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RESEARCH ARTICLE

Factors affecting continuous participation in follow-up evaluations during a lifestyle intervention programme for type 2 diabetes prevention: The Feel4Diabetes-study

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Abstract

Aims: Community- and school-based lifestyle interventions are an efficient method of preventing type 2 diabetes in vulnerable populations. Many participants, however, fail to complete the necessary follow-ups. We investigated factors affecting the continuous participation in follow-up evaluations during the Feel4Diabetes-study, a multilevel intervention programme implemented across Europe.

Methods: Socioeconomic, sociodemographic and clinical factors were assessed for 2702 participants within six participating countries: Bulgaria and Hungary (low-to-middle-income countries, LMIC), Belgium and Finland (high-income

countries, HIC) and Greece and Spain (high-income countries under austerity measures, HICAM).

Results: Statistically significant differences were detected with respect to sex, control group, education level, employment status, BMI and blood pressure measurements (systolic and diastolic blood pressure). Post hoc analysis revealed significant differences within socioeconomic regions. Higher levels of education were associated with significantly lower attrition in HIC ($p < 0.05$) and HICAM ($p < 0.001$), higher employment status was associated with lower attrition in HICAM ($p < 0.001$) and being female was associated with lower attrition in LMIC ($p < 0.001$). Surprisingly, the intervention group exhibited higher-than-expected attrition in HIC ($p < 0.001$) and HICAM ($p = 0.003$), and lower attrition in LMIC ($p = 0.007$). When tested together in the same multivariable predictive model, all sociodemographic and socioeconomic variables along with higher BMI retained their statistical significance, while systolic and diastolic blood pressure failed to remain significant.

Conclusions: Key socioeconomic and sociodemographic factors along with BMI play a significant role in determining continuous participation in follow-up evaluations during school- and community-based intervention programmes.

KEYWORDS

attrition, continuous participation, diabetes type 2, intervention, socioeconomic regions, socioeconomic/sociodemographic factors

1 | INTRODUCTION

Type 2 diabetes (T2D) is characterized by a long pre-diabetic period, with studies showing that lifestyle interventions can prevent, or at least delay, the onset of the disease.[1,2] Nevertheless, randomized controlled trials with individual counselling lasting several years are expensive and their applicability in a 'real life' setting may not always be possible.[3,4]

Consistent lifestyle patterns and behaviours are established over several years, with attitudes and perceptions towards healthier lifestyles being critically influenced at a very young age by older family members (e.g. parents and grandparents) and the direct social environment (e.g. school, community).[5–8] Therefore, any intervention programme aimed at establishing sustainable behaviours should also focus on 'influencing the influencers'. School- and community-based lifestyle interventions are an efficient method of preventing T2D in vulnerable populations.[9,10] Many participants, however, fail to complete the necessary follow-up evaluations during such interventions.[11–14]

The focus of the current study was to investigate factors affecting the continuous participation of parents from families identified as high risk for T2D in follow-up evaluations during the Feel4Diabetes-study. The EU-funded Feel4Diabetes-study was a multilevel intervention aimed at promoting healthy lifestyles and preventing T2D in vulnerable populations.[9,10] The examined

What's new?

- Community- and school-based lifestyle interventions might be an efficient and scalable method of preventing type 2 diabetes among vulnerable populations. Many participants at risk of developing diabetes fail to complete the necessary follow-ups during such interventions.
- Education and employment were associated with significantly lower attrition in high-income countries and high-income countries under austerity measures. Socioeconomic and sociodemographic variables and BMI had the greatest impact on predicting follow-up attrition.
- The results of this study can be used to customize specific elements of future community- and school-based interventions within different socioeconomic regions to combat attrition and increase participation in required follow-ups.

factors included a variety of sociodemographic and socioeconomic variables (e.g. sex, education, employment status, socioeconomic regions), T2D risk levels (diabetes risk score), control variables (intervention/control group), anthropometric variables (e.g. BMI) and related clinical assessment variables (e.g. fasting plasma glucose, blood pressure). The Feel4Diabetes study is one of the very few multi-region, multi-country studies that considered all those elements within different socioeconomic environments.[11–15]

2 | METHODS

The Feel4Diabetes-study followed a cluster-randomized design and was implemented through a collaborative effort at schools, homes and municipalities in six participating countries across Europe. The duration of the study was 4 years (2015–2019) and was registered at clinicaltrials.gov (NCT 02393872). The study adhered to the Declaration of Helsinki and the conventions of the Council of Europe, while consent and clearance were also obtained from the relevant ethical committees in all participating countries.[9]

2.1 | Participants

The Feel4Diabetes-study focused on low socioeconomic status (SES) populations across Europe, which are at a higher risk for developing T2D and at an economic disadvantage with respect to diagnosis and treatment.[16–18] The six participating countries were classified into three socioeconomic regions according to the World Bank Gross National Income (GNI) and Eurostat Government Budget Deficit data from 2014: Belgium and Finland, high-income countries (HIC); Greece and Spain, high-income countries under austerity measures (HICAM) and Bulgaria and Hungary, low-to-middle-income countries (LMIC). Within LMIC, all school districts and municipalities were considered vulnerable areas, whereas in HIC and HICAM, school districts and municipalities were selected from the lowest tertile according to local socioeconomic indices (e.g. education, level, unemployment, etc.).

Primary schools were randomly recruited from the selected vulnerable areas in each country. A total of 219 primary schools (40.2% response rate) confirmed participation and 28,075 families of children in the first three grades (6–9 years old) were contacted through the participating schools. (Note: To achieve statistical power greater than 80% for reducing BMI by 0.7 kg/m^2 for a two-sided test at 0.05 level of significance, and also account for attrition, at least 11,160 families were targeted to be recruited in the six participating countries). Schools were randomly assigned to intervention and control groups; therefore, all contacted parents were automatically assigned to their respective groups. Parents were sent a consent form, a diabetes risk assessment questionnaire[19] and an energy balance-related behaviours (EBRB) questionnaire. A total of 11,396 families confirmed participation and 20,501 parents completed the consent form and questionnaires (first-stage screening), with their children undergoing anthropometric measurements at school with the help of trained research assistants. Based on the results of their diabetes risk assessment questionnaire, 4484 families were classified as 'high-risk'.[9,10] Parents in high-risk families were invited (in a discrete manner) to participate in a more detailed baseline clinical assessment (second-stage screening) that included both anthropometric and blood measurements conducted at a local community centre (e.g. university, health centre). A total of 3153 parents from high-risk families participated (at least partially) in the baseline clinical assessment and 2702 provided baseline blood glucose measurements. The focus of the present study was to investigate factors that affected the continuous participation (and attrition) of those parents ($n = 2702$) in follow-up evaluations.

2.2 | The Feel4Diabetes intervention

The Feel4Diabetes intervention was implemented during two consecutive academic years (2016–2017 and 2017–2018) and consisted of an 'all families' component and a 'high-risk families' component. The 'all families' component was delivered by schoolteachers after receiving training and materials support prior to the beginning of the year. No training or materials were provided to teachers in control group schools. The goal of the teachers was to promote healthy and active lifestyles to students and act as role models using simple activities implemented in the classroom. Those activities were supplemented by family newsletters aimed at informing and motivating families to adopt healthier and more active lifestyles at home, while at the same time identifying and promoting available community resources (e.g. parks, playgrounds, programmes).

The additional 'high-risk families' component was delivered by trained health professionals to the families identified as high risk during the first-stage screening to further encourage adaptations of healthier lifestyles. During the first academic year (2016–2017), a total of six counselling sessions were conducted at local community centres (e.g. university, health centre). The aim of those sessions was to increase motivation and self-efficacy, set of goals and targets, provide encouragement and review clinical assessments. The second year of the intervention (2017–2018) was designed as a reinforcement to the

counselling sessions. Participants received motivational guidance through texts delivered to their mobile phones. Only one additional counselling session was conducted at the beginning of the second academic year to provide the results of each family's first follow-up evaluation; set specific, measurable, attainable, realistic and timely (SMART) goals for the second year of the intervention and introduce them to text messaging (SMS). In contrast, the control group received no intervention at the school, family or community level other than general conventional advice on healthy and active lifestyles.

2.3 | Measurements

To evaluate critical factors affecting continuous participation in follow-up assessments, parental socioeconomic and sociodemographic information was collected via questionnaires, while anthropometric and blood-related measurements were obtained by trained research assistants using standardized protocols and calibrated equipment. Measurements were collected at three different time periods: at baseline (April–September 2016), after the first year of the intervention (first follow-up: April–September 2017) and after the second year of the intervention (second follow-up: April–September 2018). Additional details of the design and implementation of the intervention have been presented elsewhere.[9,10,20]

2.3.1 | Diabetes Risk Score

The Finnish Diabetes Risk Score (FINDRISC) is a questionnaire-based tool to identify individuals at risk of developing T2D.[19] The total risk score ranges from 0 to 26 and is calculated using a point scale on responses to eight questions on age, BMI, waist circumference, physical activity, consumption of vegetables, fruit or berries, use of medication for blood pressure, high blood glucose history and family history of diabetes (type 1 or type 2). A cut-off score of ≥15 has generally been shown to identify individuals at risk of developing T2D,[19,21,22] but that may vary depending on the age and other characteristics of the population studied. In the present study, a family was classified as high-risk, if one of its adult members had a FINDRISC score greater than or equal to the country-specific cut-off point for FINDRISC that indicated increased T2D risk. For the majority of countries, considering the young age of the participants (42.0 ± 7.5 years), T2D risk was set as a FINDRISC score ≥9. Consequently, all parents in those families were invited to participate in the high-risk study component. FINDRISC scores were classified into the following categories, consistent with previous research studies: 0–11 (low to slightly elevated risk), 12–14 (medium risk) and 15–26 (high risk).[10,22,23]

2.3.2 | Control variable

Based on first-stage randomization of the recruited municipalities and schools, parents were assigned to either the intervention group or control group. In total. 1514 parents (56.0%) from high-risk families were allocated to the intervention group and 1188 parents (44%) to the control group. Control group parents did not receive the intervention but were invited to participate in all baseline and follow-up measurements.

2.3.3 | Sociodemographic and socioeconomic variables

During the first stage of screening, sociodemographic and socioeconomic information was collected via questionnaires. The following factors were considered as categorical variables: (a) Sex; (b) education level, classified as low (≤12 years of education) and high (>12 years, corresponding to at least some post-secondary education); (c) employment status, classified as low (i.e. stay at home parents, unemployed and retirees) and high (parents working full time, part time or attending academia) and (d) socioeconomic region (HIC, HICAM and LMIC).

2.3.4 | Anthropometry

BMI was calculated using the body weight and height of parents in high-risk families. Measurements were conducted in light clothing and without shoes to the nearest 0.1 kg and 0.1 cm, respectively, using calibrated portable digital scales and telescopic stadiometers. Two readings were obtained for each measurement and the mean was used for the analysis. If the two measurements differed by more than 100 g or 1 cm, respectively, a third measurement was taken to resolve the conflict. BMI measurements were obtained at baseline and during each of the two clinical follow-ups.

2.3.5 | Glucose measurements

Blood samples were drawn at baseline and during follow-ups in the morning hours. Participants were instructed to fast overnight for at least 8 hours. To ensure compliance, a reminder phone call was delivered the day before, and participants were advised to also refrain from taking their

early morning medication. Fasting plasma glucose measurements were analysed in accredited laboratories within participating countries.

2.3.6 | Blood pressure measurements

Systolic blood pressure (SBP) and diastolic blood pressure (DBP) measurements were obtained at baseline and during follow-up evaluations. Parents were instructed to avoid strenuous physical activity, eating and drinking for at least 1 hour before measurements. Blood pressure was measured on the right arm and in a sitting position using calibrated digital devices. Three measurements, 1 minute apart, were taken on each occasion and the average of the second and third measurements was used in the statistical analysis.

2.4 | Participation and attrition

In total, 2702 parents from high-risk families participated in baseline measurements, in addition to completing the first-stage screening questionnaires. Of those parents, 1796 also participated in the first follow-up, and 1296 proceeded to also complete the second follow-up. Since the primary goal of this study was to investigate key factors affecting continuous participation in follow-up evaluation, three independent participation groups were defined: (a) parents who participated only in baseline measurements (Baseline, $n = 906$, 33.5%); (b) parents who participated in baseline and only the first follow-up (Baseline +1F, $n = 500$, 18.5%) and (c) parents who participated in baseline and both follow-ups (Baseline +2F, $n = 1296$, 48%). Therefore, the Baseline only group represents attrition after baseline measurements, and the Baseline +1F group represents the corresponding attrition after the first follow-up. A summary of design, allocation and analysis is presented in the CONSORT flow diagram of Figure 1.

2.5 | Statistical analysis

Statistical analysis was performed using IBM SPSS Version 28.0 (IBM Corporation, Armonk, NY, USA). The relationships between categorical variables (e.g. socioeconomic, sociodemographic, FINDRISC) and participation groups were analysed using the Pearson Chi-Square test. Post hoc analysis between groups was performed using the adjusted residuals method and ensuing conversion to *p*-values. Multivariate analysis of covariance (MANCOVA) was employed to investigate differences in continuous variables (e.g. BMI, fasting glucose, blood pressure) across follow-up participation groups, while also statistically controlling for sex (covariate) differences.[24,25] Multivariable binary logistic regression models were developed to analyse the combined effect of categorical and continuous independent variables on predicting attrition/continuation. In all instances, statistical significance was evaluated at the 0.05 level ($p < 0.05$). During post hoc analysis and pairwise comparisons, *p*-values were adjusted using the Bonferroni correction to account for multiple comparisons.

3 | RESULTS

3.1 | Effects of categorical variables on follow-up participation

Across all countries, 919 male (34.0%) and 1783 female (66.0%) participants conducted baseline and follow-up evaluations. As shown in Table 1, statistically significant associations were observed between participation groups and sex ($\chi^2(2) = 15.03$, $p < 0.001$), experimental group ($\chi^2(2) = 16.01$, $p < 0.001$), education ($\chi^2(2) = 42.64$, $p < 0.001$), employment ($\chi^2(2) = 14.93$, $p < 0.001$), socioeconomic regions ($\chi^2(4) = 181.74$, $p < 0.001$) and participating countries ($\chi^2(10) = 207.79$, $p < 0.001$). There was no statistically significant association between FINDRISC categories and participation groups ($\chi^2(4) = 1.06$, $p = 0.901$).

Post-hoc analysis revealed that a significantly higher-than-expected proportion of male participants (39.0%, $p < 0.001$) attended only the baseline measurements. Conversely, a statistically higher proportion of female participants (68.8%, $p = 0.011$) completed baseline measurements and both follow-ups. A significantly higher-than-expected proportion of parents in the intervention group attended only baseline measurements (60.2%, $p = 0.007$) while a higher-than-expected proportion of parents in the control group attended both follow-ups (47.9%, $p < 0.001$).

Parents having lower education had higher-than-expected representation in the baseline only group (34.2%, $p < 0.001$), while a statistically higher-than-expected proportion of parents in the high education group completed both follow-ups (78.8%, $p < 0.001$). Parents with lower employment status showed significantly higher representation (26.7%, $p < 0.001$) in the baseline only group. On the other hand, parents in the higher employment group were represented by a higher-than-expected percentage (80.5%, $p = 0.017$) in the group that completed both follow-ups.

A significantly higher-than-expected proportion of parents from LMIC (34.8%, $p < 0.001$) and lower-than-expected proportions from HIC (25.5%, $p = 0.01$) and HICAM (39.7%, $p < 0.001$) were observed in the baseline only group. Additionally, a significantly

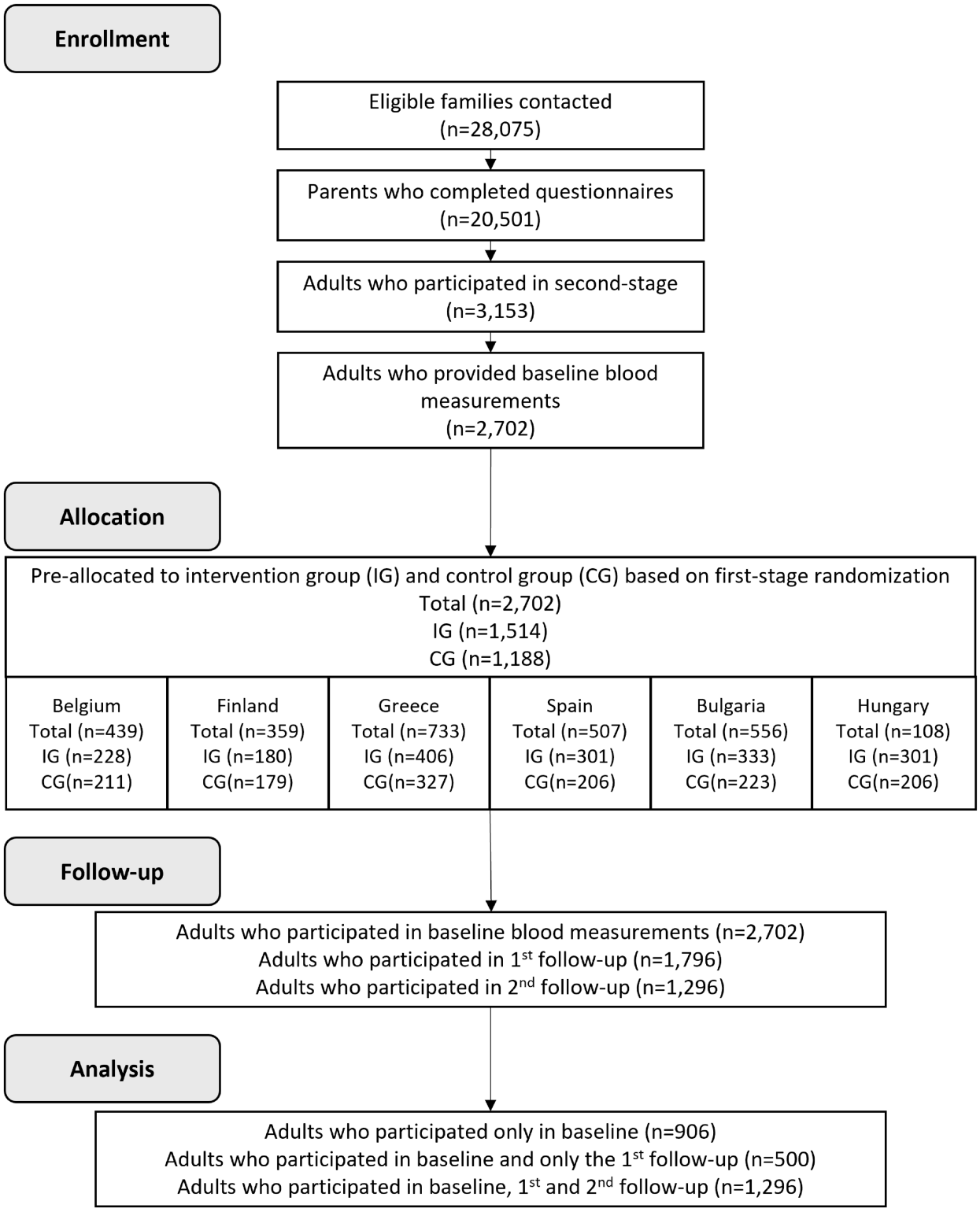

FIGURE 1 CONSORT flow diagram. CG, control group; FINDRISC, Finnish Diabetes Risk Score; IG, intervention group.

higher-than-expected percentage of parents from LMIC (34.8%, $p < 0.001$) and a lower-than-expected percentage of parents from HICAM (33.0%, $p < 0.001$) completed baseline and just the first follow-up. The group that completed baseline and both follow-ups had a higher-than-expected representation of parents from HICAM (55.2%, $p < 0.001$) and a lower-than-expected representation from LMIC (13.5%, $p < 0.001$).

In Greece (33.7%, $p < 0.001$) and Spain (21.5%, $p = 0.011$), a higher-than-expected percentage of parents completed both follow-ups, while in Bulgaria (26.9%, $p < 0.001$) and Hungary (7.8%, $p < 0.001$) a larger than

TABLE 1 Sociodemographic, socioeconomic and control effects on continuous participation.

Variable	Baseline	Baseline + 1F	Baseline + 2F	Total	p
	n (%)				
Sex					<0.001*
Male	353 (39.0)[a]	161 (32.2)	405 (31.3)[b]	919 (34.0)	
Female	553 (61.0)[b]	339 (67.8)	891 (68.8)[a]	1783 (66.0)	
FINDRISC					0.901
Low risk 0–11	506 (62.6)	297 (63.7)	770 (62.2)	1573 (62.6)	
Medium risk 12–14	183 (22.6)	108 (23.2)	296 (23.9)	587 (23.4)	
High risk 15–26	119 (14.7)	61 (13.1)	172 (13.9)	352 (14.0)	
Experimental group					<0.001*
Intervention	545 (60.2)[a]	294 (58.8)	675 (52.1)[b]	1514 (56.0)	
Control	361 (39.8)[b]	206 (41.2)	621 (47.9)[a]	1188 (44.0)	
Education					<0.001*
≤12 years	271 (34.2)[a]	122 (25.6)	270 (21.2)[b]	663 (26.1)	
>12 years	521 (65.8)[b]	354 (74.4)	1001 (78.8)[a]	1876 (73.9)	
Employment status					<0.001*
Unemp, Stay Hm, Ret	199 (26.7)[a]	88 (20.0)	233 (19.5)[b]	520 (21.8)	
Work FT, PT, Edu	547 (73.3)[b]	352 (80.0)	962 (80.5)[a]	1861 (78.2)	
Region					<0.001*
HIC	231 (25.5)[b]	161 (32.2)	406 (31.3)	798 (29.5)	
HICAM	360 (39.7)[b]	165 (33.0)[b]	715 (55.2)[a]	1240 (45.9)	
LMIC	315 (34.8)[a]	174 (34.8)[a]	175 (13.5)[b]	664 (24.6)	
Country					<0.001*
Belgium	126 (13.9)	98 (19.6)	215 (16.6)	439 (16.2)	
Finland	105 (11.6)	63 (12.6)	191 (14.7)	359 (13.3)	
Greece	207 (22.8)[b]	89 (17.8)[b]	437 (33.7)[a]	733 (27.1)	
Spain	153 (16.9)	76 (15.2)	278 (21.5)[a]	507 (18.8)	
Bulgaria	244 (26.9)[a]	149 (29.8)[a]	163 (12.6)[b]	556 (20.6)	
Hungary	71 (7.8)[a]	25 (5.0)	12 (0.9)[b]	108 (4.0)	
Total	906 (100)	500 (100)	1296 (100)	2702 (100)	

[a]Statistically higher-than-expected proportions using adjusted *p*-values using the Bonferroni correction.

[b]Statistically higher-than-expected proportions using adjusted *p*-values using the Bonferroni correction.

*Statistical significance at the 0.05 level ($p < 0.05$) using the Chi-Squared test.

expected percentage of parents did not complete any follow-ups.

3.2 | Follow-up participation within socioeconomic regions

Since one of the design objectives of the Feel4Diabetes-study was to scale school and community interventions across multiple geographic regions, we further investigated socioeconomic and sociodemographic factors within the different socioeconomic regions. In HIC (Figure 2), we observed statistically significant associations between intervention/control and participation ($\chi^2(2) = 39.68$, $p < 0.001$), as well as between education level and participation ($\chi^2(2) = 6.26$, $p = 0.044$). A higher-than-expected proportion of parents in the intervention group (38.7%, $p < 0.001$) and in the lower education group (33.1%, $p < 0.05$) attended only baseline measurements, whereas a higher-than-expected proportions of parents in the control group completed both follow-ups (59.5%, $p < 0.001$).

In HICAM (Figure 3), we observed statistically significant associations between participation and experimental group (intervention/control) ($\chi^2(2) = 16.20$, $p < 0.001$), participation and education level ($\chi^2(2) = 32.89$, $p < 0.001$) and participation and employment status ($\chi^2(2) = 15.21$, $p < 0.001$). Post hoc analysis revealed that a higher-than-expected proportion of parents with lower

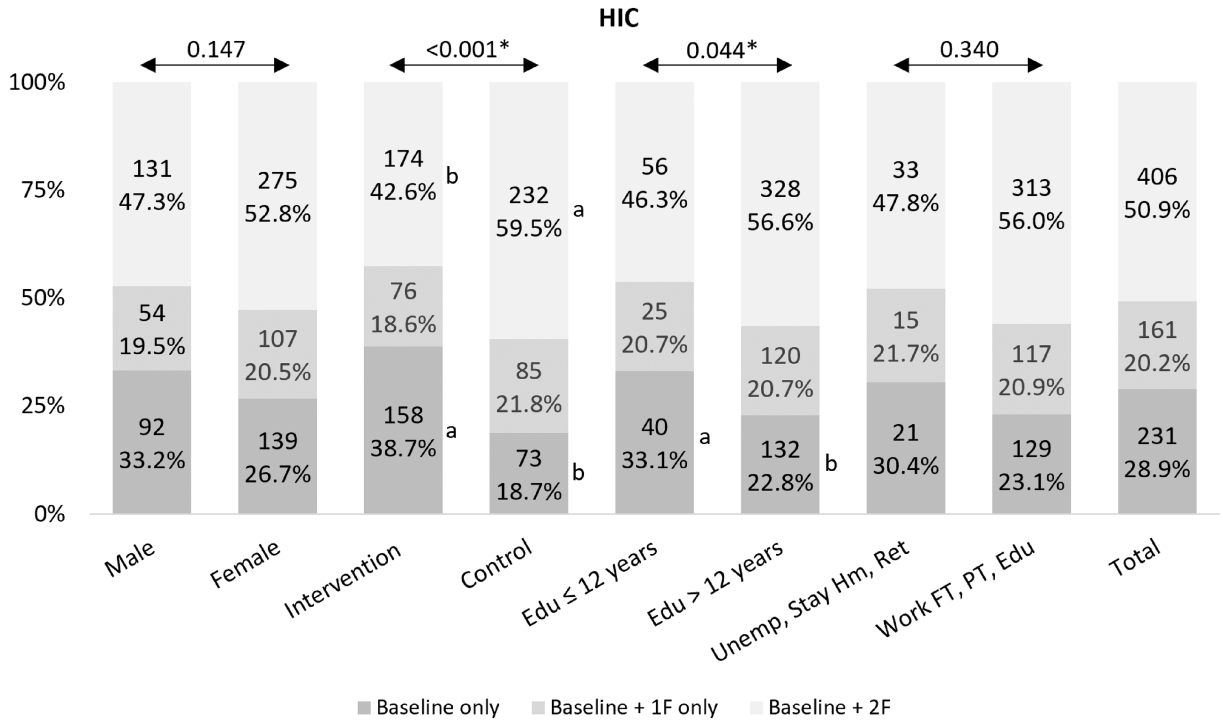

FIGURE 2 Continuous participation and attrition in high-income countries (HIC). *Statistical significance at the 0.05 level ($p < 0.05$) using the Chi-Squared test. [a]Statistically higher-than-expected proportions. [b]Statistically higher-than-expected proportions.

education (38.3%, $p < 0.001$) and lower employment status (35.3%, $p < 0.001$) attended only baseline measurements. Additionally, a higher-than-expected proportion of parents in the intervention group (16.3%, $p = 0.001$) attended baseline plus first follow-up. Lastly, there was a significantly higher percentage of parents in the control group (63.0%, $p = 0.003$), in higher education (63.8%, $p < 0.001$), and with higher employment status (62.1%, $p = 0.002$) who completed both follow-ups.

In LMIC (Figure 4), analysis revealed statistically significant relationships between continuous participation and sex ($\chi^2(2) = 24.52$, $p < 0.001$), as well as between participation and experimental group (intervention/control) ($\chi^2(2) = 9.91$ $p = 0.007$). We observed a significantly higher-than-expected percentage of male participants (61.9%, $p < 0.001$) and parents in the control group (53.2%, $p = 0.046$) in the baseline only group. In contrast, a significantly higher-than-expected proportion of female participants (30.7%, $p < 0.001$) and parents in the intervention groups (30.6%, $p = 0.007$) completed both follow-ups.

3.3 | Clinical measurements and follow-up participation

In our analysis, we also wanted to investigate the association between participation and clinical measurements conducted during baseline and the two follow-ups. Specifically, we considered anthropometric (i.e. BMI), fasting plasma glucose, and blood pressure (i.e. SBP and DBP) measurements.[24,25] Preliminary analysis verified that there were no significant violations of assumptions, including no significant interaction between participation groups and sex in the overall multivariate model, either at baseline (F (8, 5174) = 0.353, $p = 0.945$) or first follow-up (F (4, 1773) = 0.107, $p = 0.980$).

As shown in Table 2, during baseline measurements, statistically significant differences were detected between participation groups and BMI (F (2, 2591) = 9.436, $p < 0.001$), SBP (F (2, 2591) = 10.996, $p < 0.001$) and DBP (F (2, 2591) = 11.857, $p < 0.001$). However, there were no significant differences between participation groups and glucose (F (2, 2591) = 2.789, $p = 0.062$).

Similarly, during the first follow-up, significant differences were detected between participation groups in BMI (29.98 ± 5.40 vs. 28.14 ± 5.24, $p = 0.003$), SBP (118.22 ± 15.51 vs. 114.99 ± 15.45, $p < 0.001$) and DBP (77.80 ± 10.36 vs. 76.57 ± 10.37, $p = 0.029$).

3.4 | Multivariable logistic regression

Two binary logistic models were built for predicting attrition/continuation after baseline measurements and after the first follow-up. Both models contained all independent

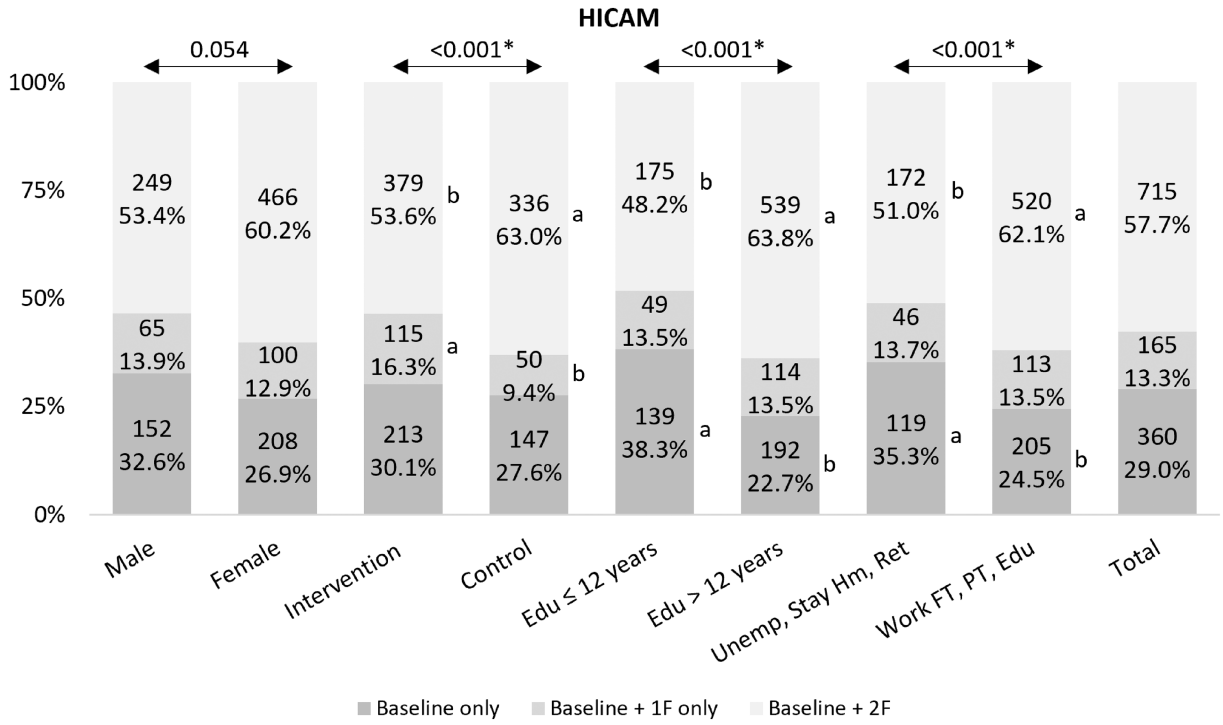

FIGURE 3 Continuous participation and attrition in high-income countries under austerity measures (HICAM). *Statistical significance at the 0.05 level ($p < 0.05$) using the Chi-Squared test. [a]Statistically higher-than-expected proportions. [b]Statistically higher-than-expected proportions.

variables (categorical and continuous) that exhibited statistically significant differences between participation groups in the earlier results sections (sex, control group, education level, employment status, socioeconomic regions, BMI, SBP and DBP).

The first model (Table 3) was statistically significant ($\chi^2(9) = 160.80$, $p < 0.001$) indicating ability to distinguish between the parents who continued evaluations after baseline and those who did not. All socioeconomic and sociodemographic variables tested were statistically significant in the model. Specifically, being female, in the control group, having higher level of education, higher employment status, in HIC and HICAM all increased the odds of continuing participation in the Feel4Diabetes-study, with socioeconomic regions being the strongest predictor in the group. However, from the clinical indices, only BMI was statistically significant, with higher BMI increasing the odds of attrition. The model correctly classified 70.8% of the parents, with very high accuracy in predicting continuation in follow-ups (94.9%), while lacking in its ability to correctly predict attrition (16.3%).

The second model (Table 4), predicting parent attrition/continuation after the first follow-up, was also statistically significant ($\chi^2(9) = 117.35$, $p < 0.00$). However, only socioeconomic regions and BMI made unique significant contributions. The model was 73.9% accurate in correctly classifying parents. Like the baseline model, the model was very accurate in predicting continuation in follow-ups (95.6%) but insufficient in predicting attrition (14.1%).

4 | DISCUSSION

Statistically significant differences were detected with respect to sex, control group, education level, employment status, body mass index (BMI) and blood pressure measurements (systolic and diastolic blood pressure). While high-risk families were successfully identified using the FINDRISC questionnaire, their respective risk level classification did not have a significant effect on their continuous participation in subsequent follow-ups.

Post hoc analysis revealed significant differences between socioeconomic regions. Parents from LMIC had much higher-than-expected attrition, both after baseline and after the first follow-up, while parents from HIC and HICAM showed statistically significant tendencies towards completing all follow-ups. While the HIC versus LMIC attrition results were not surprising based on existing regional socioeconomic trends,[26,27] the progression was not linear (HICAM showing better performance than HIC), indicating that austerity measures may have increased the importance of community- and school-based programmes as convenient and affordable alternatives to private, or other public, care options.

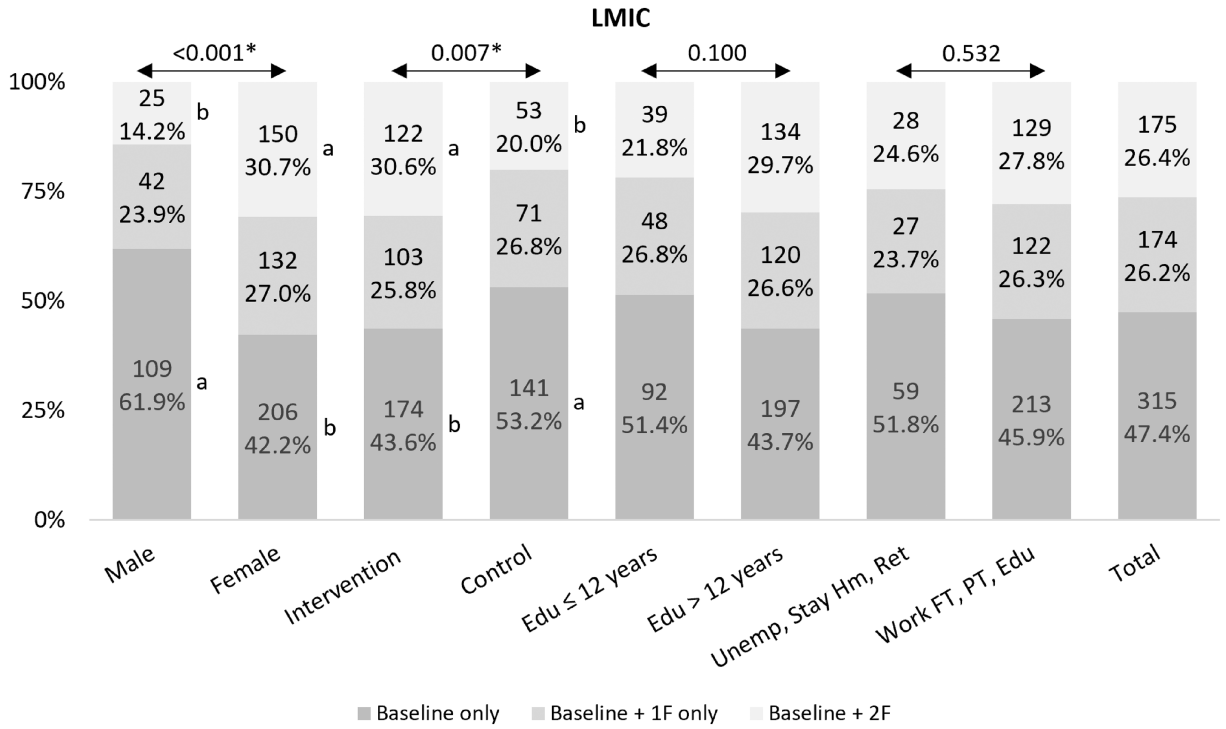

FIGURE 4 Continuous participation and attrition in low-to-middle-income countries (LMIC). *Statistical significance at the 0.05 level ($p < 0.05$) using the Chi-Squared test. [a]Statistically higher-than-expected proportions. [b]Statistically higher-than-expected proportions.

Our results revealed sex differences, consistent with previous community health programmes.[28,29] Women demonstrated significantly higher overall follow-up completion rates and significantly lower attrition rates after baseline measurements than men. These differences, however, were only statistically significant in LMIC. Parents who had attended or completed post-secondary education programmes (>12 years of education), had significantly lower rates of attrition after baseline and higher rate of follow-up completion. Those differences were only statistically significant in HIC and HICAM, and not in LMIC. Parents who were employed (either full-time or part-time) or were participating in academia were more likely to complete all follow-ups and less likely to drop after baseline as opposed to unemployed, stay-home parents and retirees. Interestingly though, further investigation into socioeconomic regions revealed that these differences were only statistically significant in HICAM.

Surprisingly, parents in the intervention group in HIC and HICAM were more likely to withdraw from further evaluation after baseline, while parents in the control group showed significant affinities towards completing both follow-ups. One logical explanation may be the required time commitment and associated constraints with personal or professional schedules. However, the opposite trend was observed in LMIC, with parents assigned to the intervention group exhibiting a statistically significant propensity towards completing both follow-ups. Those findings may indicate that in lower socioeconomic regions, intervention and clinical follow-ups (free of charge) at school and community settings provide an economic incentive that may override other social constraints.

In HIC and HICAM, emphasis should be placed on streamlining questionnaires and follow-up evaluation process to decrease attrition in the intervention group, and on providing incentives for continuous participation in the lower education segment. Within HICAM, special emphasis should be placed on improving programme elements that affect people with lower employment status, such as transportation options to and from community centres. In LMIC, programme components need to be enhanced to incentivize and reward male participants.

With respect to clinical measurements of BMI, glucose levels, SBP, and DBP, our study revealed that more favourable measurements were associated with higher participation rates. While the differences between participation groups were statistically significant for BMI, SBP and DBP, the differences in glucose measurements were not significant. Less favourable measurements may impel participants to seek more individualized alternatives to treatment and avoid participation in public settings.

Tested together in multivariable binary logistic models, all sociodemographic and socioeconomic variables exhibited statistical significance, with socioeconomic regions and BMI having the greatest impact. While such logistic models demonstrated very high accuracy in predicting

TABLE 2 Differences in clinical measurements across participation groups.

Variable	Baseline ($n=906$)		Baseline + 1F ($n=500$)		Baseline + 2F ($n=1296$)		
	Mean	SD	Mean	SD	Mean	SD	*p*
BMI at baseline (kg/m^2)	29.3[a]	5.9	29.0[b]	5.3	28.1[a,b]	5.3	<0.001*
BMI at 1F (kg/m^2)			29.0	5.4	28.1	5.2	0.003*
BMI at 2F (kg/m^2)					28.2	5.4	
Glucose at baseline (mmol/L)	5.4	1.5	5.3	1.2	5.3	0.9	0.062
Glucose at 1F (mmol/L)			5.4	1.3	5.3	1.0	0.242
Glucose at 2F (mmol/L)					5.4	0.9	
SBP at baseline (mmHg)	121.2[a]	17.9	119.9[b]	16.6	117.0[a,b]	16.3	<0.001*
SBP at 1F (mmHg)			118.2	15.5	115.0	15.5	<0.001*
SBP at 2F (mmHg)					115.8	15.9	
DBP at baseline (mmHg)	80.2[a]	11.7	79.6[b]	11.3	77.5[a,b]	11.2	<0.001*
DBP at 1F (mmHg)			77.8	10.3	76.6	10.4	0.029*
DBP at 2F (mmHg)					76.9	10.6	

Note: [a,b]Participation groups with the same superscript exhibited statistically significant differences in adjusted *p*-values, calculated using the Bonferroni correction to account for multiple comparisons.

Abbreviations: Baseline, parents who participated only in baseline measurements; Baseline +1F, parents who participated in baseline and only the first follow-up; Baseline +2F, parents who participated in baseline and both follow-ups; BMI, body mass index; DBP, diastolic blood pressure; SBP, systolic blood pressure.

*Statistically significant differences at the 0.05 level ($p<0.05$) across participation groups using MANCOVA.

TABLE 3 Binary logistic regression for predicting attrition (1)/continuation (0) after baseline measurements.

	B	*SE*	Wald	*df*	*p*	Odds ratio	95% CI for odds ratio	
							Lower	Upper
Sex (female)	−0.452	0.111	16.504	1.000	<0.001	0.636	0.512	0.791
Control group	−0.251	0.096	6.829	1.000	0.009	0.778	0.645	0.939
Education (high)	−0.469	0.109	18.700	1.000	<0.001	0.625	0.506	0.774
Employment (high)	−0.421	0.119	12.546	1.000	<0.001	0.656	0.520	0.829
Regions			77.801	2.000	<0.001			
HICAM	−0.945	0.120	61.802	1.000	<0.001	0.389	0.307	0.492
HIC	−0.989	0.133	54.987	1.000	<0.001	0.372	0.286	0.483
BMI	0.021	0.009	5.311	1.000	0.021	1.022	1.003	1.040
DBP	0.004	0.007	0.296	1.000	0.587	1.004	0.990	1.018
SBP	0.002	0.005	0.191	1.000	0.662	1.002	0.993	1.012
Constant	−0.208	0.474	0.193	1.000	0.661	0.812		

Abbreviations: BMI, body mass index; DBP, diastolic blood pressure; HIC, high-income countries; HICAM, high-income countries under austerity measures; SBP, systolic blood pressure.

continuation in follow-ups (94.9% and 95.6% respectively), they were inadequate in predicting attrition, that is, accurately predicting a priori which parents will be lost to attrition.

Our study also has some limitations. Specific reasons for attrition (directly from parents) were difficult to collect in a school- and community-based programme. Some differences between socioeconomic regions may have been attributed to country-specific dissimilarities in school and community environments. Furthermore, since incentives have proven to decrease attrition in other settings,[30] future adjustments and improvements to the Feel4Diabetes-study and other similar health programmes need to incorporate motivational incentives to deter attrition.

TABLE 4 Binary logistic regression for predicting attrition (1)/continuation (0) after first follow-up.

	B	*SE*	Wald	*df*	*p*	Odds ratio	95% CI for odds ratio	
							Lower	Upper
Sex (female)	−0.094	0.148	0.399	1.000	0.527	0.911	0.681	1.217
Control group	−0.225	0.120	3.554	1.000	0.059	0.798	0.631	1.009
Education (high)	−0.210	0.146	2.047	1.000	0.152	0.811	0.609	1.081
Employment (high)	−0.124	0.159	0.603	1.000	0.437	0.884	0.647	1.207
Regions			85.188	2.000	<0.001			
HICAM	−1.497	0.162	85.133	1.000	<0.001	0.224	0.163	0.308
HIC	−0.876	0.163	28.906	1.000	<0.001	0.417	0.303	0.573
BMI	0.040	0.012	11.656	1.000	<0.001	1.041	1.017	1.065
DBP	0.000	0.007	0.001	1.000	0.981	1.000	0.987	1.014
SBP	−0.001	0.010	0.005	1.000	0.943	0.999	0.981	1.018
Constant	−0.714	0.651	1.201	1.000	0.273	0.490		

Abbreviations: BMI, body mass index; DBP, diastolic blood pressure; HIC, high-income countries; HICAM, high-income countries under austerity measures; SBP, systolic blood pressure.

5 | CONCLUSIONS

Our study showed that key socioeconomic and sociodemographic factors along with BMI play a significant role in determining continuous participation in follow-up evaluations during school- and community-based intervention programmes. The results of our study can be used to customize specific elements of future intervention programmes within different socioeconomic regions to combat attrition and increase participation in required follow-ups.

AUTHOR CONTRIBUTIONS

EK conducted the statistical analysis and wrote the first draft of the manuscript. SL led the conception of the study. YM was the primary investigator in the overall Feel4Diabetes study. KM coordinated the reviews. EK, KM, GD, VI, KT, RD, GC, EGG, LM, JK, JL, IR, EA, PT, PS, CM, YM and SL all critically revised the manuscript and approved the submitted version.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

DATA AVAILABILITY STATEMENT

The data of the present study are available from the Feel4Diabetes-study group on reasonable request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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