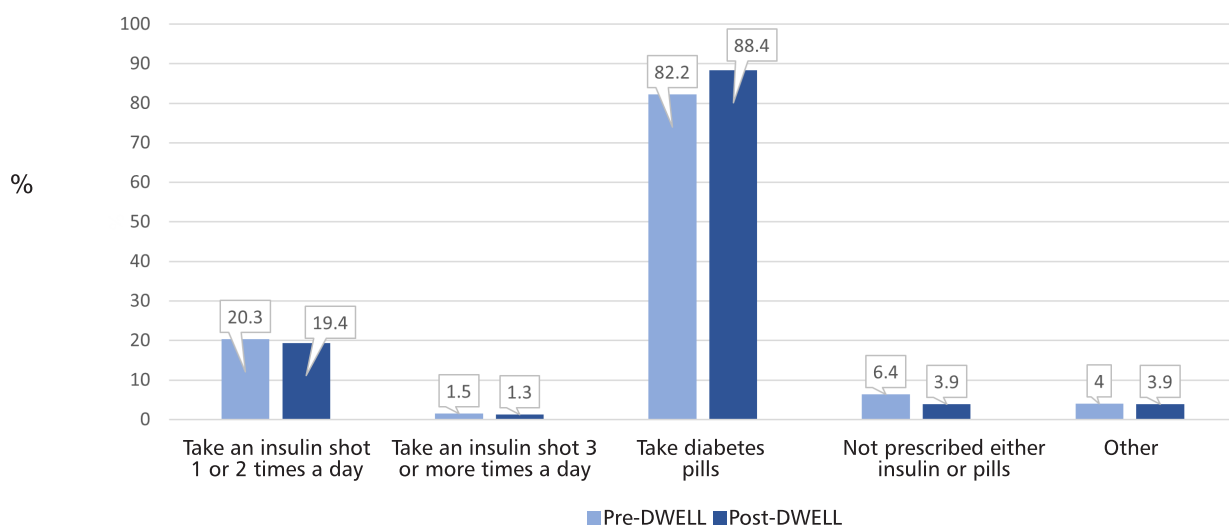


Figure 22 Reported medication prescription from healthcare team pre-post DWELL – French participants

In France, data was also gathered on footcare advice. These results suggest that footcare advice was an aspect of self-care which became more pertinent after participants had attended the DWELL programme. Participants' recollection of advice increased in all areas of footcare, apart from the "other" and "no advice given" options which fell. Once again, this may be because healthcare teams mentioned this aspect more, however, it is likely that participants in the DWELL programme became more engaged with their disease leading to a better understanding, more inclination to engage in subjects with their healthcare team and a greater ability to recollect important aspects of diabetes.

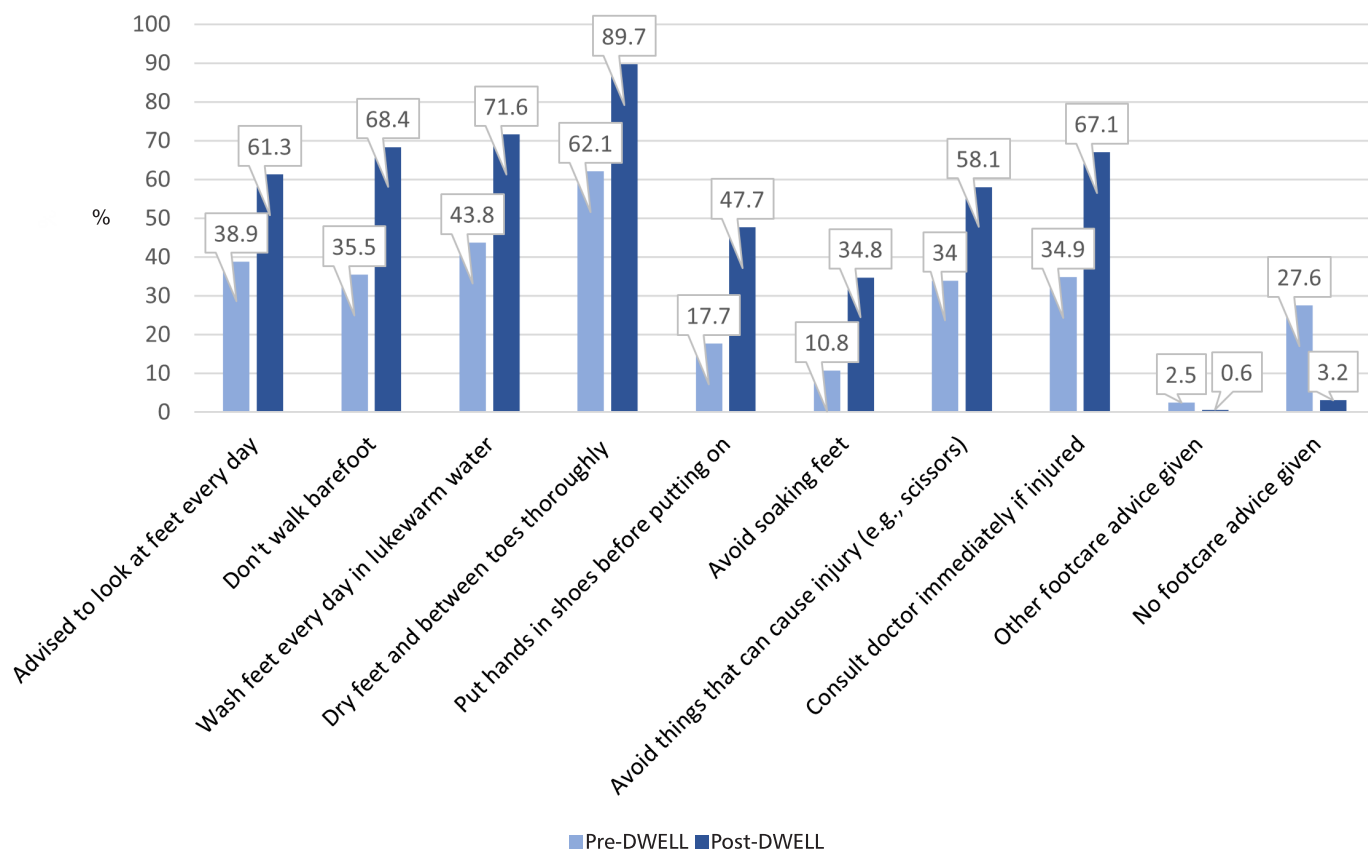


Figure 23 Reported footcare advice from healthcare team pre-post DWELL – French participants

In terms of daily adherence to spacing carbohydrate intake, washing and drying but not soaking feet and taking prescribed medication, French data showed no change pre-post DWELL; carbohydrate intake remained at 3 days per week ( $z = -2.655, p = .008$ ), footcare behaviours remained at 4.3 days a week ( $z = -3.691, p < .001$ ) and medication adherence remained at 3 days per week ( $z = -1.912, p = .056$ ). These results differed from the UK ones, possibly indicating the different care systems and protocols between countries.

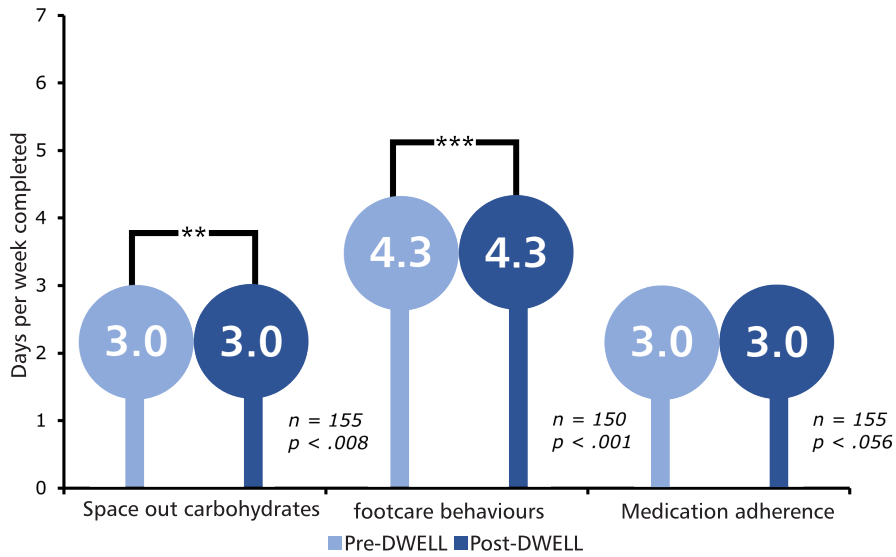


Figure 24 Comparison of diet, footcare and medication adherence self-care behaviours pre-post DWELL – French participants

### Physical Activity

When physical activity was compared pre-post DWELL in France, all activity measures indicated an increase, however, only the walking activity results were statistically significant. This lack of statistical significance might be due to relatively low response rate in this scale:

- Total MET-minutes per week increased from 1671 to 2226 MET-minutes ( $z = -1.751$ ,  $p = .080$ )
- Walking activity increased from 396 to 693 ( $z = -2.695$ ,  $p = .007$ )
- Moderate activity increased from 520 to 780 ( $z = -.514$ ,  $p = .607$ ); however, the difference was non-statistically significant
- Vigorous activity remained the same 0 ( $z = -2.177$ ,  $p = .029$ )

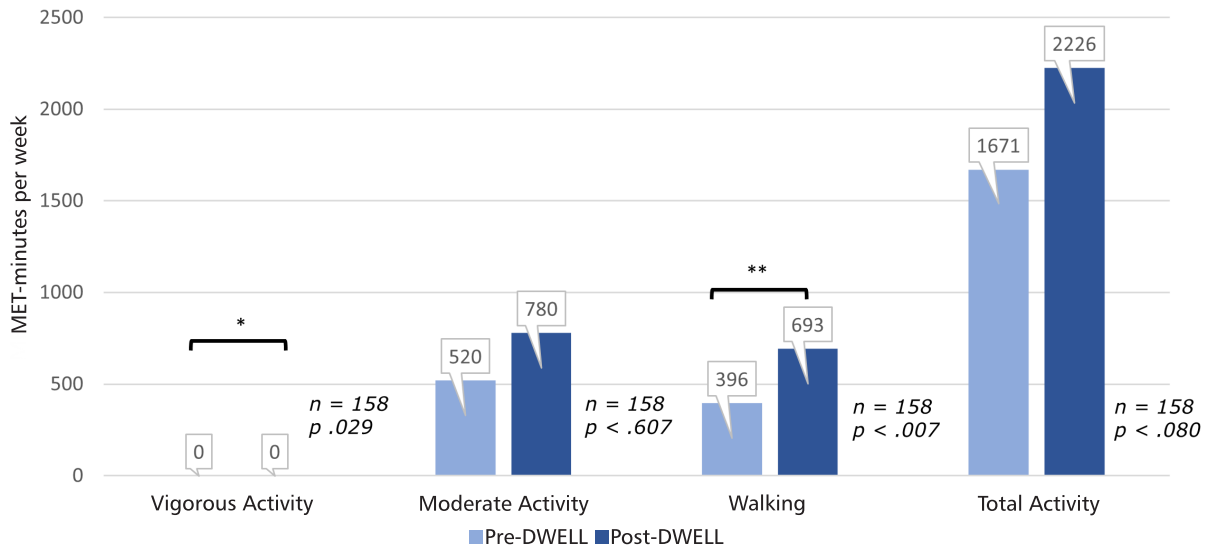


Figure 25 Median MET-minutes per week spent on vigorous, moderate, walking and total physical activity pre-post DWELL – French participants

### Health-Related Quality of Life

The EQ visual analogue scale (EQ VAS) records respondent's self-rating of health on a visual scale, expressed as 0 (the worst health imaginable) to 100 (the best health imaginable). In the figure below, the median values for EQ VAS rating are presented. There was no clear increase in how participants saw their health from pre-DWELL to post-DWELL with a median result at both time-points of 70 ( $z = -4.318, p = <.001$ ).

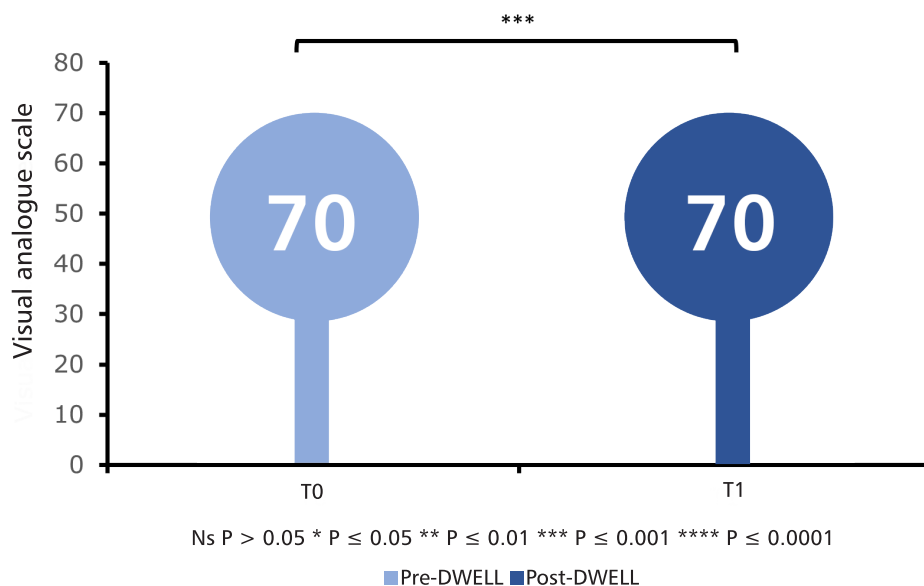


Figure 26 Health-related Quality of Life scores pre-post DWELL – French participants



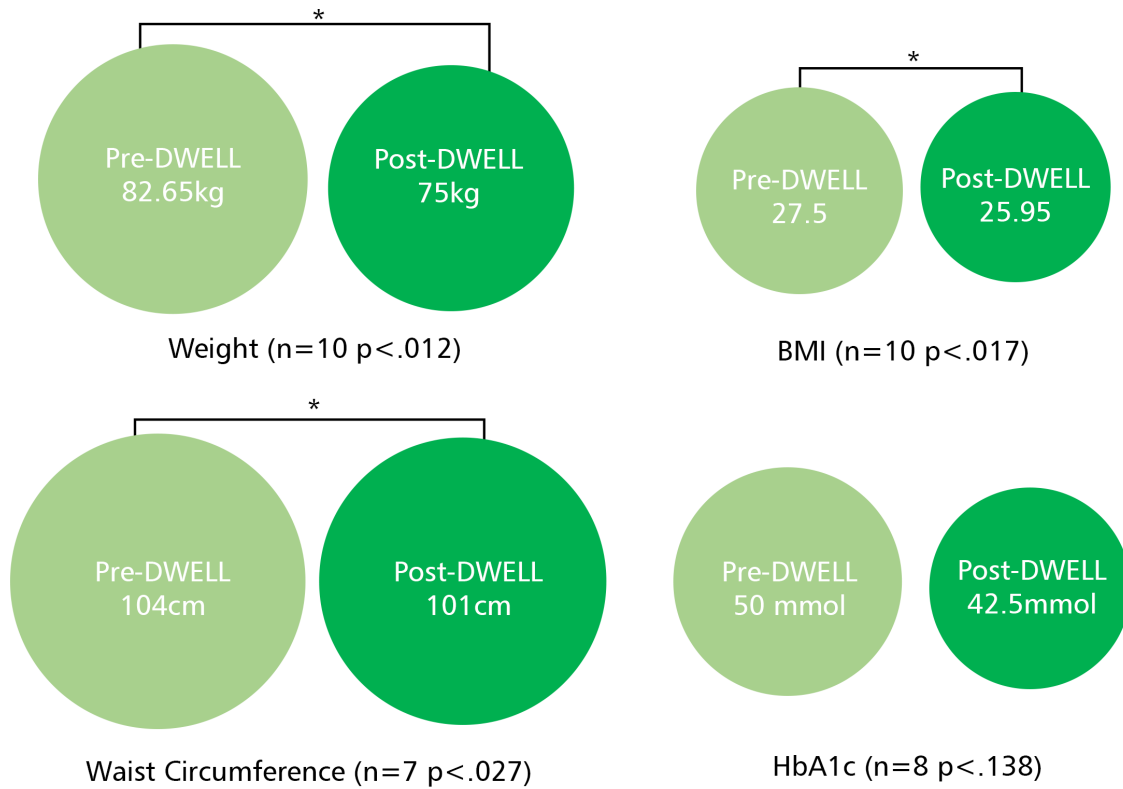


### 4.1.3 Belgium

#### Metabolic Health

Belgium participant numbers were smaller than those in the UK and France, with participant numbers measured for metabolic outcomes for weight (n = 10), BMI (n = 10), waist circumference (n = 7) and HbA1c (n = 8). Despite small sample size, comparisons of pre-post DWELL metabolic health outcomes indicated positive changes as follows:

- Weight loss of 7.65 kg (z = 2.527, p = .012)
- BMI reduction of 1.3 (z = 2.395, p = .017)
- Waist circumference reduction of 3cm (z = 2.207, p = .027)
- HbA1c reduction of 7.5mmol/mol (z = 1.483, p = .138.) – non-statistically significant difference.



Ns P > 0.05 \* P ≤ 0.05 \*\* P ≤ 0.01 \*\*\* P ≤ 0.001

Figure 27 Comparison of metabolic health outcomes pre-post DWELL - Belgian participants

### Participant Empowerment

In Belgium, despite the small sample size ( $n = 13$ ), participation in the DWELL programme resulted in a statistically significant increase of empowerment and self-efficacy:

- Participant Empowerment and Self-Efficacy increased from 29 to 32 ( $z = 3.066, p = .002$ ).

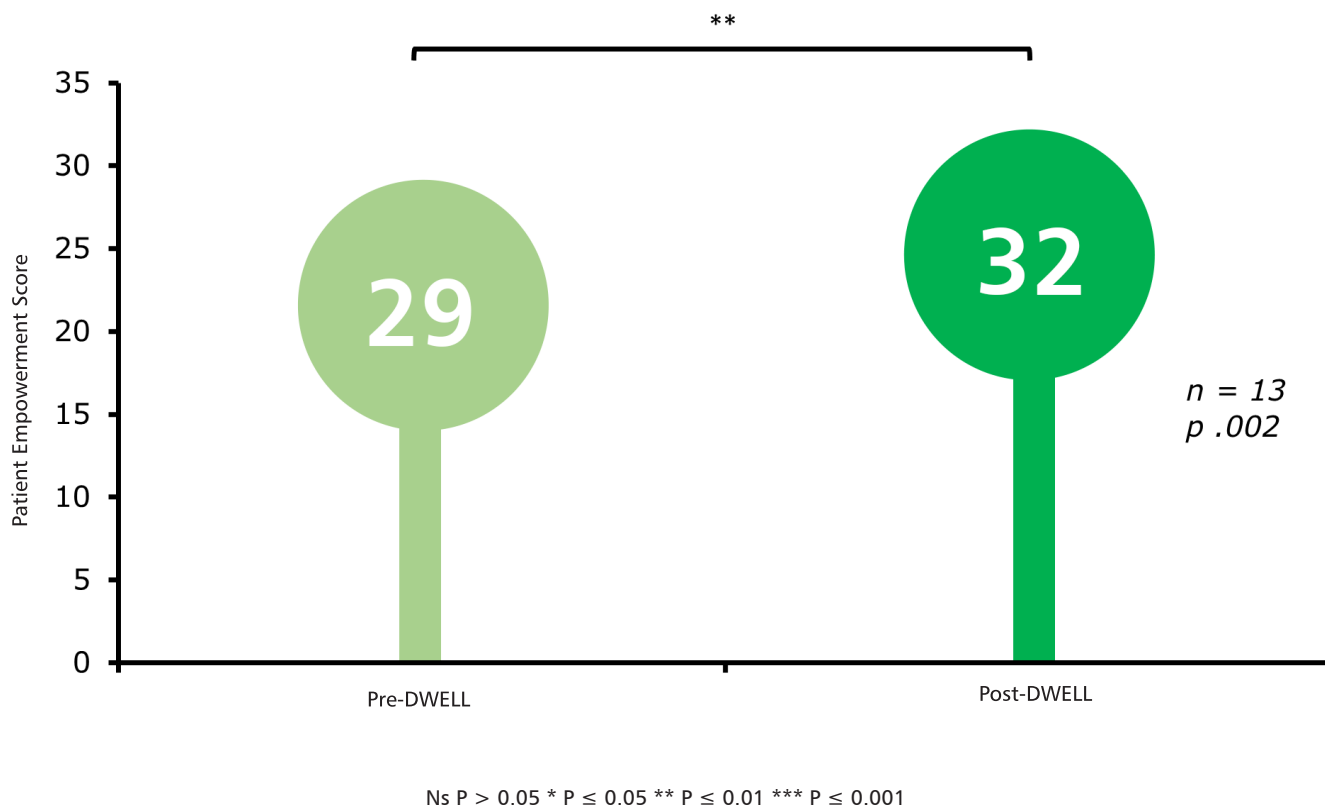
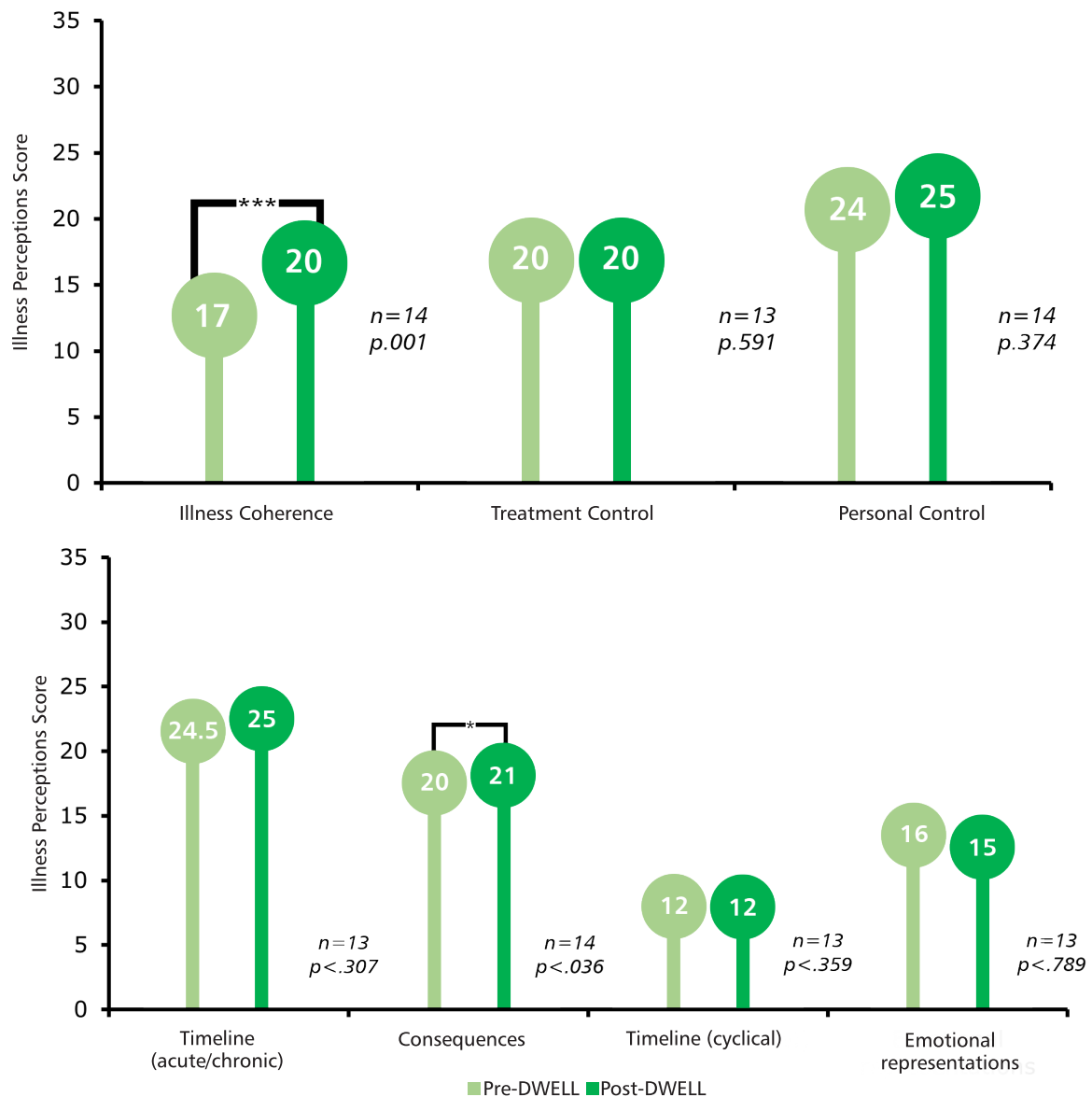


Figure 28 Comparison of Participant Empowerment scores pre-post DWELL – Belgian participants

### Illness Perceptions

In Belgium, no statistical significance was found in most Illness Perception scores, likely owing to the small sample size. Nonetheless, there was a positive impact in two areas:

- Illness Coherence from 17 to 20 ( $z = 3.175, p = .001$ )
- Perceived negative life consequences of diabetes from 20 to 21 ( $z = 2.100, p = .036$ )



Ns P > 0.05 \* P ≤ 0.05 \*\* P ≤ 0.01 \*\*\* P ≤ 0.001

Figure 29 Comparison of Illness Perceptions scores pre-post DWELL – Belgian participants

### Eating Behaviours

Similarly to UK and France, Belgian participants reported positive changes in eating behaviours at the end of the DWELL programme, despite the fact that not all perceived changes were statistically significant due to the small sample size:

- Restrained Eating improved from 30.5 - 28 (z = 2.317 p = .020)
- External Eating was reduced from 30.5 to 28 (z = .970, p = .332).

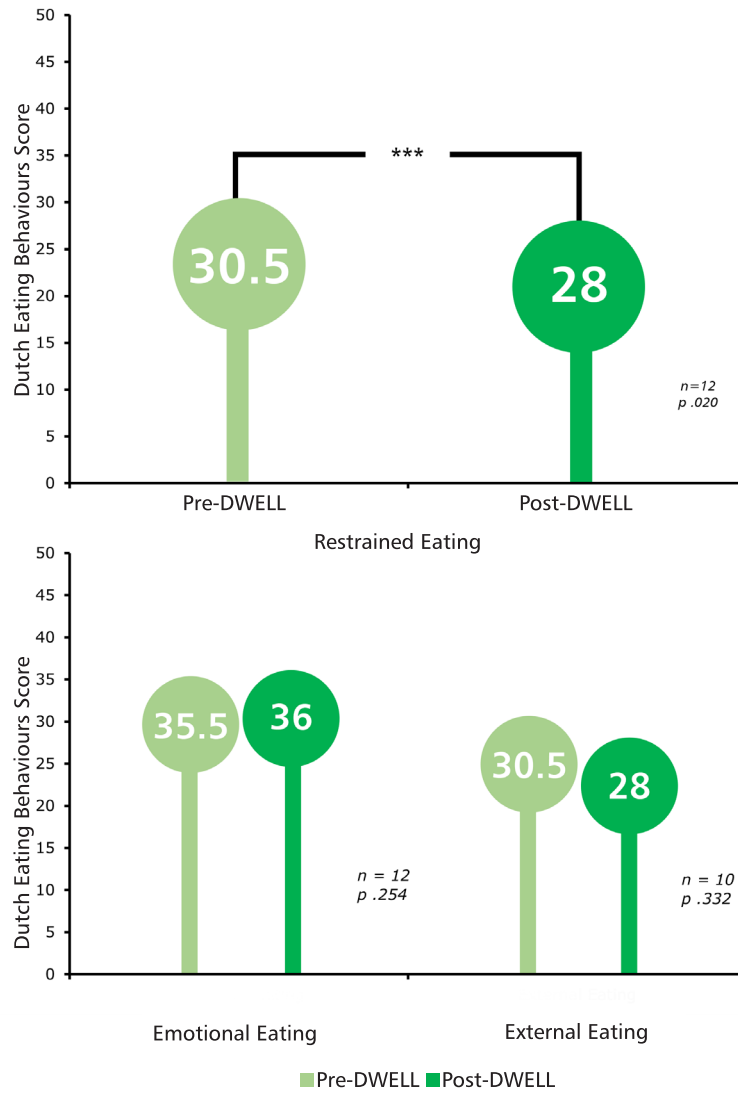
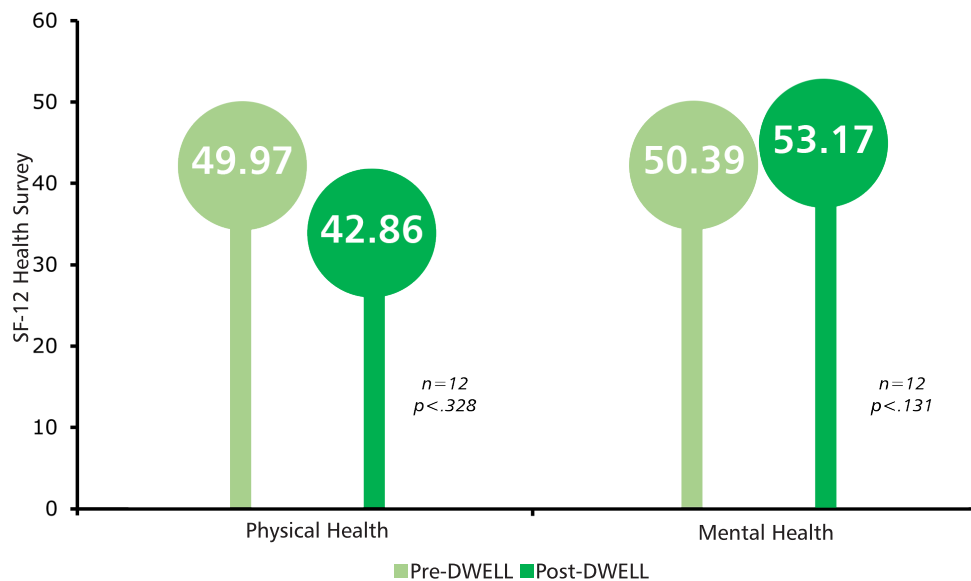


Figure 30 Comparison of Eating Behaviours scores pre-post DWELL – Belgian participants

### Physical and Mental Health

Aligned with UK and France, Belgian participants reported positive change to mental health, however due to the small sample size (n = 12), this change was not statistically significant:

- Mental health improved from 50.39 to 53.17 (z = 1.511, p = .131)



Ns P > 0.05 \* P ≤ 0.05 \*\* P ≤ 0.01 \*\*\* P ≤ 0.001

Figure 31 Comparison of Physical and Mental Health scores pre-post DWELL – Belgian participants

## Self-care Behaviours

Like in UK and France, most positive change was reported by Belgian participants in relation to dietary and exercise advice with an increased level of advice received at the end of the DWELL programme. This suggests that participants recalled their advice more clearly immediately post-DWELL. There was only a slight change in reported blood sugar measurement and medication prescription advice, possibly suggesting that the DWELL diabetes education may have assisted participants to engage more with advice given by healthcare professionals about their day-to-day management of the condition.

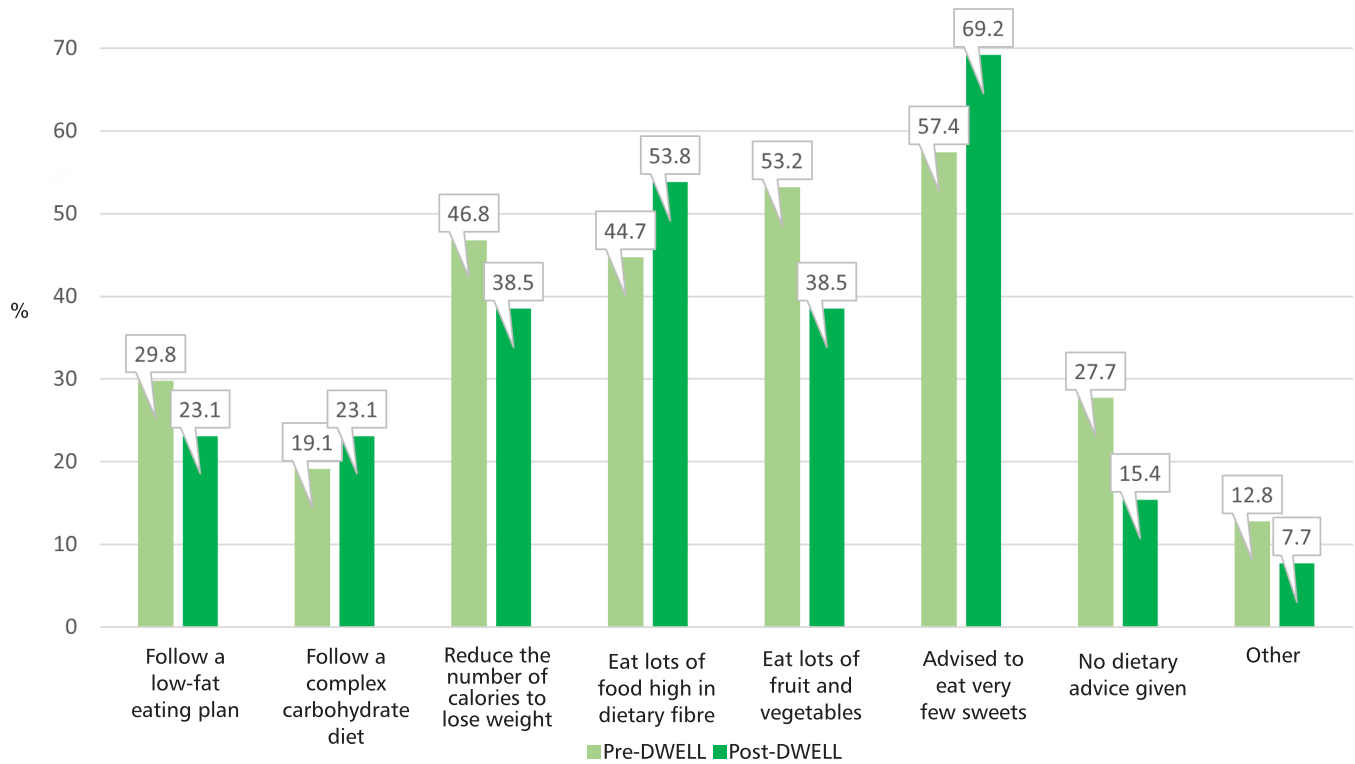


Figure 32 Reported dietary advice from healthcare team pre-post DWELL – Belgian participants

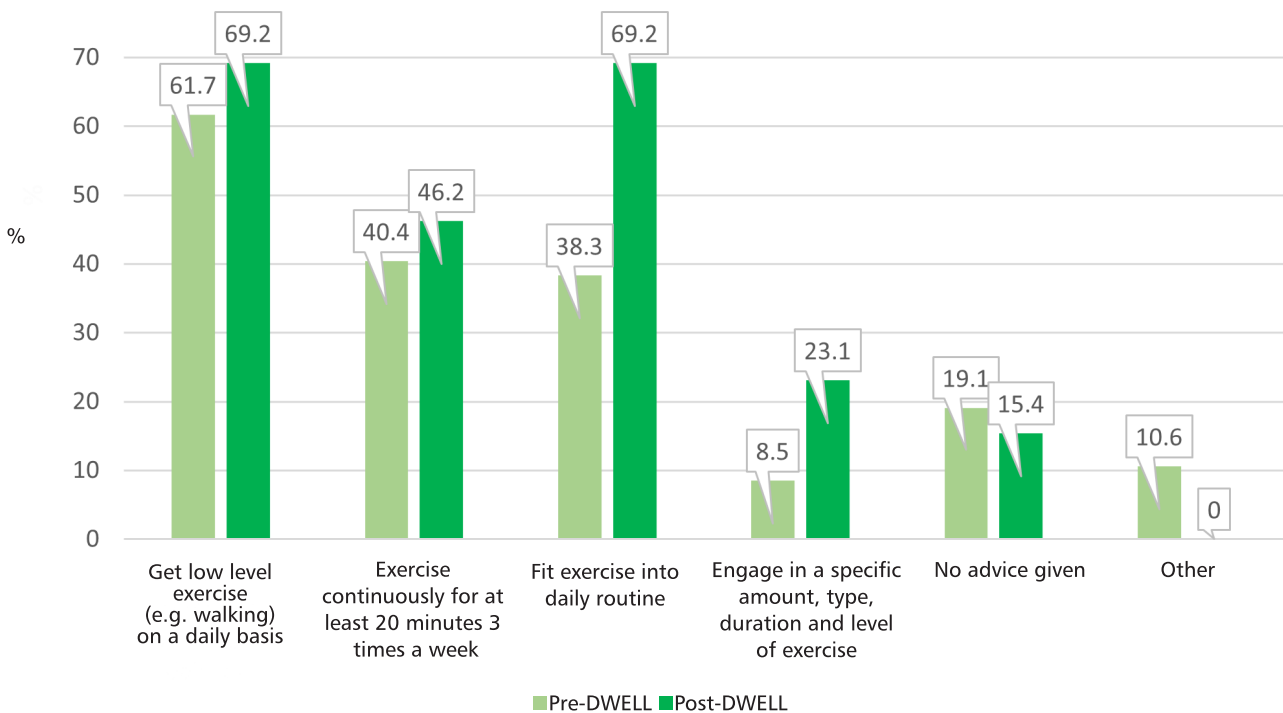


Figure 33 Reported exercise advice from healthcare team pre-post DWELL – Belgian participants

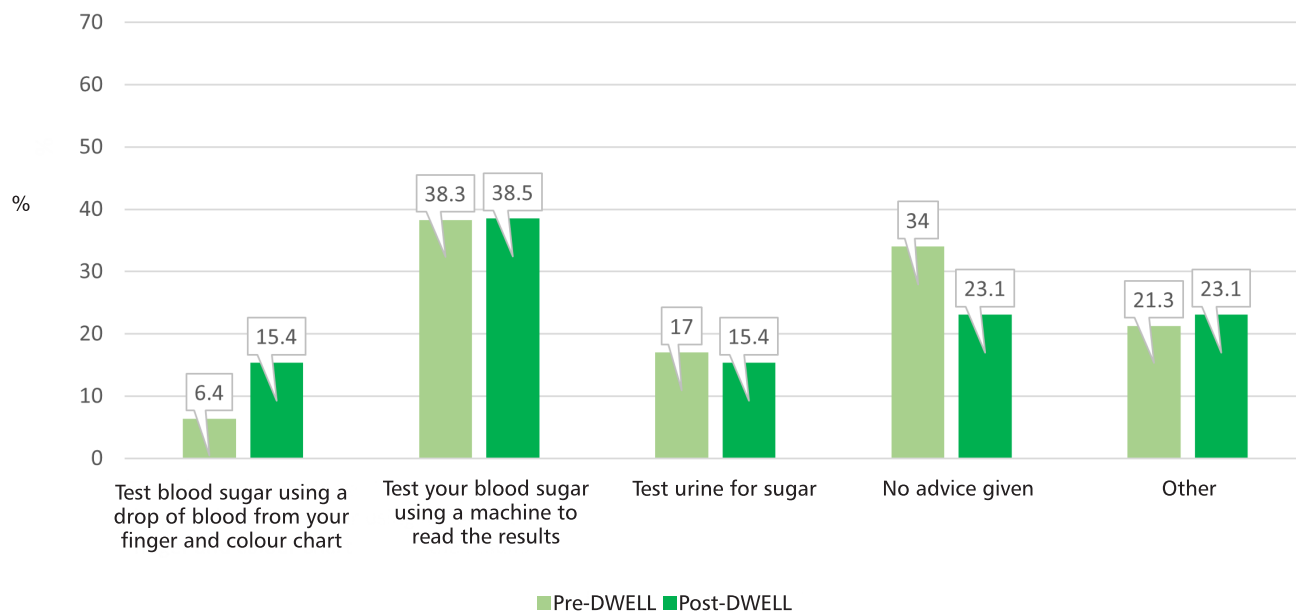


Figure 34 Reported blood sugar measurement advice from healthcare team pre-post DWELL – Belgian participants

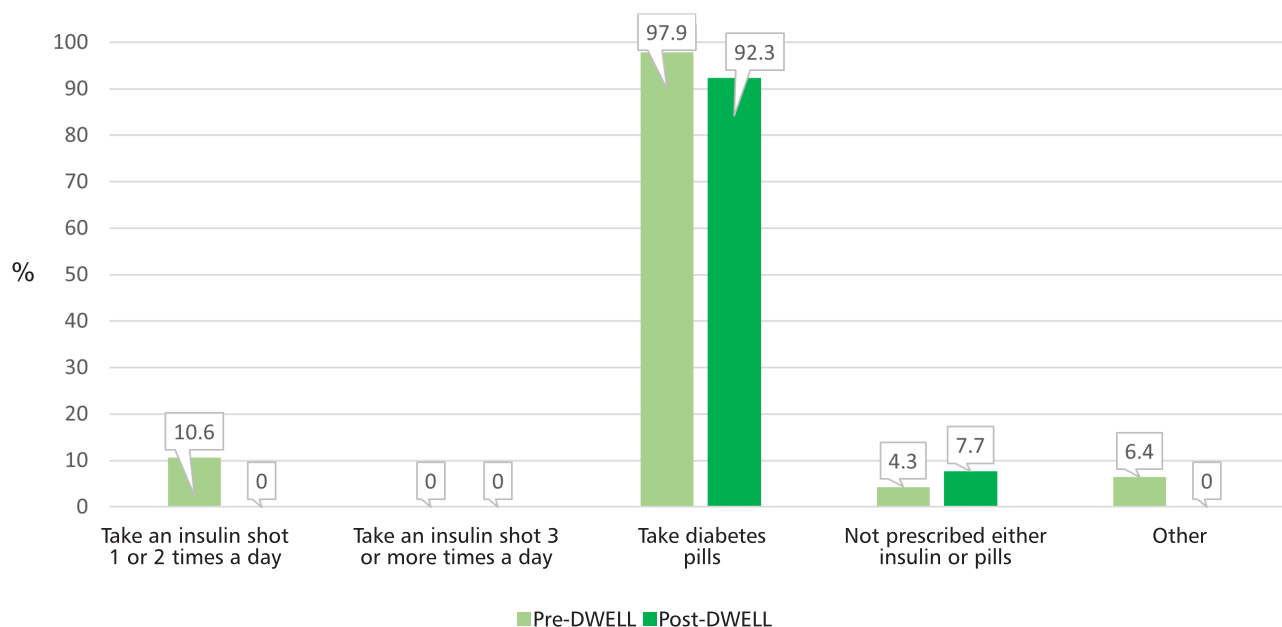
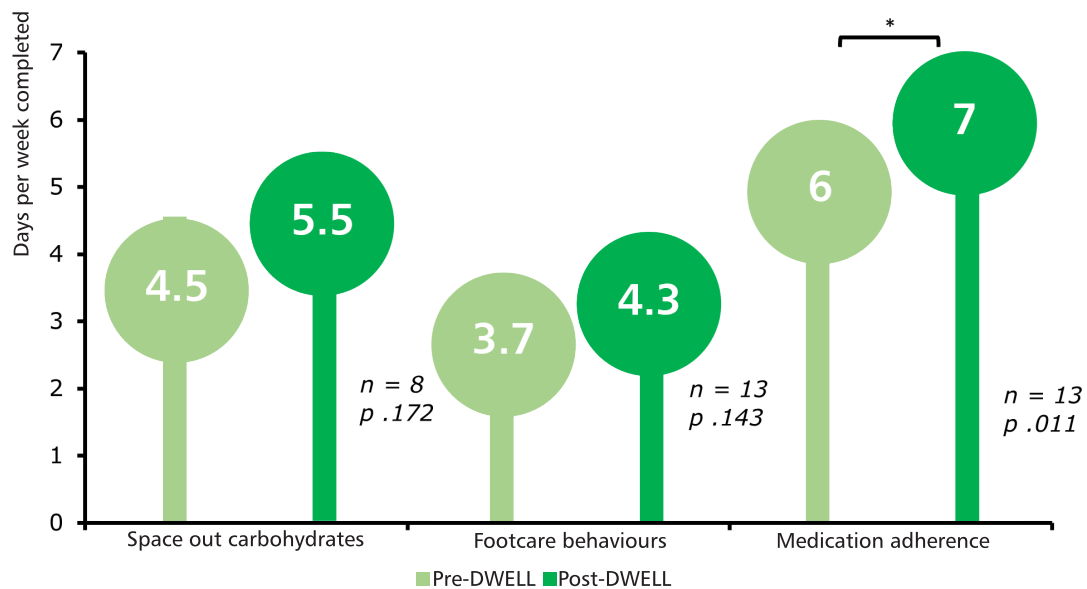


Figure 35 Reported medication prescription from healthcare team pre-post DWELL – Belgian participants

Unlike UK and France, Belgian participants reported improvements in all self-care behaviours however, due to low number of responses, only medication adherence results were statistically significant:

- Space out carbohydrates' adherence improved from 4.5 to 5.5 ( $z = -1.367, p = .172$ )
- Footcare behaviours improved from 3.7 to 4.3 ( $z = -1.465, p = .143$ )
- Medication adherence improved from 6 to 7 ( $z = -2.530, p = .011$ )

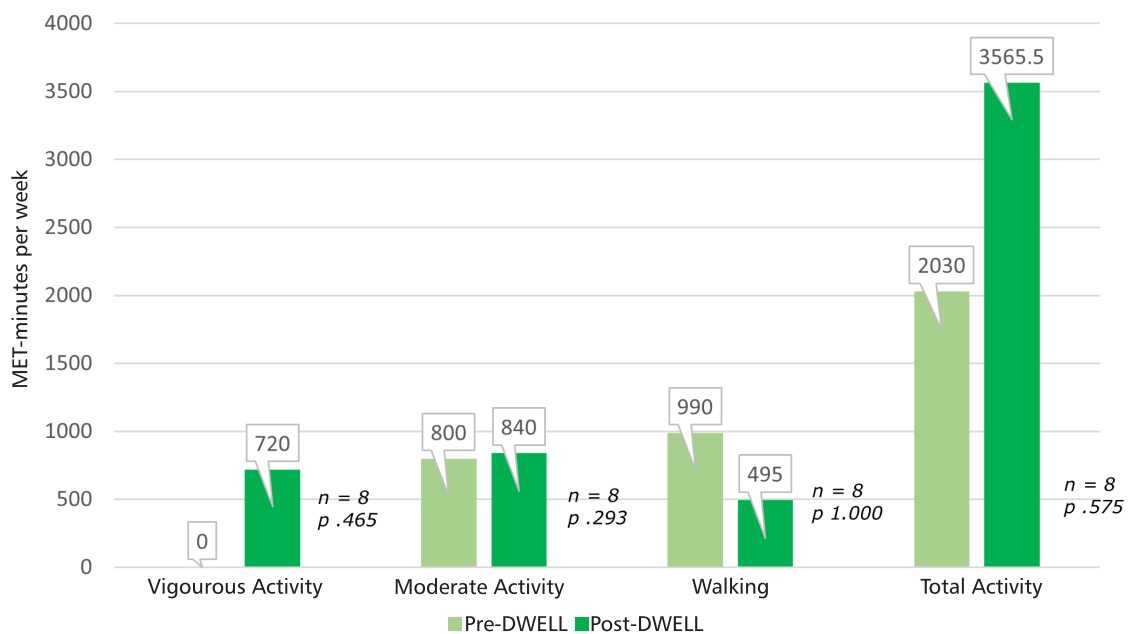


Ns P > 0.05 \* P ≤ 0.05 \*\* P ≤ 0.01 \*\*\* P ≤ 0.001 \*\*\*\* P ≤ 0.0001

Figure 36 Comparison of diet, footcare and medication adherence self-care behaviours pre-post DWELL – Belgian participants

### Physical Activity

In relation to reported physical activity, although results were not statistically significant, the trend appeared to broadly follow that of the UK and France with increased total activity from 2030 to 3565.5 MET minutes (z = -.730, p = .465).



Ns P > 0.05 \* P ≤ 0.05 \*\* P ≤ 0.01 \*\*\* P ≤ 0.001 \*\*\*\* P ≤ 0.0001

Figure 37 Median MET-minutes per week spent on vigorous, moderate, walking and total physical activity pre-post DWELL – Belgian participants

### Health-Related Quality of Life

Belgium DWELL participants, like their counterparts in the UK and France, reported improvement of health-related quality of life, however results were not statistically significant, likely due to the small sample size ( $n = 14$ ). There was an increase in how participants saw their health pre-post DWELL with a median result pre-DWELL 72.5 and immediately post-DWELL 75 ( $z = -.767, p = .443$ ).

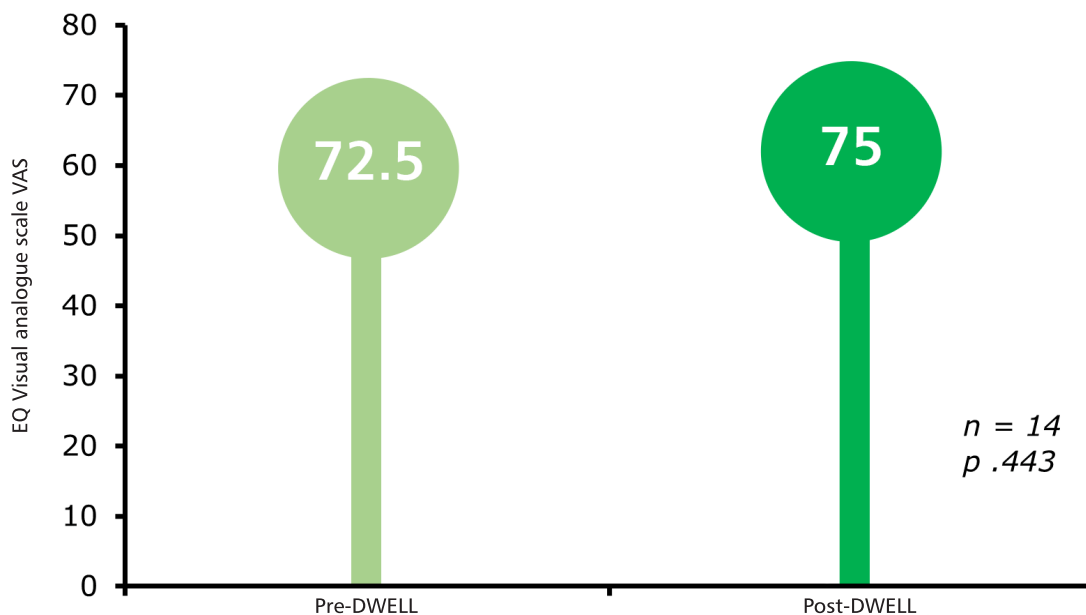


Figure 38 Health-related Quality of Life scores pre-post DWELL – Belgian participants





### 4.1.4 The Netherlands

#### Metabolic Health

Similar to Belgium, Dutch participant numbers were smaller than those in the UK and France (weight/BMI n=35, waist circumference n=29 and HbA1c n=33). Immediately post-DWELL scores for the Netherlands site demonstrated reductions in weight: 97.2kg – 95.5kg ( $z = .715, p = .472$ ), waist circumference: 112cm – 110cm ( $z = .315, p = .752$ ) and HbA1c: 81 -74 ( $z = 1.561, p = .118$ ), and a slight increase in BMI: 30.86 – 31.09 ( $z = .627, p = .531$ ). Although these results support findings in the UK, France and Belgium demonstrating the trend of improvement following participation in the DWELL programme, differences were not statistically significant when tested.

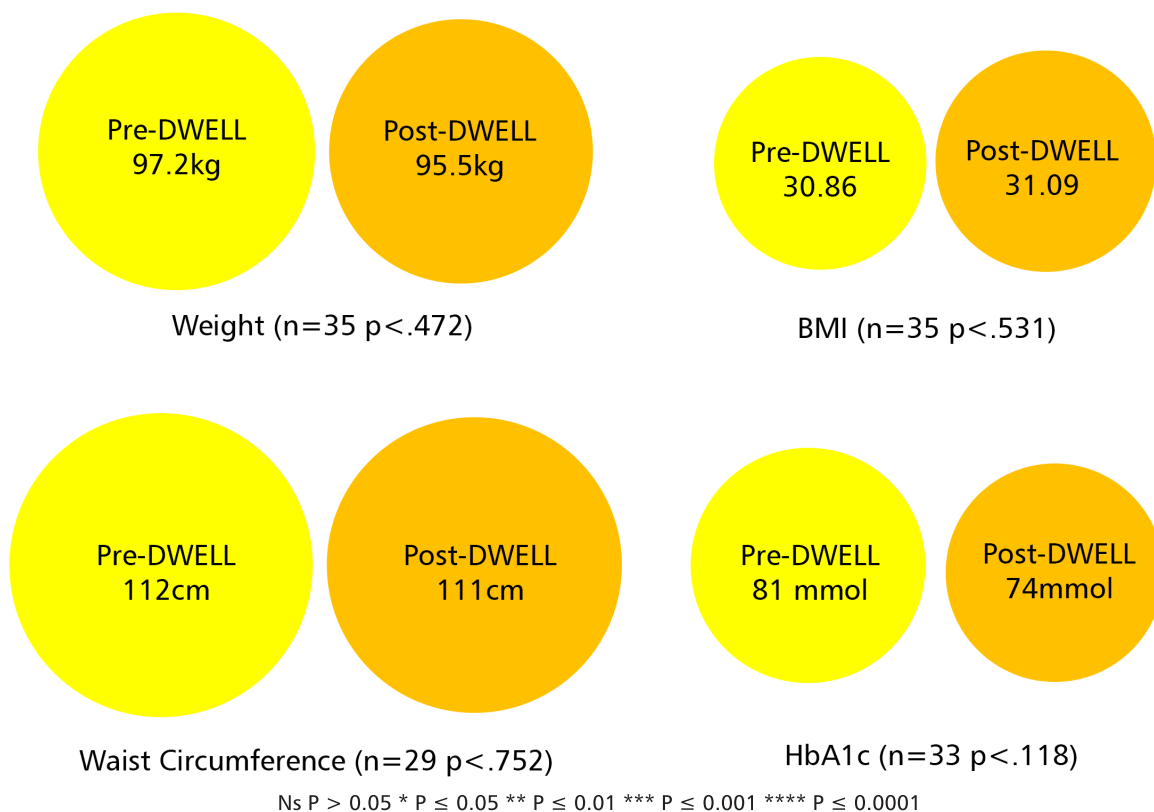


Figure 39 Comparison of metabolic health outcomes pre-post DWELL - Dutch participants

### Participant Empowerment

In the Netherlands, participation in the DWELL programme resulted in a statistically significant increase in participant empowerment and self-efficacy, with scores increasing from 28 to 31 ( $z = 2.723, p = .006$ ).

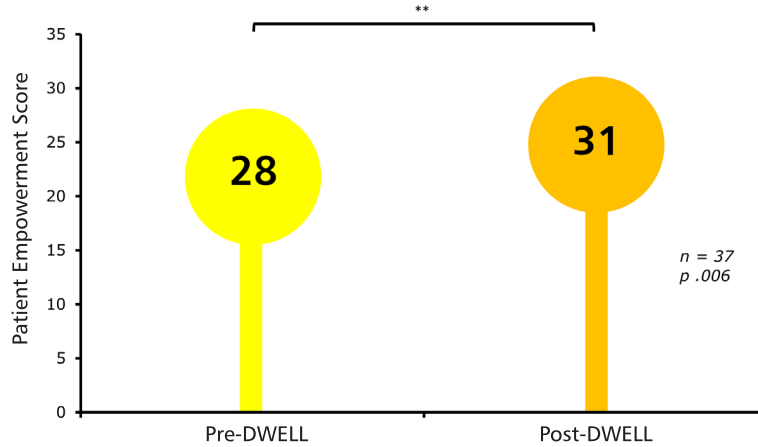


Figure 40 Comparison of Participant Empowerment scores pre-post DWELL – Dutch participants

### Illness Perceptions

In the Netherlands, participants' perceptions of diabetes was measured using the Brief version of the Revised Illness Perceptions Questionnaire (BIPQ-R) (Broadbent et al., 2006). Illness perceptions were measured similarly to the IPQ-R using only nine items, compared to the 38 items found in the full IPQ-R questionnaire.

Results were consistent to feedback provided in the other three countries, namely statistically significant increase of personal control, which supports a beneficial effect of DWELL in improving participant confidence in managing their condition:

- Personal Control improved from 6 to 7 ( $z = 2.402, p = .016$ )

In addition, positive changes were reported by participants in relation to:

- Perceived negative consequences of diabetes were decreased from 7 to 6 ( $z = 2.341, p = .019$ )

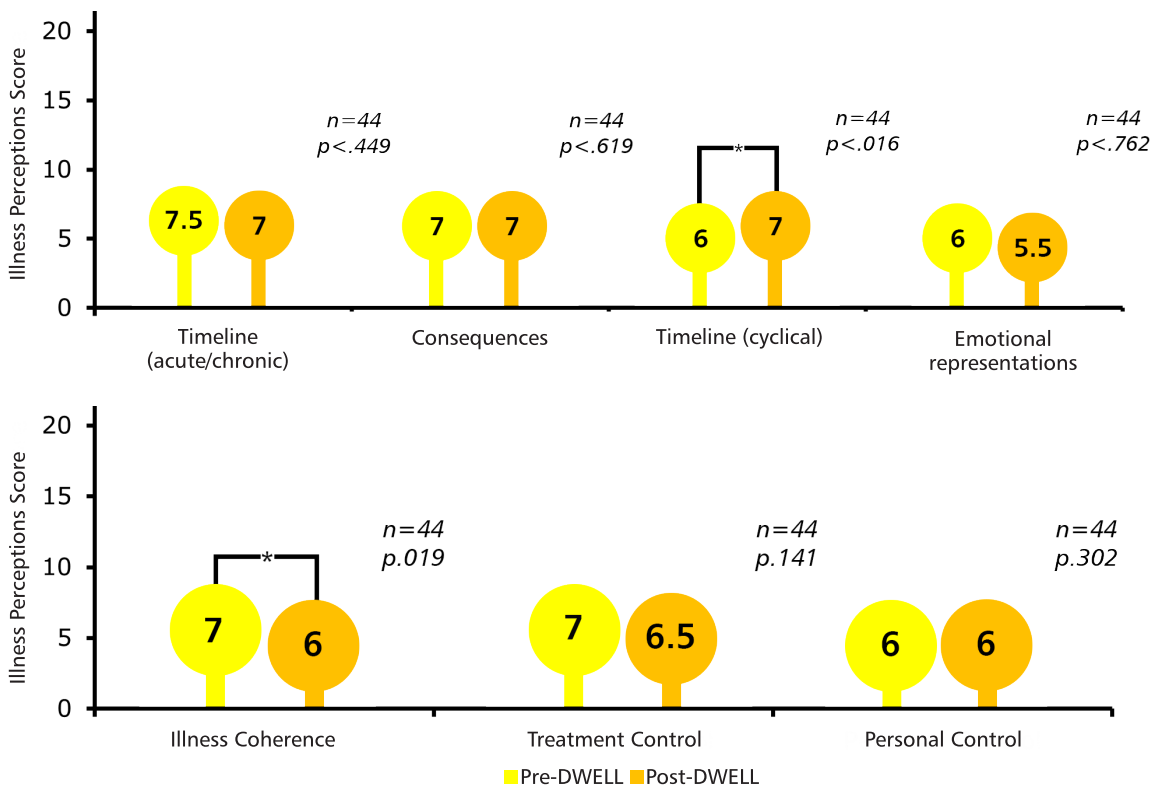


Figure 41 Comparison of Illness Perception scores pre-post DWELL – Dutch participants

### Eating Behaviours

Similarly to the other three countries, there was a statistically significant decrease in participants' emotional eating from 34 to 26 ( $z = 4.023, p < .001$ ) while there was a marginally statistically significant increase of external eating from 22 to 23 ( $z = 1.824, p = .068$ ). Also, there was a trend for restrained eating to increase following participation in the DWELL programme, from 25 to 27 ( $z = .703, p = .482$ ), however the difference was not statistically significant.

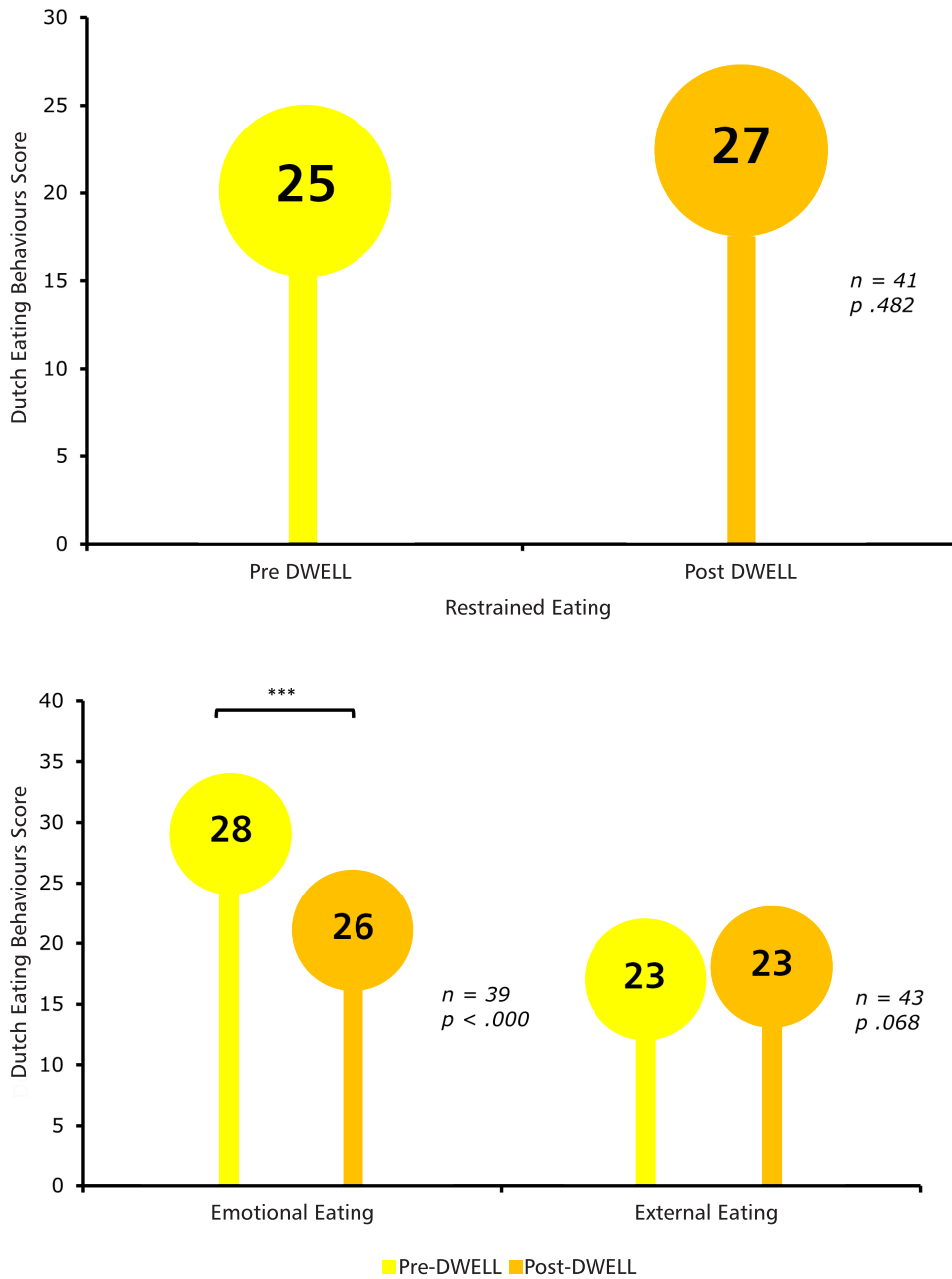


Figure 42 Comparison of Eating Behaviours scores pre-post DWELL – Dutch participants

### Physical and Mental Health

Unlike the feedback received in the other three countries, no statistically significant changes were shown pre-post DWELL in either perceived physical or mental health, although there was a positive shift in mental health from 52.16 to 54.23, as found in other countries. Absence of statistically significant improvement may be due to the small sample size or the way DWELL was delivered in Netherlands, i.e. on individual rather than group basis.

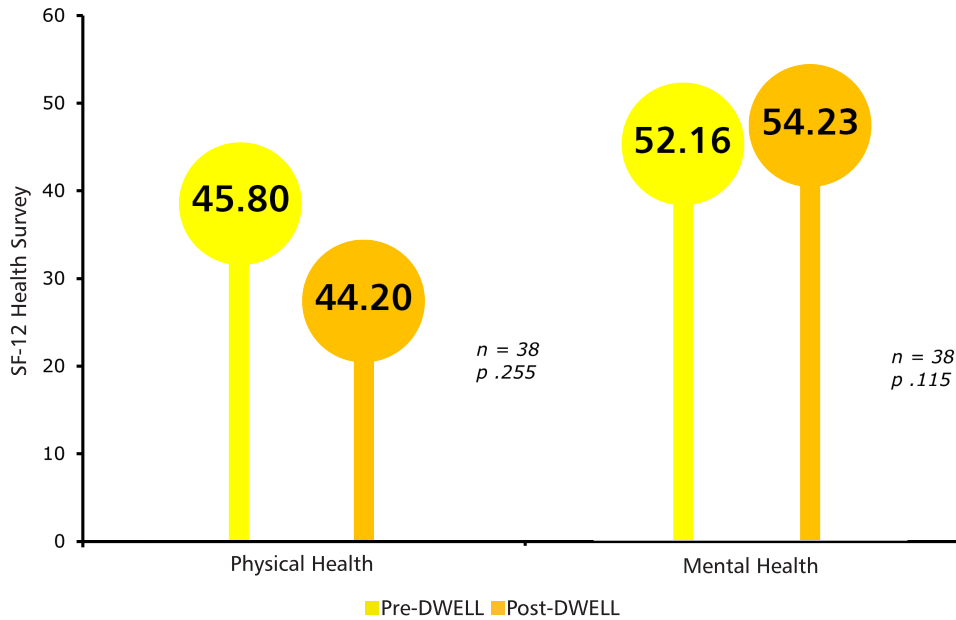


Figure 43 Comparison of Physical and Mental Health scores pre-post DWELL – Dutch participants

### Self-Care Behaviours

Reported advice Dutch participants received pre- post DWELL regarding diet, exercise, testing blood sugar and medication was varied. In line with other countries, “no advice” responses post-DWELL fell, indicating potentially that learning from the DWELL programme activated participants to engage more with available advice given by healthcare professionals.

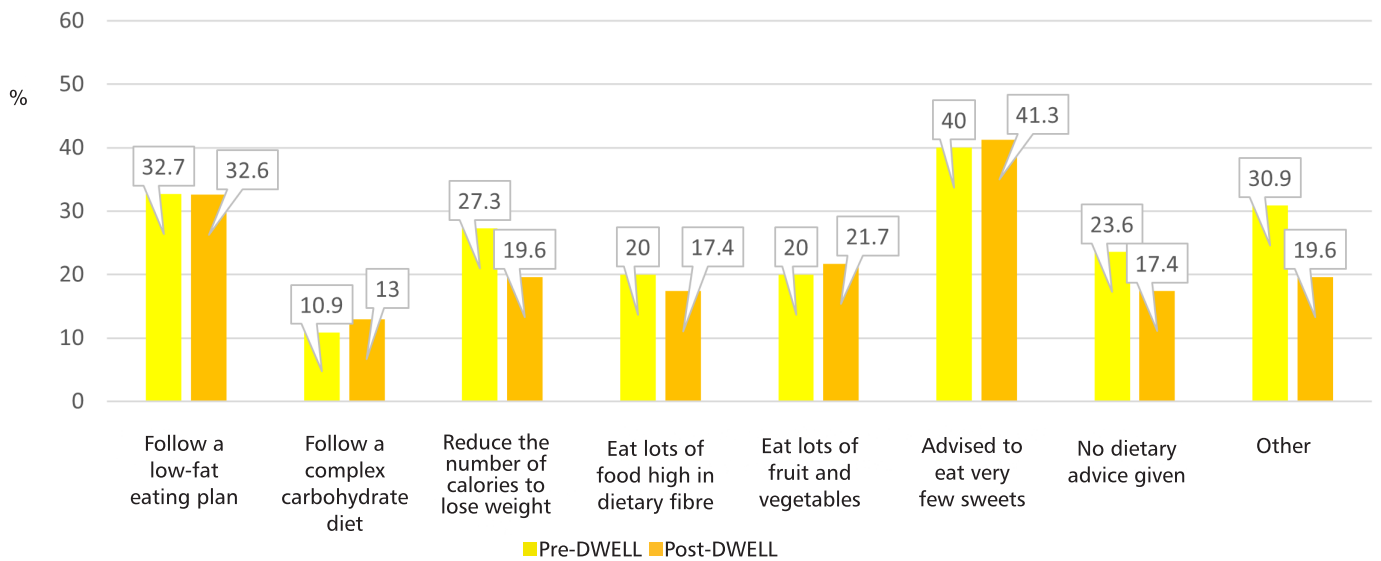


Figure 44 Reported dietary advice from healthcare team pre-post DWELL – Dutch participants

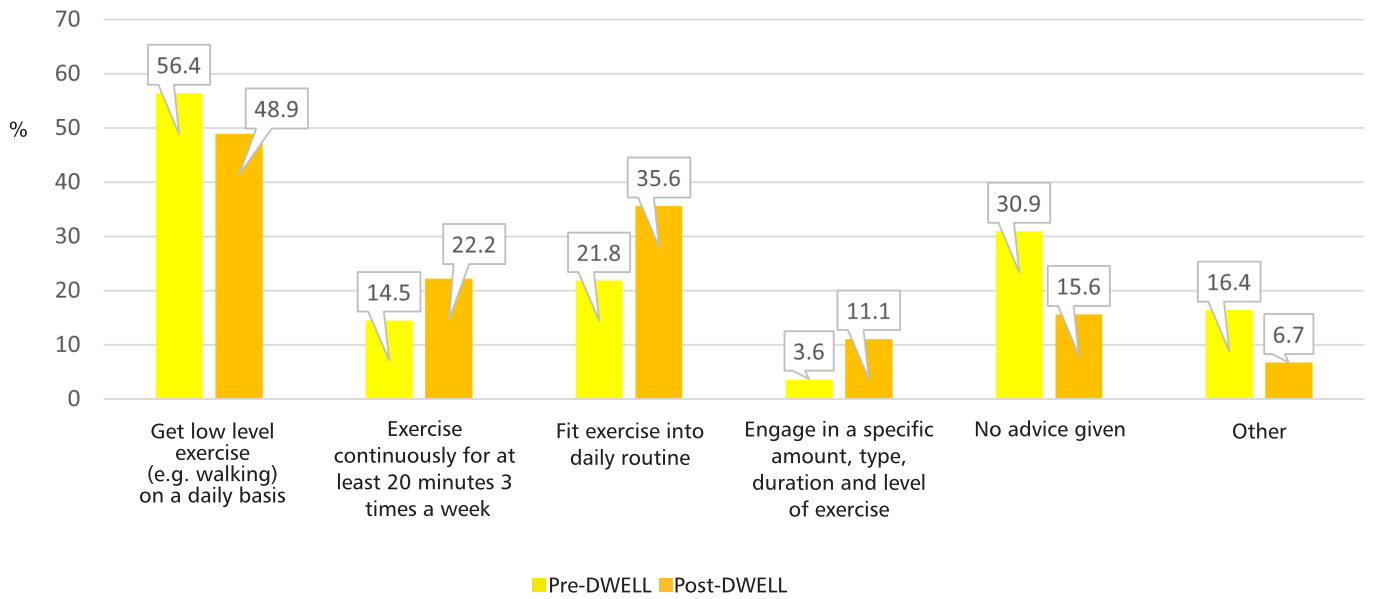


Figure 45 Reported exercise advice from healthcare team pre-post DWELL – Dutch participants

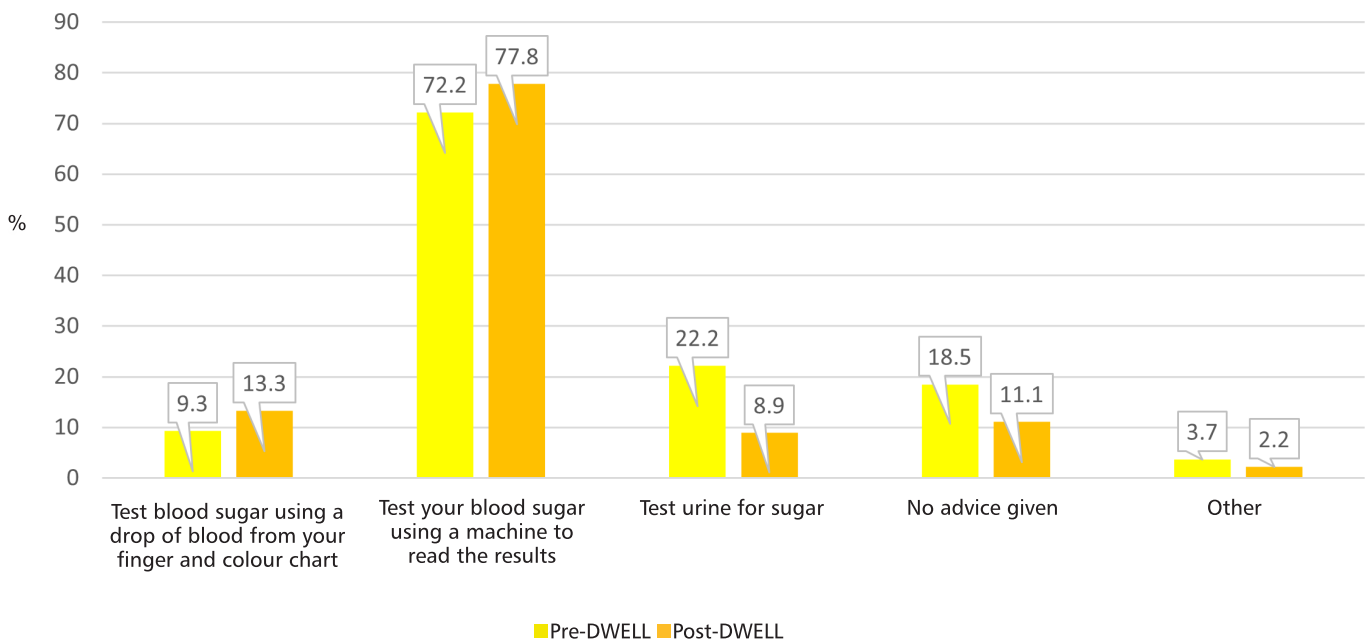


Figure 46 Reported blood sugar measurement advice from healthcare team pre-post DWELL – Dutch participants

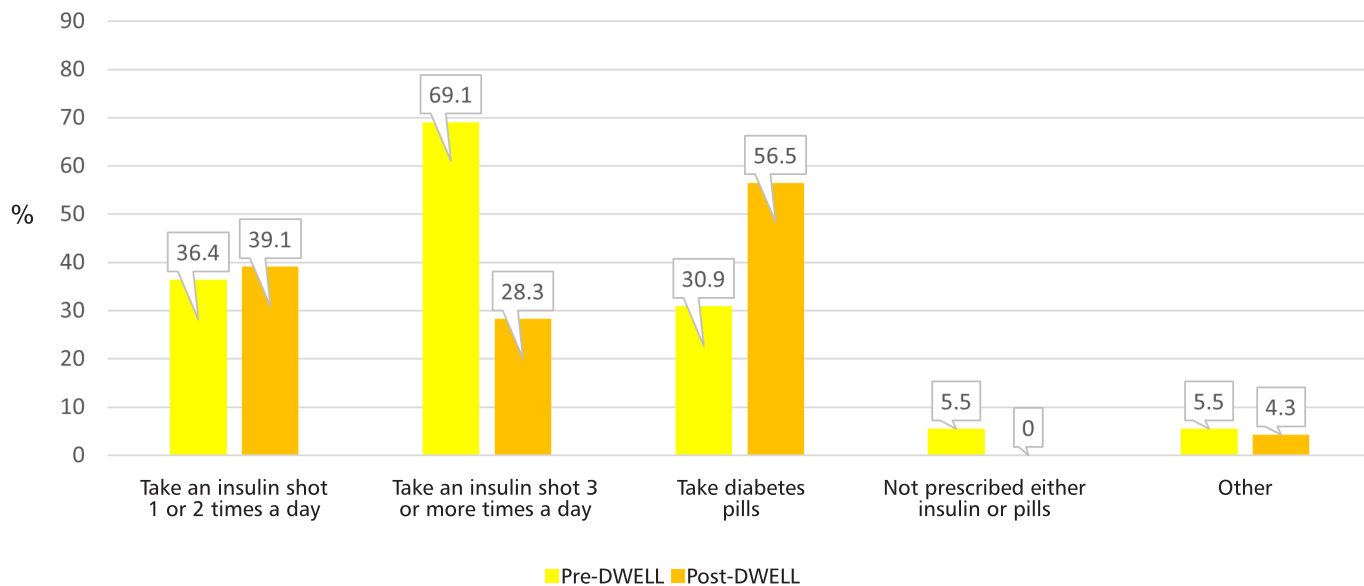


Figure 47 Reported medication prescription from healthcare team pre-post DWELL – Dutch participants

Pre-post-DWELL comparisons of participants' daily adherence to spacing carbohydrate intake, washing and drying but not soaking feet and taking prescribed medication, confirmed there were no statistically significant changes. Nonetheless, these results matched the trends found in the UK, France and Belgium.

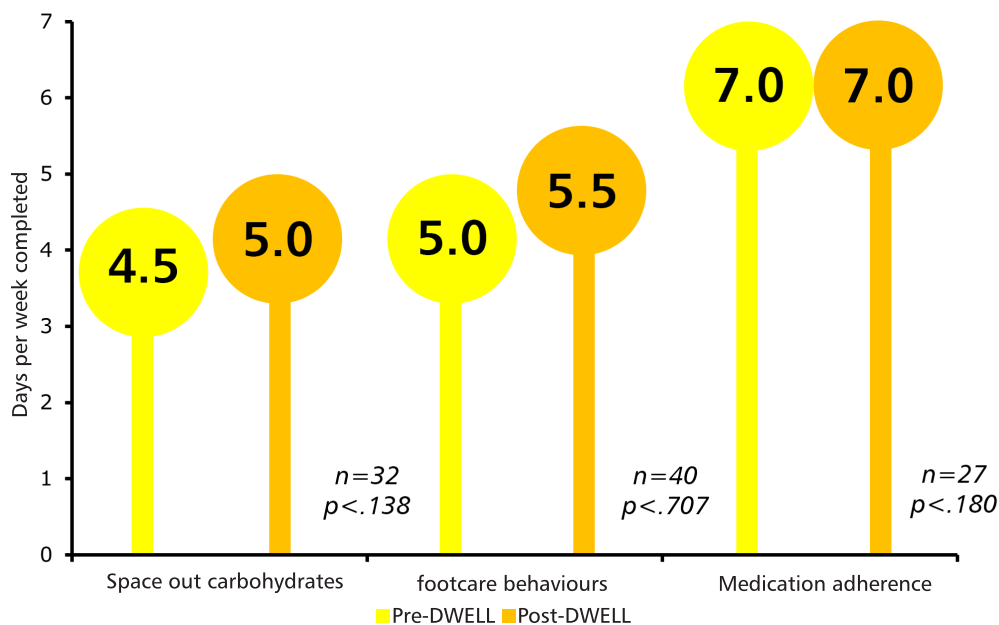


Figure 48 Comparison of diet, footcare and medication adherence self-care behaviours pre-post DWELL – Dutch participants

### Physical Activity

When comparing Dutch participants' physical activity levels pre-post DWELL, there were no statistically significant improvements, however, the trend appeared to broadly follow that of the UK, France and Belgium with increased total activity, although to a lesser extent (Total activity increased from 3036 to 3068 ( $z = -.267, p = .790$ )).



Figure 49 Median MET-minutes per week spent on vigorous, moderate, walking and total physical activity pre-post DWELL – Dutch participants

### Health-Related Quality of Life

Health-related quality of life reported by Dutch participants remained at the same levels, although results were not statistically significant.

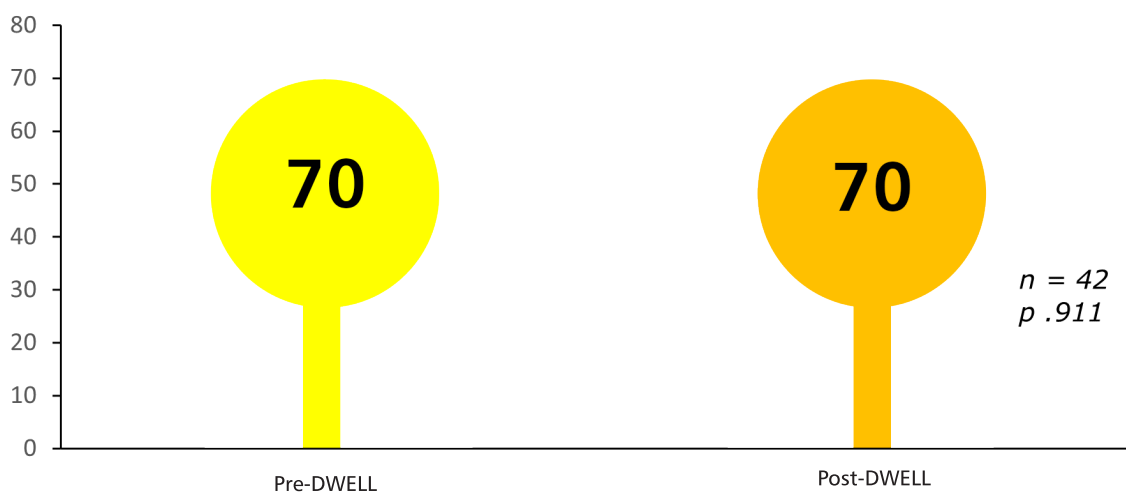


Figure 50 Health-related Quality of Life scores pre-post DWELL – Dutch participants

## 4.2 Longitudinal Effects of the DWELL programme

The sustainability and long-term efficacy of the DWELL programme was investigated over the mid-term (6 months) and long-term (12 months) follow up period after the end of the programme. Comparisons were made for those participants who had completed all four time-points: baseline, end of programme, 6 months and 12 months post-DWELL. Where analysis could not establish meaningful comparisons for the whole 12-month follow up period, results from participants who completed three evaluation time-points are presented. A positive longitudinal result would be indicated either by continued improvement, or a maintenance of the improvement achieved by the end of the DWELL programme. In this section, the longitudinal results of all sites are presented under the key outcome areas.<sup>2</sup>

### 4.2.1 Metabolic Health

Participants' metabolic health was measured at all four timepoints of the evaluation, which gave the opportunity to assess long-term changes after the end of the DWELL programme. Findings were stronger in UK and France, whereas this analysis was not possible in Belgium and Netherlands due to the small sample sizes and high attrition rates in T2 and T3 measurement points.

In the UK, there was a steady reduction, which was statistically significant, from end of programme to a year later in:

- Weight loss - from 98.7 kg to 91.8kg ( $z = 2.710$ ,  $p = <.007$ ) ( $n=29$ )
- BMI reduction - from 34.2 to 32 ( $z = 2.801$ ,  $p = .005$ ) ( $n=29$ )

These results demonstrate that these metabolic health gains were maintained a year after the intervention had ended. Despite the small sample of this longitudinal analysis ( $n = 29$ ), non-parametric statistical analysis (Friedman test) to detect differences across multiple timepoints, showed a statistically significant positive change for metabolic outcomes from baseline to 12 months post-DWELL in weight ( $\chi^2 = 14.453$ ,  $df = 3$   $p = .002$ ) and BMI ( $\chi^2 = 13.185$ ,  $df = 3$   $p = .004$ ).

In addition, statistically significant changes were found to be sustained 6 months after the end of the programme in relation to:

- Waist Circumference reduction - from 113cm to 111cm ( $z = 3.869$ ,  $p = <.001$ ) ( $n=107$ )
- HbA1c reduction – from 54.1 to 53.05 mmol/mol ( $z = -2.366$ ,  $p = .018$ ) ( $n=84$ )

Results from non-parametric statistical analysis (Friedman Test) demonstrated statistically significant changes both in waist circumference ( $\chi^2 = 35.770$ ,  $df = 2$   $p = <.001$ ) and HbA1c ( $\chi^2 = 18.596$ ,  $df = 2$   $p = <.001$ ). Similar trends were observed for those who also completed the 12-month follow up, albeit with no statistical significance.

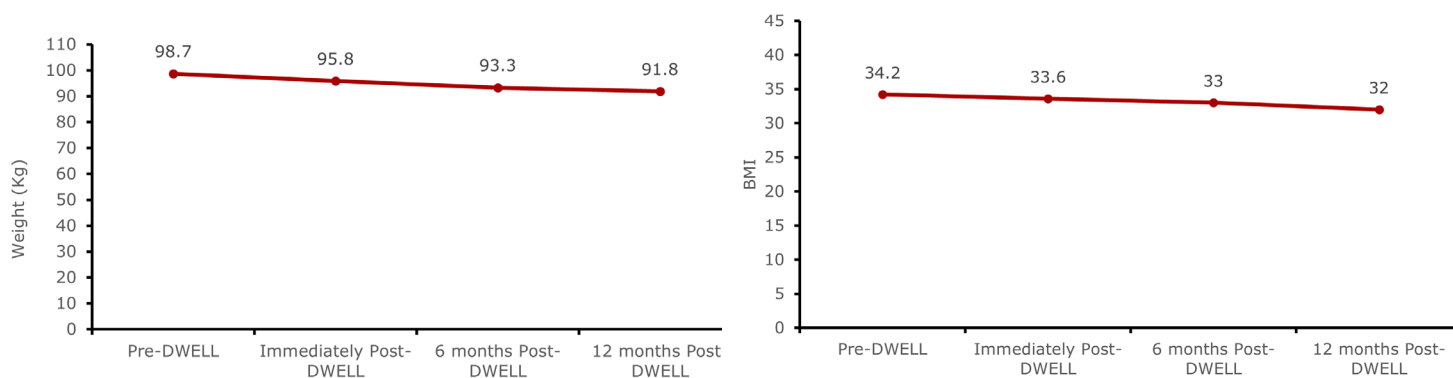


Figure 51 Longitudinal metabolic health changes in weight and BMI over 15 months (from baseline to 12 months after the end of programme) – UK participants

2. Due to natural drop out over the mid- (6-months) to long- (12-months) term and the Covid-19 pandemic which affected certain sites, the number of participants, for each measure, at each site and at each timepoint varied considerably. In this context, longitudinal comparisons were not always possible. Where there were small sample numbers, or the results were not statistically significant, participants who completed the 12-month post-DWELL time-point were removed and changes were investigated comparing baseline to 6-months post-DWELL programme results. However, on occasion, where no further clarity was provided by this longitudinal evaluation, this analysis is not included.



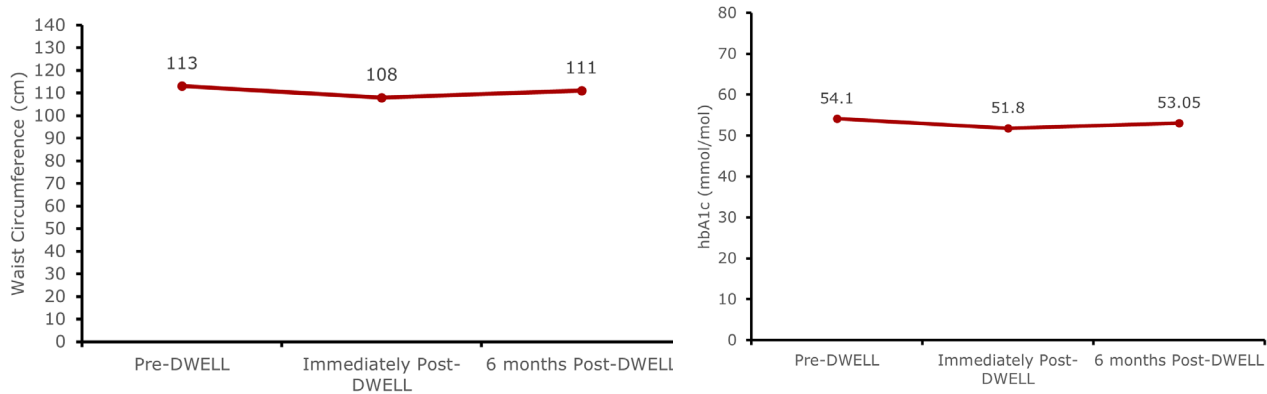


Figure 52 Longitudinal metabolic health changes in waist circumference and HbA1c over 9 months (from baseline to 6 months after the end of programme) - UK participants

Similarly, in France, there was a steady and statistically significant positive change in all metabolic health outcomes across the overall evaluation period:

- Weight loss - from 94.7 kg to 91.7kg ( $z = -3.719$ ,  $p = <.001$ ) ( $n=93$ )
- BMI reduction - from 33.6 to 33.18 ( $z = -3.826$ ,  $p = <.001$ ) ( $n=94$ )
- Waist circumference reduction – from 113cm to 110cm ( $z = 4.576$ ,  $p = <.001$ ) ( $n=92$ )
- HbA1c reduction - from 59.6 to 52 ( $z = -2.753$ ,  $p = .006$ ) ( $n=92$ )

These findings confirm improvements achieved during the DWELL programme were still present one year later. Non-parametric test results (Friedman test) demonstrated statistically significant changes for all metabolic health outcomes over 15 months since baseline - weight ( $\chi^2 = 19.720$ ,  $df = 3$   $p = <.001$ ), BMI ( $\chi^2 = 21.219$ ,  $df = 3$   $p = .001$ ), waist circumference ( $\chi^2 = 46.457$ ,  $df = 3$   $p = <.001$ ), and HbA1c ( $\chi^2 = 9.113$ ,  $df = 3$   $p = .028$ ).

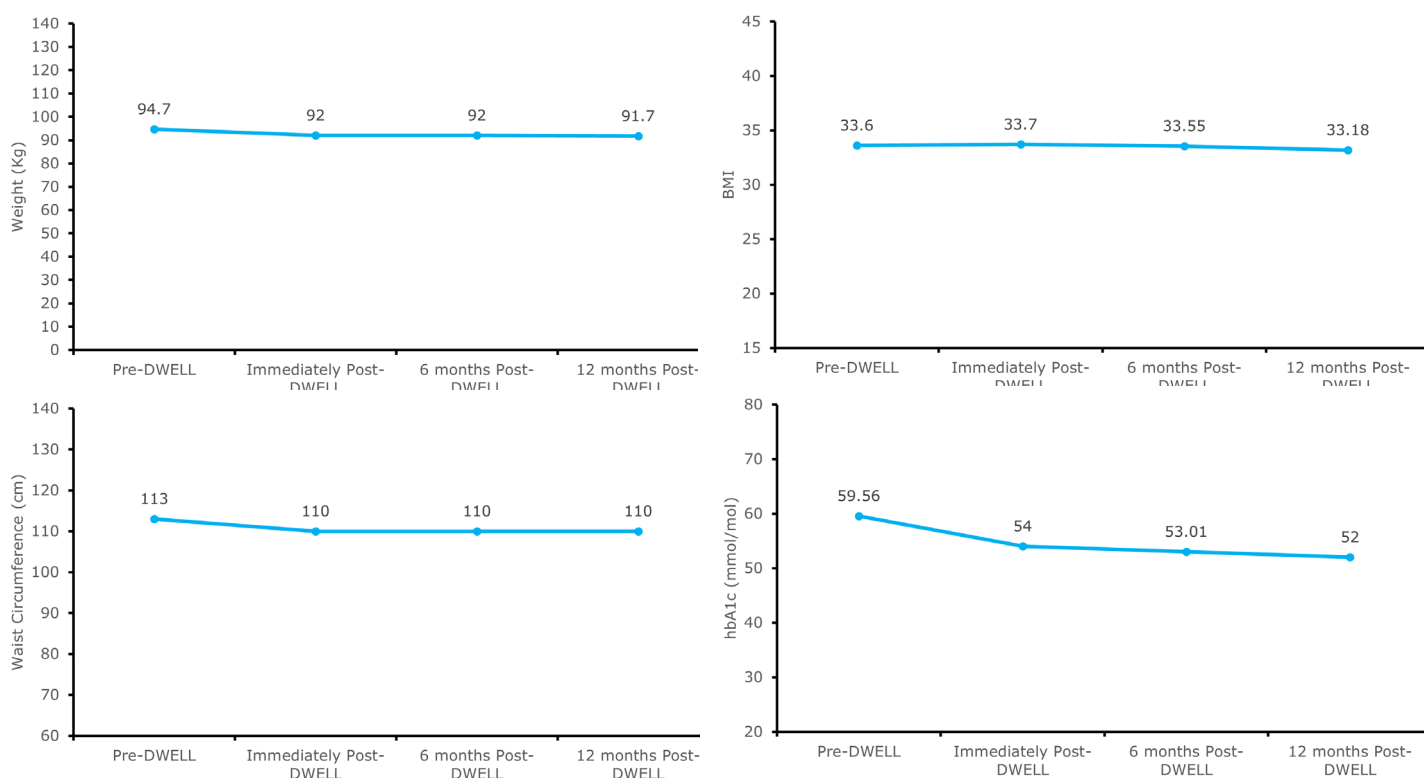


Figure 53 Longitudinal metabolic health changes in weight, BMI, waist circumference and HbA1c over 15 months of the evaluation (from baseline to 12 months after the end of programme) – French participants

In Belgium and Netherlands, high attrition, coupled with COVID-19 interruption and missing cases, meant there were insufficient numbers of participants for analysis of metabolic health outcomes at 6 and 12 months post-DWELL.

### 4.2.2 Participant Empowerment

Longitudinal changes in self-reported participant empowerment and self-efficacy were also assessed across the four countries.

In the UK, analysis revealed a statistically significant improvement at the end of the programme, which plateaued six months later and was maintained 12 months after the end of the programme, above baseline levels. Non-parametric analysis (Friedman test) confirmed changes after the end of the programme were statistically significant ( $\chi^2 = 24.096$ ,  $df = 3$   $p = <.001$ ) ( $n=34$ ).

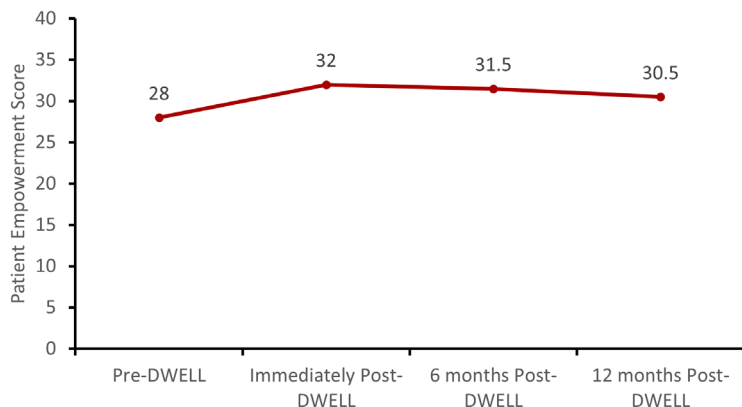


Figure 54 Longitudinal Participant Empowerment changes over 15 months of evaluation (from baseline to 12 months after the end of the programme) – UK participants

In France, analysis confirmed a statistically significant improvement in participant empowerment and self-efficacy 6 months after the end of the programme which rebounded to baseline levels at 12 months. Non-parametric analysis (Friedman test) confirmed observed changes were statistically significant ( $\chi^2 = 58.019$ ,  $df = 3$   $p = <.001$ ) ( $n=103$ ).

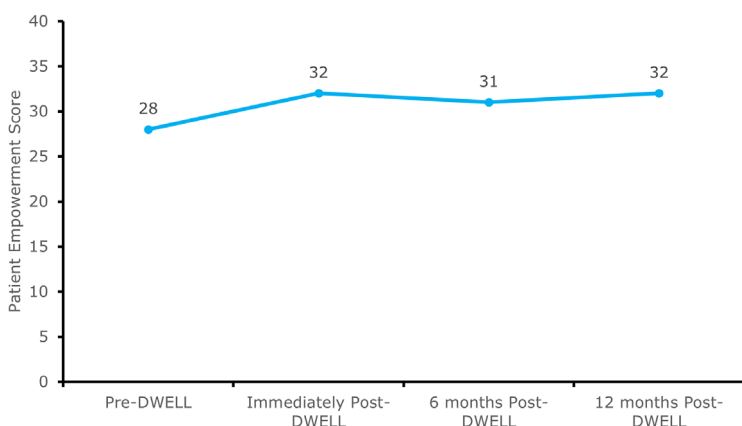


Figure 55 Longitudinal Participant Empowerment changes over 15 months of evaluation (from baseline to 12 months after the end of the programme) – French participants

In Belgium, attrition, coupled with COVID-19 interruption and missing cases, meant there were insufficient cases for analysis across all four timepoints. Therefore, longitudinal comparison of participant empowerment at the Belgian site was restricted up to 6-months post-DWELL only. Positive changes at the end of the programme tailed off slightly at the 6-month follow up. Non-parametric analysis (Friedman test) confirmed that changes were statistically significant ( $\chi^2 = 9.188$ ,  $df = 2$   $p = <.010$ ) ( $n=9$ ).

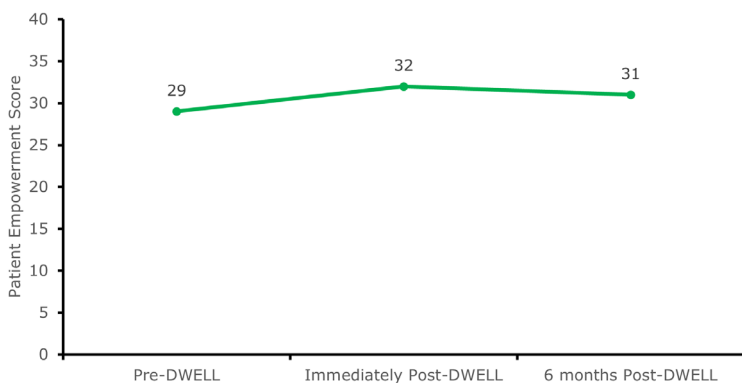


Figure 56 Longitudinal Participant Empowerment changes over 9 months of evaluation (from baseline to 6 months after the end of the programme) – Belgian participants

In the Netherlands, there was a statistically significant improvement from baseline to 12-months post-DWELL in participant empowerment. Non-parametric analysis (Friedman test) confirmed that changes were statistically ( $\chi^2 = 7.85, p = .049$ ) (n=13).

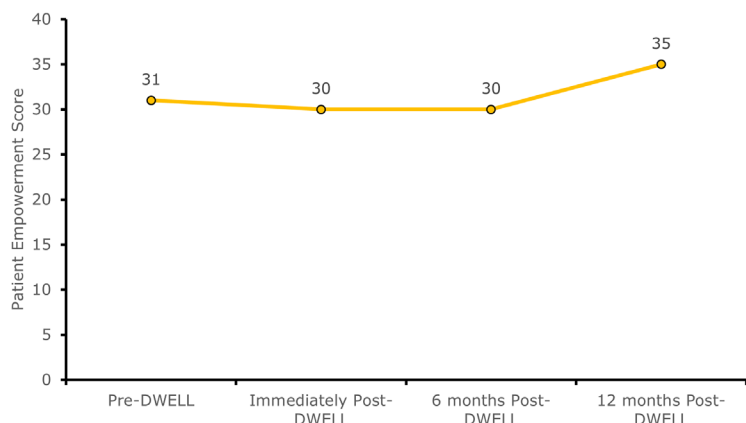


Figure 57 Longitudinal Participant Empowerment changes over 15 months of evaluation (from baseline to 12 months after the end of the programme) – Dutch participants

### 4.2.3 Illness Perceptions

The longitudinal effect of the DWELL programme on participants' illness perceptions were investigated across the four countries.

In the UK, one of the dimensions of illness perceptions which was most evident in the pre-post evaluation, illness coherence, showed consistent, statistically significant changes over time ( $z = -3.194, p = .001$ ), suggesting that participants had retained what they had learnt about diabetes during the DWELL programme, a finding which demonstrates continued engagement and understanding of their condition. Non-parametric analysis (Friedman test) confirmed that positive changes across the whole evaluation period were statistically significant ( $\chi^2 = 32.443, df = 3, p < .001$ ).

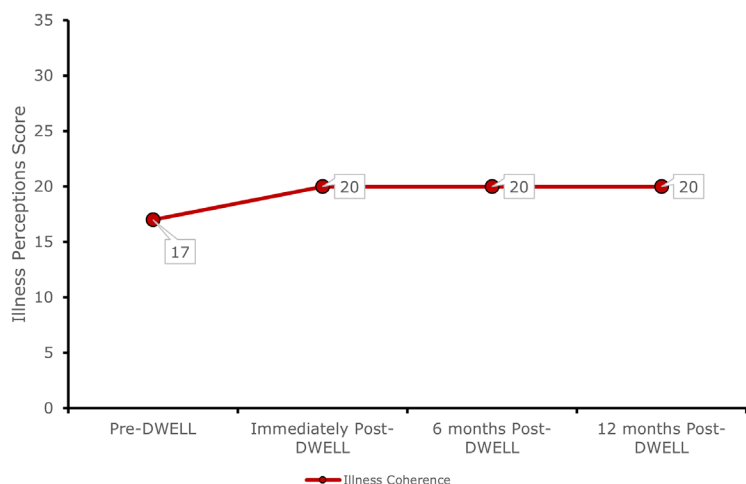


Figure 58 Longitudinal Illness Coherence changes over 15 months of evaluation (from baseline to 12 months post-DWELL) – UK participants

Changes were also investigated from end of programme to the two follow up timepoints of 6 and 12 months post-DWELL. Statistically significant results were found in relation to Personal Control and Emotion subscales. When comparing from baseline to 6 month post-DWELL, there was a statistically significant reduction in participants' scores on negative emotions associated with diabetes ( $z = -4.444, p = < .001$ ), while perceived personal control rose increased during the same period ( $z = -3.2, p = .001$ ). Non-parametric tests confirmed that these changes were statistically significant both for Emotion ( $\chi^2 = 22.921, df = 2, p = < .001$ ) and Personal control ( $\chi^2 = 14.567, df = 2, p = < .001$ ).

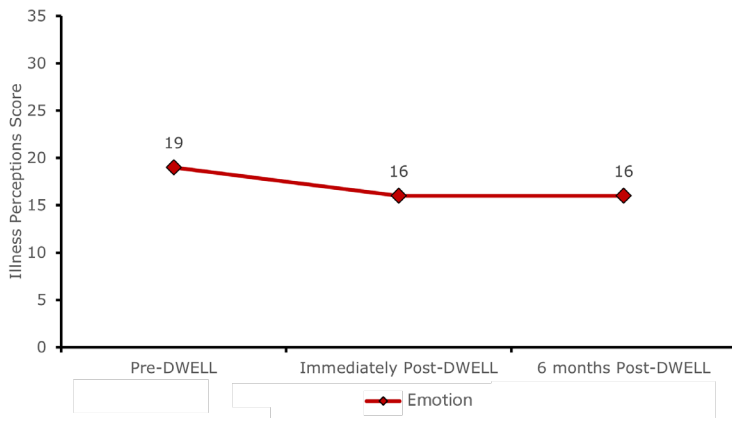


Figure 59 Longitudinal Emotion changes over 9 months of evaluation (from baseline to 6 months post-DWELL) – UK participants

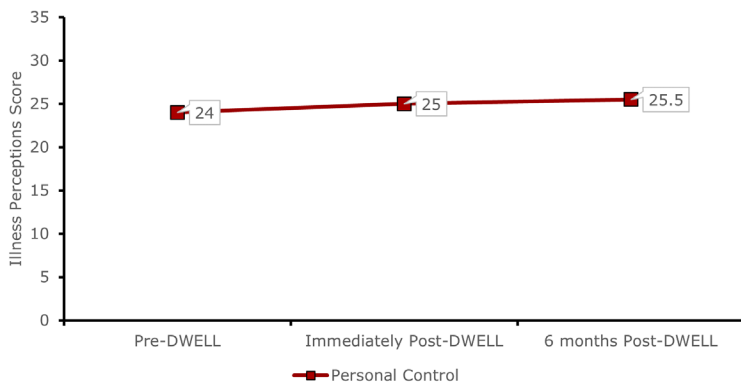


Figure 60 Longitudinal Personal Control changes over 9 months of evaluation (from baseline to 6 months post-DWELL) – UK participants

In France, similarly to the UK, illness coherence positive changes were sustained one year after the end of the programme, which suggests that participants' personal and psychological improvement is sustained over the long term. Another aspect which showed improvement over the long term was reduction in negative emotions associated with diabetes (Emotion). Non-parametric tests confirmed these changes were statistically significant (Illness Coherence -  $\chi^2 = 29.265$ ,  $df = 3$   $p = <.001$ ; Emotion -  $\chi^2 = 13.358$ ,  $df = 3$   $p = <.004$ ).

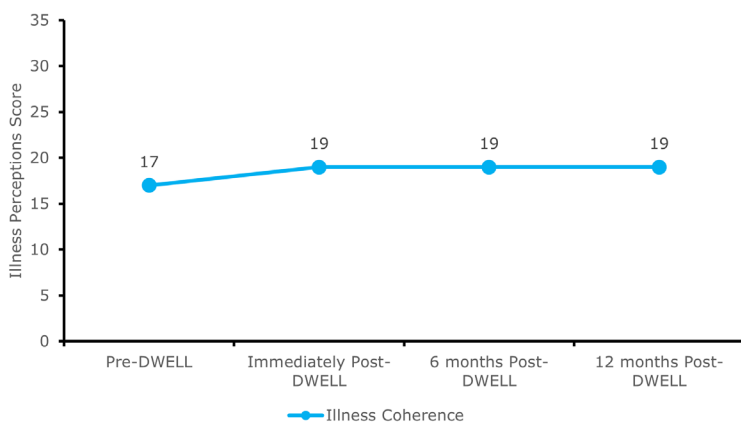


Figure 61 Longitudinal Illness Coherence changes over 15 months of evaluation (from baseline to 12 months post-DWELL) – French participants

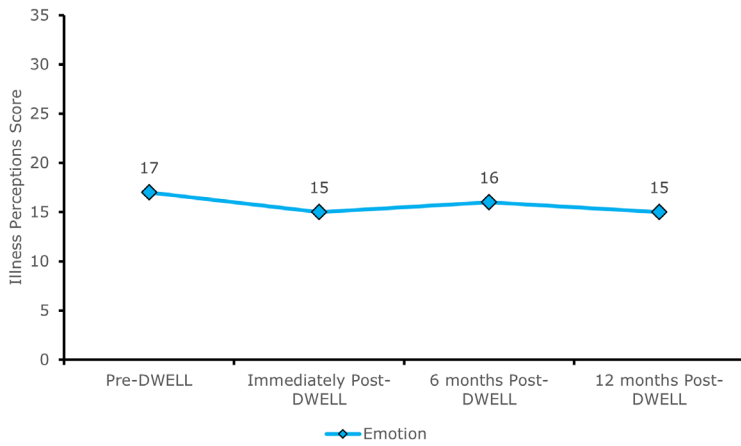


Figure 62 Longitudinal Emotion changes over 15 months of evaluation (from baseline to 12 months post-DWELL) – French participants

Statistically significant changes were also found in Consequences (how participants perceived negative life consequences associated with diabetes) from baseline to 6 months post-DWELL, as demonstrated by non-parametric test results ( $\chi^2 = 3.470$ ,  $df = 2$ ,  $p = .176$ ) ( $n=125$ ).

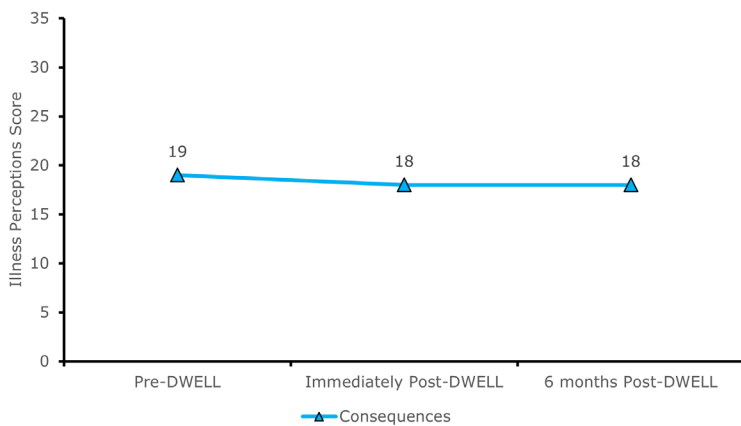


Figure 63 Longitudinal Consequences changes over 9 months of evaluation (from baseline to 6 months post-DWELL) – French participants

In Belgium, longitudinal analysis of Illness Perceptions was not possible due to small sample completing T2 and T3 measures.

In Netherlands, post-hoc comparisons revealed that there was only one aspect of illness perceptions that showed statistically significant results over the evaluation period, perceived Personal Control, which had sustained improvement, as demonstrated by non-parametric analysis results ( $\chi^2 = 9.06$ ,  $p = .028$ ) ( $n=16$ ).

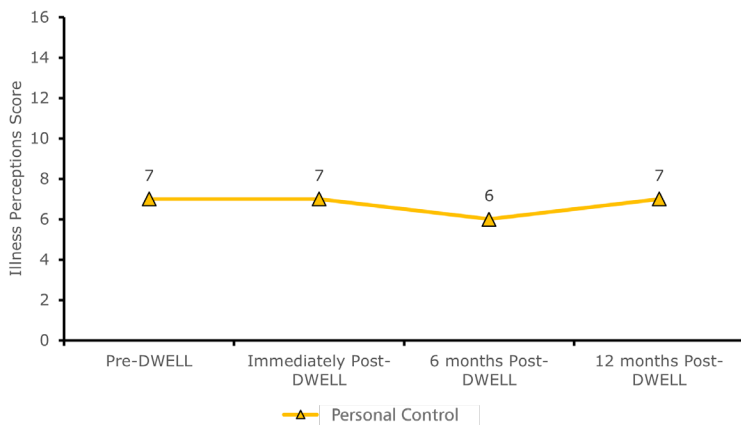


Figure 64 Longitudinal Personal Control changes over 15 months of evaluation (from baseline to 12 months post-DWELL) – Dutch participants

#### 4.2.4 Eating Behaviours

In the UK, due to high attrition at T3, analysis was carried out only with participants who had completed the evaluation at three timepoints. Restrained Eating was sustained over the medium term (6-months), although, like other measures, the greatest improvement was found immediately post-DWELL and began to tail off over the mid-term. External

Eating also appeared to be maintained 6 months post-DWELL. Non-parametric tests confirmed statistically significant changes for restrained eating ( $\chi^2 = 13.370$ ,  $df = 2$ ,  $p = .001$ ) ( $n=103$ ) and external eating ( $\chi^2 = 2.507$ ,  $df = 2$ ,  $p = .012$ ) ( $n=112$ ).

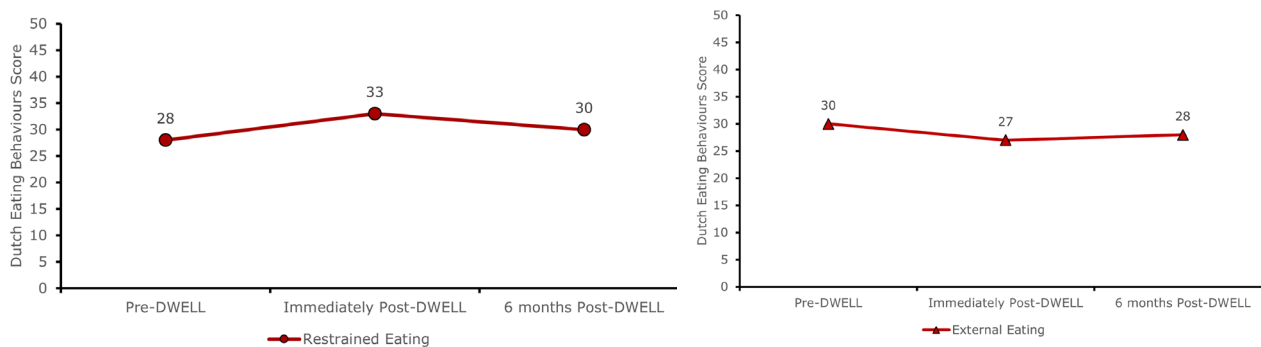


Figure 65 Longitudinal Restrained and External Eating changes over 9 months of evaluation (from baseline to 6 months post-DWELL) – UK participants

In France, analysis revealed a statistically significant improvement in External Eating. While improvement in Emotional Eating was sustained 6 months post-DWELL, it returned to baseline levels one year after the end of the programme. Non-parametric tests confirmed statistically significant changes for external eating ( $\chi^2 = 14.171$ ,  $df = 3$ ,  $p = .003$ ) ( $n=105$ ) and emotional eating ( $\chi^2 = 11.831$ ,  $df = 3$ ,  $p = .008$ ) ( $n=105$ ).

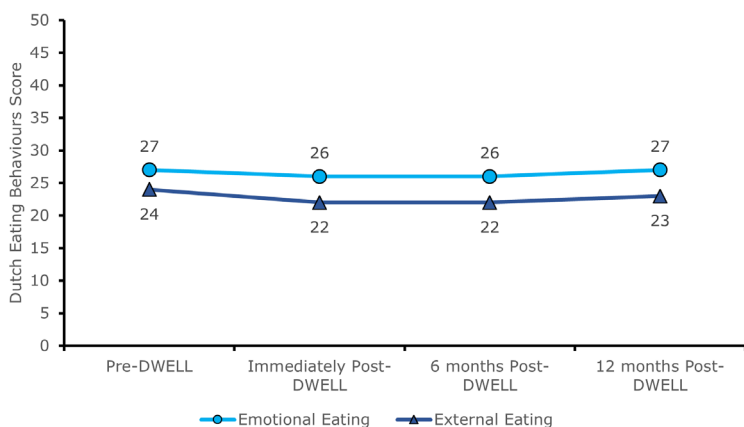


Figure 66 Longitudinal External and Emotional Eating changes over 15 months of evaluation (from baseline to 12 months post-DWELL) – French participants

In Belgium, there were too few valid cases to conduct longitudinal analysis.

In Netherlands, analysis revealed a statistically significant improvement in Emotional Eating, with improvement tailing off at 6 months and 12 months. Non-parametric tests confirmed statistically significant changes over the 15-month evaluation period ( $\chi^2 = 11.618$ ,  $df = 3$ ,  $p = .009$ ) ( $n=13$ ).

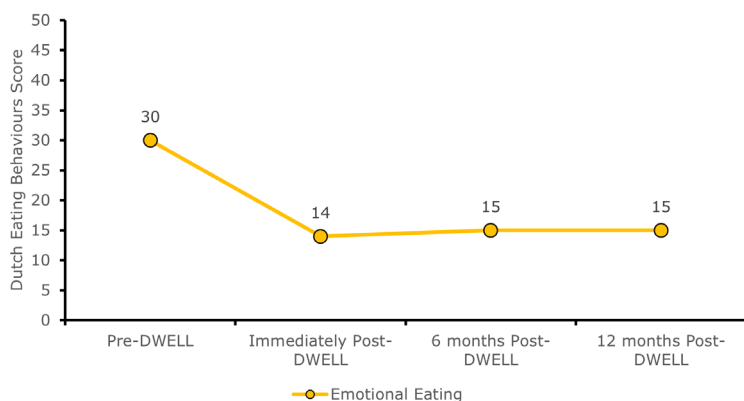


Figure 67 Longitudinal Emotional Eating changes over 15 months of evaluation (from baseline to 12 months post-DWELL) – Dutch participants

#### 4.2.5 Physical and Mental Health

In the UK, analysis did not show any statistically significant results in participants' physical and mental health from baseline or end of programme to 6 and 12 months follow ups.

In France, post-hoc comparisons revealed statistically significant improvement were maintained at 6 months post-DWELL both in perceived physical and mental health. Non-parametric tests confirmed statistically significant changes both for physical health ( $\chi^2 = 13.516$ ,  $df = 2$ ,  $p = .001$ ) ( $n=128$ ) and mental health ( $\chi^2 = 9.037$ ,  $df = 2$ ,  $p = .011$ ) ( $n=128$ ).

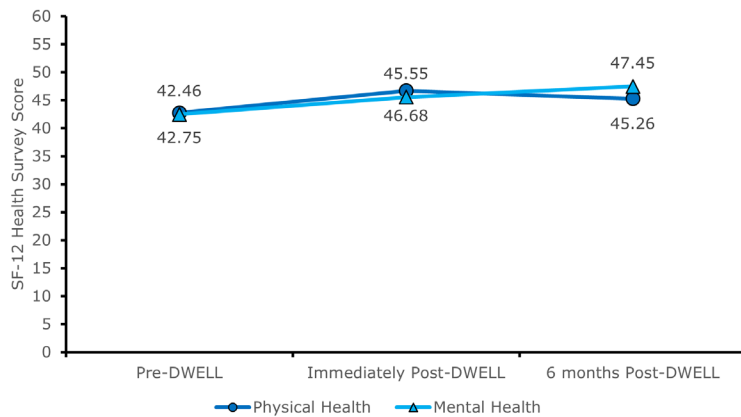


Figure 68 Longitudinal Physical and Mental Health changes over 9 months of evaluation (from baseline to 6 months post-DWELL) – French participants

In Belgium and Netherlands, due to small sample size in T2 and T3, it was not possible to conduct meaningful longitudinal comparisons.

#### 4.2.6 Note on further longitudinal analysis across countries

Due to natural attrition exacerbated by the COVID-19 pandemic which affected sample sizes at follow up points, it was not possible to conduct meaningful longitudinal analysis for Self-Care Behaviours, Physical Activity and Health-Related Quality of Life.



## 5. Conclusions

### 5.1 Efficacy, Trends and Cross-Border Learnings

Analysis of metabolic and psychometric outcome measures for participants who completed the 12-week DWELL programme revealed improvements across all project sites. These results were clearer in the UK and France, where larger samples enabled more robust statistical analysis which yielded high levels of statistical significance in several outcome improvements. Even where levels of statistical significance did not reach sufficient levels, results tended to follow overall positive trends.

Participants reported statistically significant positive metabolic health improvements at the end of the DWELL programme in weight loss, BMI reduction, waist circumference reduction and HbA1c reduction across countries, even in sites where we had small samples and statistical significance could not be demonstrated<sup>3</sup>.

As well as positive metabolic results, participants also had a more coherent understanding of diabetes and felt more empowered across all sites. This may help to explain why participants also felt more personal control, experiencing increased positive feelings about changes in symptoms. Participants also felt better equipped to deal with life consequences associated with diabetes. Overall, participants reported reduced negative emotions associated with their diabetes and improved overall mental health.

Behaviours around eating and food also improved with better control and awareness of eating (Restrained Eating) and reduction in eating habits related to emotions (Emotional Eating) and external cues (External Eating).

Participants improved their adherence to dietary, footcare and medication advice in most countries. Broadly, they reported receiving more advice on diet, exercise, blood sugar measurement and medication prescriptions after they had completed the DWELL programme and there was a decrease of participants who received no advice from their GP or healthcare professional. This may suggest that upon DWELL programme completion, having learnt more about diabetes, participants were more engaged with services, and were more receptive to specific diet advice, footcare and medication management. Wider cultural and healthcare systems factors may have impacted on engagement with and uptake of services.

Findings suggest that the effect of the DWELL programme reached a peak at the end of the programme delivery. Comparative analysis of pre-post DWELL outcomes demonstrated improved self-reported physical and mental health and overall physical activity at all sites, with those results in the UK and France being statistically significant.

Longitudinal analysis highlighted some broad patterns in participant outcomes. In the medium-term post-DWELL, there were improvements in both metabolic and psychosocial outcomes. In the long term, a year after the programme, most outcomes either continued to improve, or remained at end-of-programme levels, although still being improved from pre-DWELL levels.

More sustained outcomes were found in relation to weight loss (in UK and France); HbA1c reduction (in France); empowerment and personal control (in UK, France and Belgium); and, mental health (in France). In all these outcomes, improvements continued when comparisons were made across all four evaluation timepoints.

In a few cases, positive changes noted at the end of the programme or at the medium term post-DWELL, appeared to be 'reversed', i.e. returned to baseline levels. This was observed in two cases, participant empowerment levels in Netherlands and emotional eating in France, where 12-month post-DWELL results indicated that scores were reverted back to pre-DWELL levels. There may be a number of reasons for this finding, including the 'maintenance' issue flagged up by participants in the process evaluation (namely, continuing to be in contact with DWELL facilitators and peers after the end of the programme) or level/type of support provided post-DWELL in each delivery site.

Another interesting finding which emerged from longitudinal analysis was the difference between outcomes which

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<sup>3</sup> Where measure results were not statistically significant, they are only reported where their inclusion is pertinent and helps to demonstrate overall trends.



relied on personal cognitive and psychological improvement, and outcomes which relied on the contribution of others or factors beyond the direct control of participants. Long-term positive changes, personal control and mental health, were related to the first type of outcomes and this was demonstrated from the pre-post analysis and improvements in illness coherence, empowerment, personal control, dealing with negative emotions, consequences and symptoms, overall mental health and control, awareness, and response to food cues. However, there were no sustained changes in outcomes of the second type, i.e., feeling of control over treatment, which relies on external factors (healthcare professionals and care provision systems), and perception of duration of diabetes (there is no cure for type 2 diabetes and can be beyond the direct control of participants).

## 5.2 Future Research

Further analysis of DWELL evaluation data will offer greater insight into the programme's impact on participants' lives. The relationship between participants' personal, cognitive and psychological improvements and externally determined factors such as healthcare systems would benefit from a more detailed analysis. This may require investigating correlations between participant outcomes and site differences in delivery of the DWELL programme, but also demographic differences, such as gender, ethnicity and economic background, as well as societal differences in healthcare system, political decision-making and even societal relationship to food and exercise.

Additional analysis could also shed greater light on how DWELL programme elements affected participants, at country level considering in more detail the local aspects of diabetes care. For example, it would be beneficial to know why in France BMI did not improve following the DWELL programme, whether this had anything to do with the discrepancy in dietary advice and whether this was the result of broader cultural and social focus on food, which has traditionally been associated with cultural attitudes towards eating in this country.



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