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Science & Technology in childhood Obesity Policy**



Science and Technology in  
childhood Obesity Policy

# Science & Technology in childhood Obesity Policy

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## D6.4: Evaluation of the Industry-led Pilot Projects

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Science and Technology in  
childhood Obesity Policy

<b>Abbreviation</b>	<b>Definition</b>
<b>TRL</b>	Technology Readiness Levels
<b>RCT</b>	Randomized Controlled Trial
<b>Pre-PAQ</b>	Preschool-aged Children's Physical Activity Questionnaire
<b>R-FEAHQ</b>	Revised Family Eating and Activity Habits Questionnaire
<b>HAF</b>	Holiday Activity and Food Programme



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## 1 Introduction

This report constitutes Deliverable 6.4 following **Task 6.4 - Evaluation of the industry-led pilot projects** under **Work Package 6 - Healthy food and food choice environments** of the STOP project. As described in Task 6.3 in the Grant Agreement, the STOP project released a call for proposals for industry-led pilot projects aimed at developing innovations (TRL 4 or 5) that have the potential to make critical improvements in the food environments faced by children and their families.

The call received a modest 27 applications from industry partners, of which, four were funded through being engaged as subcontractors. Most applicants were SMEs or start-ups and were mostly technology companies. The lack of large companies from the food industry demonstrates either the collective offering was insufficient to attract food industry commitment or may point to the tribalism that exists between academia and industry in health-related fields.

The organisations issued with subcontracts were:

- **Foodpairing** – To develop FlavorID, an online tool collecting information on taste preferences and nudging families towards developing healthy eating behaviours through incorporating a larger variety of vegetables into the diet;
- **The Old Library Trust** – To develop SWEET App, a digital App working directly with families and young children to promote physical activity and healthier food choices;
- **Pennotec** – To develop MilaCel a high-fibre low-calorie dietary paste from apples to extend meals and replace fat in school and home meals for children.
- **Shift Design** – To develop a "cold-delivered" nutrient-rich and cultural-relevant meals for low-income families at a subsidized price.

The terms of each subcontract provided the above organisations with resources to develop their respective innovations over an 18-month period, after which STOP partners would undertake an independent evaluation of their outcomes (Task 6.4), aimed at identifying the potential for each proposed innovation to make a significant impact on children's behaviours and on the spread of childhood obesity in Europe.

Independent evaluations of each pilot project were planned with each project team. It was determined that the best use of available resources for evaluating the pilots independently would be to utilise the data being collected by each pilot, as part of their planned evaluations, and independently analyse the data. This would not require research staff to travel to each site and collect primary data separately, therefore duplicating the efforts of the core pilot teams and would overcome some of the barriers associated with COVID-19 restrictions in place at the time. However, only one such evaluation (FlavorID) met the study design and sample size requirements that would enable submission to a peer-reviewed journal, while the rest did not due to the limitations outlined above. We will, however, endeavour to submit a manuscript to a peer-review journal focusing on the lessons learned from commissioning and evaluating the pilot projects. It was decided that a more thorough independent evaluation of the FlavorID project would be carried out by running a Randomized Controlled Trial (RCT) with families using the innovation in



the UK. After the follow-up has been completed, a subsequent peer-reviewed publication is planned to illustrate the outcomes of the FlavorID trial.

## **2 Pilot Innovations**

### **2.1 FlavorID Innovation**

Foodpairing, a flavour Intelligence company based on Belgium, developed the FlavorID technology, a web-based app platform, which attempts to determine a user's food taste preferences. The technology creates an individual "flavour ID" which in turn can recommend healthy alternatives to common recipes, using their Happy Plate recommendation engine, to improve diets.

### **2.2 SWEETApp Innovation**

The Old Library Trust in North Ireland developed the SWEET App, an interactive mobile-based app designed for families with children aged between 2 and 5 years. It aims to help families to achieve a healthy lifestyle through three unique key features: a community asset map, healthy recipes, and gamified educational content. Once an account has been created, multiple user profiles can be set up. They can use the community asset map to browse and self-refer themselves or invite their family members to self-refer to locally based community assets (gyms, gardens, programmes, etc.). The feature of healthy recipes provides users with tools to eat healthily, and users can also learn the nutritional knowledge and benefits of physical activity in the module of learning content.

### **2.3 MilaCel Innovation**

Pennotec aims to develop new functional food ingredients from surplus food industry resources in Wales and use them to replace high calorie ingredients such as fat in the kinds of food that are particularly popular with children to tackle childhood obesity. The MilaCel apple fibre paste is made from dietary fibre sourced from out-graded apples and apples used in juice and cider production. Before making the paste, seeds are removed, and the mashed apple is gently washed to remove sugars. After grinding the dietary fibre it swells up in water. The apple fibre paste has a natural color, is fairly tasteless and is very low in calories. Pennotec piloted the MilaCel Apple fibre paste in primary schools in Gwynedd, Wales by adapting desserts on the school lunch menus where a proportion of the fat is replaced with MilaCel Apple fibre paste.

### **2.4 SHIFT Innovation**

SHIFT Design is a charity in London aiming to help low-income families with access to healthy food by providing innovative products and services. Their primary focus is centred around obesity among young people living in deprived areas. SHIFT developed a localised food system that provided nutrient-rich and culturally relevant cold meals branded as Mama Leys to low-income families in South London. The Mama Leys meals were heavily subsidized in order to compete with cheap and unhealthier alternatives.



### 3 Study design

#### 3.1 FlavorID – a cooking trial

Imperial College London devised and conducted an independent evaluation of FlavorID – a 4-week randomised controlled cooking trial, with the aim of assessing the ability of the HappyPlate with FlavorID innovation to improve families' preference on vegetables, increase their vegetable intake and improve their health.

Following ethics approval from Imperial College, a 4-week cooking trial was conducted. We recruited 90 families (one parent and one child) in the UK through a third-party recruiter called Roots Research using the following criteria:

##### **Inclusion criteria:**

- a. families with NRS social grade C2, D, E;
- b. with at least one child aged 8-14 years;
- c. accepting to be randomly assigned to an intervention or a control group.

##### **Exclusion criteria:**

- a. with no access to a computer or mobile phone and internet;
- b. on a diet or planning to go on a diet.

Participating families were randomly assigned to an intervention group and a control group by the age (8-11 years and 12-14 years) and sex (male and female) of eligible children. Families in the intervention group had access to HappyPlate while families in the control group had access to the BBC Good Food website. They were suggested to prepare meals using HappyPlate recipes and BBC Good Food recipes, respectively, and send us photos of plate/ cooking pot during the four-week trial.

Each participant (both parent and child) was asked to recall their 24-hour food intake using a food diary on one weekday and one day on the weekend (the specific day is decided by participants) using Intake24 platform and to complete the dedicated questionnaire aimed at understanding participants' taste preferences. Participants were asked to complete these questionnaires and recalls at two time points: one week before the trial and one week after the trial.

#### 3.2 SWEET App – a community-based trial

The Old Library Trust, as part of their project, developed an evaluation involving an 8-week community-based trial and a semi-structured telephone interview in the Creggan area of Derry in North Ireland. Rather than duplicating data collection, it was determined that Imperial College would conduct a secondary analysis of the data collected to determine whether the SWEET App has the ability to increase physical activity among children.

The Old Library Trust recruited 14 families with children aged between 2-5 years that reside in the Creggan area of Derry in North Ireland based on the following inclusion/exclusion criteria:

- a. Family with at least one child aged 2 –5 years
- b. Currently residing in the Creggan area of Derry City



- c. Internet connection (Wi-Fi) in the home
- d. At least one mobile device that can be accessed by both parents and children

Recruitment was advertised via Old Library Trust social platforms and among local parent groups e.g., Sure Start by project staff at Old Library Trust. Families were randomly assigned into an intervention group and a control group by the age of the children. Families in the intervention group received a link to download a full version of the SWEETApp on their mobile device while participants in the control group will receive a link to download a “lite” version of the SWEETApp on their mobile device, where the asset map function had been removed.

Old Library Trust started the SWEETApp trial through administering a reduced Preschool-aged Children’s Physical Activity Questionnaire (Pre-PAQ) (Silva et al., 2011) and the Revised Family Eating and Activity Habits Questionnaire (R-FEAHQ) (Golan, 2014) to participants to collect data related to participants’ physical activities and diet quality at baseline. This was followed by an 8-week SWEET App trial where participants in the intervention and control groups used the full and lite versions of the SWEETApp respectively. The Pre-PAQ and R-FEAHQ was administrated again to participants to capture the behaviour change by the intervention after the trial. 11 out of 14 families completed both the pre- and post-trial questionnaires. Then, a semi-structured interview conducted over the telephone was carried out in the intervention group right after the completion of the 8-weeks SWEET App trial; however, only 2 parents participated in the interview.

### 3.3 MilaCel – a school-based trial

Pennotec conducted a controlled pre-post trial, in which they served desserts containing their Milacel innovation, over seven weeks at local schools in Wales. In total, 126 year 5 and 6 students in three primary schools in Gwynedd in Wales participated, with 60 in the intervention arm and two schools and 66 students in the control arm.

Prior to conducting the evaluation, Pennotec first accessed the primary school menu that is unified across primary schools in Gwynedd with the support of the Gwynedd School Catering Leads. Then they identified five adaptable school menu desserts and developed new recipes by replacing fat in the desserts with the MilaCel apple fibre. As shown in **Table 1**, the school menus were served on a three-week rotation and the selected five desserts were served on five weekdays over three weeks.

Pennotec surveyed school cooks from nine primary schools in Gwynedd selected by School Catering Leads to get their feedback on the use of the reduced-calorie dessert recipes. According to Pennotec, the survey showed that the school cooks provided generally positive feedback on the recipes.

Primary Schools with positive feedback from cooks on the adapted dessert recipes were invited to participate in the evaluation via email. Schools who responded positively were sent the participant information, consent, and withdrawal forms. In total, three schools consented to participate in the evaluation.

As can be seen from **Table1**, the trial started with the first five-day trial over three consecutive weeks, in which all three schools provided students with standard school lunch desserts in three school lunch menus on each five weekdays. It was followed by another five-day trial over the next four weeks, in which two control schools continued to serve students the same standard desserts on each of the five weekdays while the intervention school provided students with the corresponding adapted desserts on each of these five days. Since primary schools in Gwynedd are



small, all students were provided with adapted desserts but only year 5 and 6 students were asked to complete food diaries after lunch every day in these ten days with the support of teachers. The trial ended up with 60 students completing both the pre- and post-trial food dairies.

**Table1: School menu desserts tested in the school trial**

Menu1/W1 <sup>[a]</sup>		Menu2/W2		Menu3/W3
Thursday	Friday	Thursday	Monday	Thursday
Fruit Muffin	Date Flapjack	Syrup Sponge	Jam Sponge	Chocolate Muffin
Menu1/W3		Menu2/W4		Menu3/W7 <sup>[b]</sup>
Thursday	Friday	Thursday	Monday	Thursday
Adapted Fruit Muffin	Adapted Date Flapjack	Adapted Syrup Sponge	Adapted Jam Sponge	Adapted Chocolate Muffin

<sup>[a]</sup> Week 1 (W1) commenced from 25/04/2022.

<sup>[b]</sup> Due to two Bank Holidays (Spring Bank Holiday and Platinum Jubilee bank holiday) in Week 6 commencing from 30/05/2022, Week 6 is used as Half Term Holiday for primary schools in. As a result, Menu 3 that is supposed to be used in Week 6 is used in Week 7.

### 3.4 SHIFT – community-based activities

As a result of changes in their business model, compounded by the COVID-19 pandemic, SHIFT design was forced to cease trading at the end of the 18-month pilot period. The business relied heavily on grants to subsidise meals for their customers, to ensure they could be priced to compete with cheap healthier alternatives. However, prior to ceasing trading, SHIFT was able to collect some data on their users and practices, although data were piecemeal as their business was heavily disrupted by the pandemic. Rather than attempting to conduct a secondary analysis of the data collected by SHIFT, Imperial College decided to better understand why the business was not sustainable as these insights might prove useful for others attempting to run similar enterprises.

The data used in the analysis was collected by SHIFT from the activities including holidays programs, a school pilot and a café pilot. In the holiday programs, SHIFT partnered with 14 community organizations in the Borough of Southwark in London to provide meals to children under Holiday Activity and Food Programme (HAF) in both the Easter holiday and summer holiday in 2021. In order to understand how Mama Leys meals were perceived, they undertook interviews with 11 organizations and 137 families during Easter holiday and interviewed 28 families. However, the interviews were only partly recorded, and the data quality was poor. For this reason, we decided not to analyse the interview data but only analyse the sales data.

During September and October in 2021, SHIFT conducted a school pilot called ‘After School Grab n Go’ in three primary schools in the Borough of Southwark and the Borough of Lambeth in London to understand if Mama Leys meals are acceptable and affordable for families and what other meals they can substitute. Families can pre-order and buy in person at a stall in the school on either Thursday or Friday for 4 weeks. SHIFT undertook a survey with 67 families using a self-administrated questionnaire to understand the feasibility of the school channel and acceptability of the meals. Since the sales data and survey data were both available and reliable, it was used in our analysis.

In the café pilot, SHIFT contracted with the Oasis Hub café in Waterloo in London Borough of Lambeth over May and June in 2021. SHIFT supplied Mama Leys meals at wholesale prices to Oasis Hub café that sold meals at retail prices in the café either for onsite consumption or





takeaway. SHIFT did not take any survey in this pilot. We can only use the sales data to understand the performance of this channel.

Because of the data availability and reliability, we only used sales data from these activities together with the school pilot survey data to understand the feasibility of different sales channels used in these activities and acceptability of the Mama Leys meals.

## 4 Results

### 4.1 FlavorID

The FlavorID innovation was piloted among families with children between 8 and 14 years, demonstrating its ability to accurately estimate children’s taste preferences and increase their vegetable intake. 62 out of 90 families completed both the pre- and post-trial questionnaires. Both parents’ Children’s vegetable intake and energy consumption were analyzed to evaluate the potential of the FlavorID innovation.

#### 1. Daily vegetable intake

We compare pre-post vegetable intake by parents and children in both intervention and control groups on weekends and weekdays separately using Wilcoxon signed-rank test. As shown in **Table 2**, the pre-post comparison in both parents’ and children’s vegetable intake on either weekdays or weekends did not show significant differences, which indicates HappyPlate recipes did not increase families’ vegetable intake.

**Table 2 Vegetable intake in Intervention and Control participants before and after the 4-week cooking trial.**

Daily Vegetable Intake [g]*												
	Intervention						Control					
	Weekday		p-value	Weekend day			Weekday			Weekend day		
	pre-trial	post-trial		pre-trial	post-trial	p-value	pre-trial	post-trial	p-value	pre-trial	post-trial	p-value
Parents												
Mean ± SD	104 ± 96	101 ± 130	0.72	64 ± 64	108 ± 96	0.06	144 ± 108	111 ± 89	0.3	154 ± 143	144 ± 140	0.63
Median	93	73		44	83		118	107		122	95	
Children												
Mean ± SD	66 ± 58	77 ± 81	0.87	61 ± 59	79 ± 55	0.2	103 ± 96	116 ± 157	0.86	111 ± 115	116 ± 107	0.81
Median	56	66		40	84		64	84		79	77	



## 2. Total reported energy intake

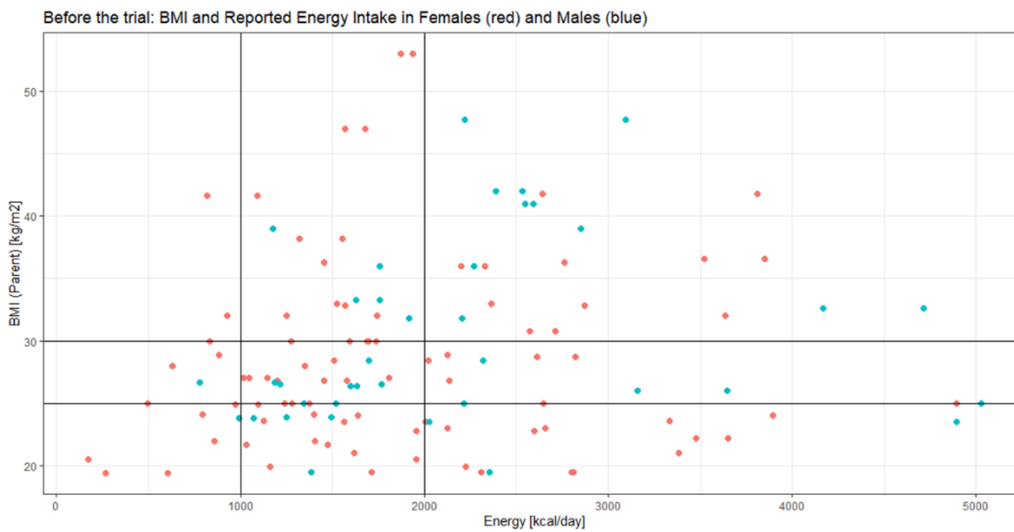
We did not find significant differences in total energy intake by parents and children in the intervention group. The energy intake was significantly lower after the trial in the control group in both parents and children. The results are shown in **Table 3**. Given, that the recommended, average energy intake is 2000 and 2500 kcal/day for adult women and men respectively, most participants had too low reported energy intake. It is well known that, especially overweight people, tend to under-report their energy intake and it is one of the main limitations in nutritional research that relies on self-reported data. As **Figures 1** and **2** show, participants' BMI and their energy intake many participants with high BMI (>25), reported low energy intake, which suggests under-reporting.

**Table 3 Total Daily Energy Intake in Parents and Children Before the Trial and After the Trial (Intervention and Control).**

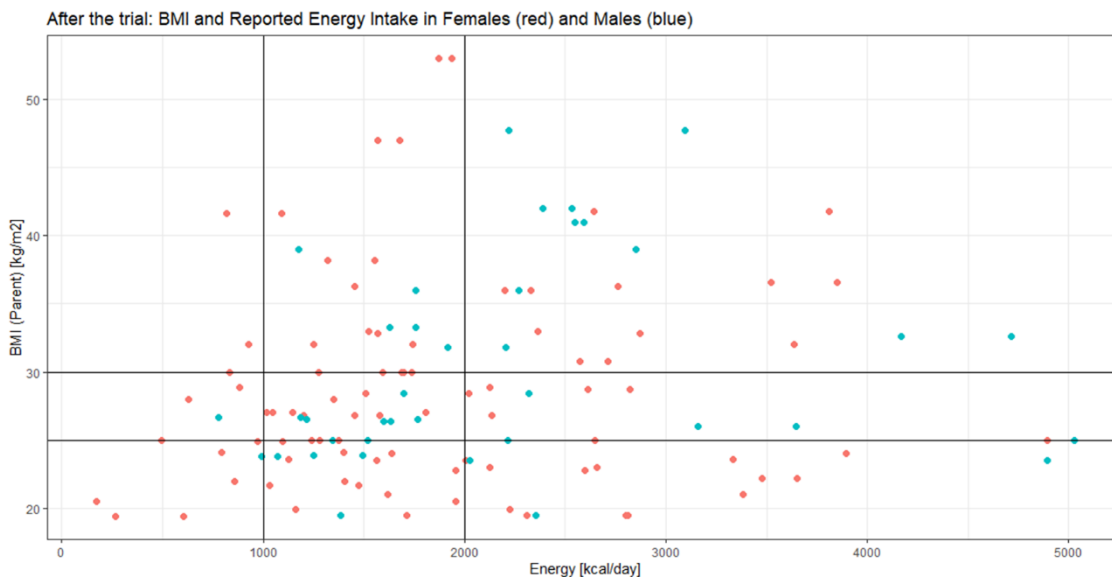
		Before Trial	After Trial	
INTERVENTION	Parents	Energy Intake [kcal/day]		p-value
	mean	1929	1668	0.09
	SD	987	853	
	median	1679	1477	
	Children			p-value
	mean	1834	1595	0.16
	SD	894	719	
	median	1555	1502	
	CONTROL	Parents		
mean		2269	1592	0.005*
SD		1326	807	
median		1916	1462	
Children				p-value
mean		2089	1658	0.01*
SD		1138	895	
median		1771	1488	



**Figure 1 BMI and Reported Total Daily Energy [kcal] in Men and Women (Before the Trial)**



**Figure 2 BMI and Reported Total Daily Energy [kcal] in Men and Women (After the Trial)**



## 4.2 SWEET App

In the SWEET App project, only 14 families were recruited and 11 of them completed the trial, with 6 in the intervention group using the full version of the SWEET App and 5 in the control group using the lite version of the SWEET App. Furthermore, only two participants were willing to attend the semi-structured interview. There were several reasons for the low participation: 1) the recruitment centre associated with the Old Library Trust is based 30 miles away and social media channels only largely engaged people living outside of the specified study area (Creggan). Thus, the usual methods of recruitment were unlikely to be effective; 2) the cost-of-living crisis since the beginning of 2022 discouraged families' interest in the trial. The sample size is insufficient for the statistical analysis to provide reliable results. Thus, we had to drop the plan of both the quantitative and qualitative statistical analyses. Instead, we chose to report the results from the descriptive analysis

**Table 4** shows the baseline characteristics of families. The 14 families were randomly assigned to the intervention and control groups by the children's age at baseline, which can be shown by the distribution of children by age. Meanwhile, it also can be seen that the families were well balanced



in terms of other characteristics including gender, age of parents, marital status, ethnicity, and education. It should be noted that in both groups 4 of 7 parents are single and one of families in the intervention group was divorced/separated. Since the project targeted low-income families with young children, it indicated the single parents with young children were financially disadvantaged. A large proportion of such families in the study sample indicated that health interventions like SWEET App are needed to help them develop a healthy lifestyle. However, the need for a healthy lifestyle from such families was also very sensitive to financial status, which suggests the cost-of-living crisis since the beginning of 2022 might discouraged families' interest in the project.

**Table 4: Baseline characteristics in two groups in the SWEET App community-based trial**

	Intervention	Control
<b>Gender (Parent) (N)</b>		
Male	1	0
Female	6	6
NA	0	1
<b>Age (Parent) (Mean ± SD)</b>	32 ± 3	32 ± 6
<b>Age (Child) (N)</b>		
2-3 years old	4	5
4-5 years old	3	2
<b>Marital Status (N)</b>		
Married	2	2
Single	4	4
Divorced/separated	1	0
NA	0	1
<b>Ethnicity (N)</b>		
White Irish	6	5
Black African/Caribbean	1	0
Latino	0	1
NA	0	1
<b>Education (N)</b>		
Secondary education (GCSE or equivalent)	2	2
Further education (BTEC or equivalent)	1	0
Higher education (undergraduate degree)	2	3
Higher education (postgraduate degree (MSc/PhD))	1	1
Prefer not to say	1	0
NA	0	1

**Table 5** shows the time spent by children in the intervention and control groups on different physical activities including leisure activities, bike riding, walking, gymnastics, dancing and other physical activities. It showed that the time spent by children at baseline between two groups varied a lot for each activity, which could be caused by the sample size, especially, considering the baseline characteristics were well balanced between two groups. However, it can be seen that walking was the activity that children spent most time on both at baseline and after the trial in either group. A pre-post comparison in the intervention group showed that there was an increase in the time spent on bike riding (+0.830 hours, 65%), walking (+0.82 hours, 28%), gymnastics (+2.661 hours, 373%) and other physical activities (+0.85 hours, 600%). Children in the control group also increased time on bike riding (+0.917 hours, 157%), gymnastics (+2.083 hours, 147%) and other



physical activities (+0.833 hours, 499%) but spend less time on walking (-1.834 hours, 32%). Comparing the time spent on these activities between two groups, children in the intervention group increased more time on walking, gymnastics, and other physical activities than children in the control group did but less time on bike riding. For the other activities, children in intervention group spent less time on the leisure classes (-0.411, 32%) and dancing (-0.107, 12%). Children in the control group spend less time on the leisure classes (-0.583, 19%) and dancing (-0.500, 37%) as well. However, the decreases in time spent on these activities were smaller than the time increase.

Therefore, through the descriptive analysis, we can find that children increased physical activities using the full version SWEET App with community-based assets incorporated, although the findings were not very robust due to the small sample size. Future work should be done with a sufficient number of local families to show robust evidence on the potentials of the SWEET App.

**Table 5: Time spent by children in two groups on different activities**

	Intervention			Control		
	Pre-trial	Post-trial	Change (%)	Pre-trial	Post-trial	Change (%)
Leisure classes	1.286	0.875	-0.411 (32%)	3.083	2.500	-0.583 (19%)
Bike riding	1.286	2.125	0.839 (65%)	0.583	1.500	0.917 (157%)
Walking	2.929	3.75	0.821 (28%)	5.667	3.833	-1.833 (32%)
Gymnastics	0.714	3.375	2.661 (373%)	1.417	3.500	2.083 (147%)
Dancing	0.857	0.75	-0.107 (12%)	1.333	0.833	-0.500 (37%)
Other physical activities	0.143	1.000	0.857 (600%)	0.167	1.000	0.833 (599%)

### 4.3 MilaCel

The acceptability of the MilaCel low-calorie apple fibre was tested with three primary school students in Wales. In total, 60 of 126 year five and six students completed the MilaCel school desserts trial, with 30 from the intervention school and 30 from the two control schools. The other students did not complete either the pre-trial questionnaires or the post-trial questionnaires. **Table 6** shows the baseline characteristics of students who completed the trial in the intervention and control schools by desserts. It showed that there was no significant difference in gender, main meal preference and consumption, side preference and consumption between students in the intervention and control groups for each dessert, which means students were well balanced and the insignificant difference in these factors should not contribute to change in students' dessert preference and consumption.



**Table 6: Baseline comparison between groups in MilaCel school-based dessert trial**

**Fruit Muffin**

	Fruit Muffin Intervention (15)	Fruit Muffin Control (19)
Gender (%female)*	8 (53%)	7 (34%)
Main preference (s.d.)	2.67 (0.62)	2.47 (0.61)
Main consumption (s.d.)	4.67 (1.05)	4.47 (1.02)
Side preference (s.d.)	2.33 (0.62)	2.26 (0.73)
Side consumption (s.d.)	5 (0)	3.68 (1.34)

**Date Flapjack**

	Date Flapjack Intervention (16)	Date Flapjack Control (5)
Gender (%female)*	7 (44%)	1 (20%)
Main preference (s.d.)	2.56 (0.73)	2.8 (0.45)
Main consumption (s.d.)	4.63 (0.89)	4.6 (0.89)
Side preference (s.d.)	2.25 (1.06)	2 (0.71)
Side consumption (s.d.)	3.94 (1.77)	3 (1.41)

**Syrup Sponge**

	Syrup Sponge Intervention (17)	Syrup Sponge Control (15)
Gender (%female)*	9 (53%)	4 (25%)
Main preference (s.d.)	2.65 (0.61)	2.73 (0.46)
Main consumption (s.d.)	4.76 (0.97)	4.8 (0.56)
Side preference (s.d.)	2.59 (0.51)	2.47 (0.64)
Side consumption (s.d.)	5 (0)	4.07 (1.16)

**Jam Sponge**

	Jam Sponge Intervention (15)	Jam Sponge Control (19)
Gender (%female)*	8 (53%)	5 (26%)
Main preference (s.d.)	2.67 (0.49)	2.63 (0.5)
Main consumption (s.d.)	4.73 (0.46)	4.74 (0.65)
Side preference (s.d.)	2.6 (0.63)	2.21 (0.63)
Side consumption (s.d.)	4.87 (0.35)	3.68 (1.2)

**Chocolate Muffin**

	Chocolate Muffin Intervention (14)	Chocolate Muffin Control (5)
Gender (%female)*	7 (50%)	1 (25%)
Main preference (s.d.)	2.86 (0.36)	3 (0)
Main consumption (s.d.)	5 (0)	4.6 (0.55)
Side preference (s.d.)	2.36 (0.93)	2.2 (1.1)
Side consumption (s.d.)	4.07 (1.64)	3.0 (1.52)

\* means there is significant difference in the variable at baseline between the intervention and control groups. As it showed above, there is only a significant difference in the gender composition between groups

The ANOVA-CHANGE method was used to analyse the acceptability of adapted desserts. However, the analysis was limited by the small sample sizes. Date Flapjack and Chocolate Muffin were excluded from the ANOVA-CHANGE analysis because of extremely small sample sizes in



the control schools. Instead, we applied a pre-post analysis for these two adapted desserts using the paired t test.

The ANOVA-CHANGE test results in **Table 7** show a significant decrease in students' preference for the adapted Fruit Muffin (F-statistic = 5.67, p = 0.023). However, students did not significantly change their consumption of the adapted Fruit Muffin. This suggested the adapted Fruit Muffin was acceptable but not preferred. There was no evidence showing a significant change in the students' preference for the adapted Syrup Sponge (F-statistic = 0.011, p = 0.918) and the adapted Jam Sponge (F-statistic = 3.984, p = 0.055). Students' consumption of the adapted Syrup Sponge (F-statistic = 2.754, p = 0.107) and adapted Jam Sponge (F-statistic = 0.514, p = 0.479) did not significantly change either.

These results suggest adapted desserts with the MilaCel apple fibre were acceptable to students, although they are limited in their robustness. Furthermore, according to Pennotec, the adapted desserts had a marginally reduced calorie content, making them much less innovative. Future work should investigate the potential of the MilaCel apple fibre to be used in home meals.

**Table 7: Tests for the acceptability of adapted desserts**

ANOVA-CHANGE test on preference		
	F statistic	p_value
Fruit Muffin	5.67	0.023**
Syrup Sponge	0.011	0.918
Jam Sponge	3.984	0.055
ANOVA-CHANGE test for consumption		
	F statistic	p_value
Fruit Muffin	0.001	0.999
Syrup Sponge	2.754	0.107
Jam Sponge	0.514	0.479
Pre-post test using paired t test for preference		
	T statistic	p_value
Date Flapjack	-0.808	0.403
Chocolate Muffin	1.472	0.165
Pre-post test using paired t test for consumption		
	T statistic	p_value
Date Flapjack	1.379	0.188
Chocolate Muffin	1.273	0.176

\*\* p<0.05

#### 4.4 SHIFT

Imperial College London evaluated the performance of sales channels using the sales data of the Mama Leys meals and the acceptability and affordability of the meals using the school pilot survey data.

As **Table 8** shows, SHIFT sold 8,704 Mama Leys meals at price between £2.50 and £3.00 to 14 community organizations in the Borough of Southwark in London that provide these meals for free



to children under HAF Programme. Among these meals, 5,385 meals were provided in Easter Holiday and 3,319 meals were provided in the summer holiday, respectively. SHIFT also sold 552 meals at the price of £2.00 to £2.50 to families in the school pilot over four weeks and 332 meals at £3.00 to £6.00 in the café pilot over two months. The data show that providing meals through community organizations was most successful, which was mainly attributable to widely established supply networks. With a similar price, the sales through a newly-built stall at a school were much smaller. This highlights the importance of integration into the local food landscape. For a start-up like SHIFT, it appears important to build upon existing local food supply networks rather than compete with them, which can minimise wasted resources and maximise opportunities for scaling up, ultimately achieving greater impact. The higher price of meals sold through the café channel may be a key driver of the low sales, which highlights the importance of financial subsidy to serve low-income people with healthier food.

**Table 8: Sales of the Mama Leys meals through different channels in 2021**

	Sales (N)	Price (£)
Community organizations	8704	2.5 - 3.0
<i>Easter holiday</i>	5385	2.5 - 3.0
<i>Summer holiday</i>	3319	2.5 - 3.0
School pilot	552	2.0 - 2.5
Café pilot	336	3.0 - 6.0

The results from the descriptive analysis can be found in **Table 9**. The total number of participating parents was 67, with various numbers of parents reporting on different questions. Parents found Mama Leys meals acceptable (mean score out of  $10 \pm SD: 8 \pm 1$ ). 59.7% of parents ( $n = 40$ ) reported that their children ate the meals, which didn't strongly indicate the acceptability of meals to children. Parents also found the meals affordable (mean score out of  $10 \pm SD: 8 \pm 1$ ). In addition, 44.8% ( $n = 30$ ) parents reported their financial well-being as 'Just Getting By' and 24 (35.8%) as 'Doing Alright', which indicated that the meals were appealing to the low-income families. The meals seemed to substitute a variety of meal options, which was consistent with its acceptability and affordability. It also showed that the school as a collection location was found convenient by the majority of parents ( $n = 65, 97\%$ ). In total, 37 (55.2%) participants have decided to reorder Mama Leys meals.





**Table 9: Families characteristics in the school pilot survey**

		(n)	(%)
School	Oasis	27	40.3
	Allen Edwards	17	25.4
	Reay	23	34.3
Was it convenient	Yes	65	97
	No	2	3
Children ate the food	Yes	40	59.7
	No	27	40.3
Substitution meal	Community provision	3	4.5
	Convenience store	4	6
	High street takeaway	3	4.5
	Online takeaway	3	4.5
	Home cooking	5	7.5
	Supermarket ready meal	9	13.4
	Mixed	30	44.8
	NA	10	14.9
Acceptability (out of 10)	Mean	8	
	SD	1	
	Median	8	
	Mode	8	
Affordability (out of 10)	Mean	8	
	SD	1	
	Median	8	
	Mode	8	
Repeat Order	Yes	37	55.2
	No	30	44.8
Financial wellbeing	Just Getting By	30	44.8
	Doing Alright	24	35.8
	Comfortable	6	9
	NA	7	10.4

The proportion of parents reordering meals was close to the proportion of children who ate meals, which may suggest that parents' reordering decisions were strongly driven by the acceptability of meals to their children. We applied a logistic regression model to understand this better. The dependent variable was binary. It is equal to one if the parents reordered the meal and zero otherwise. The independent variable is whether children ate the meals or not. The financial wellbeing was also a control variable in the model to control the possible effects of affordability on parents' reordering decisions.

The regression results can be found in **Table 10**. It shows that whether children ate the meals significantly affected whether parents would reorder Mama Leys ( $p = 0.0253$ , Odds Ratio: 3.41), with the odds for parents to reorder if their children ate the meals was 3.41 times than that if children did not eat the meals. This is consistent with families' feedback from promotion activities, which was the Mama Leys meals' flavour was too complex for most children.

In conclusion, from the experience of SHIFT, it is crucial for start-ups doing similar business to widely integrate its business with the existing supply networks. Sustainable funding to subsidize



products is also key to the success of the business providing healthier food to low-income families. Meanwhile, the food served for families should consider various needs for family members.

**Table 10: Estimates from logistic regression model on parents reordering decisions**

	Estimate	Std. Error	z-value	p - value	Odds Ratio
Intercept	-0.5754	0.4167	-1.381	0.1673	0.56
Children ate food	1.226	0.5481	2.237	0.0253**	3.41**

\*\*p<0.05

## 5 Commercial plan

Since SHIFT Design ceased trading, and The Old Library Trust has figured out the commercialisation plan for the SWEET App, we will only report the commercialisation plan for the FlavorID project and MilaCel projects.

### 5.1 FlavorID

The long-term goal is to integrate the functionality of the platform into third party applications (e.g., lifestyle, health, shopping apps). The testing of the prototype carried out within the STOP project allowed for successful validation of the prototype. Following completion of the prototype testing, FoodPairing is now in discussion with third parties, including:

- A major Belgian/Dutch retailer that is interested in using this technology for their website in the recipes search section to help increase vegetable intake.
- A food service provider in Spain, in collaboration with AZTI scientific and technological centre, to develop an application that can recommend the most compatible dinner recipes to parents, based on what their children ate at school during their lunchtime.

A health insurance company in Belgium about integrating the technology into their own application, subject to technical upgrades which ensure compatibility of the products.

### 5.2 MilaCel

The testing element of this product was hindered due to COVID-19 so insights on acceptability are limited. However, the product has shown potential and overall there is a sense that the product will best serve the needs of caterers, rather than as a consumer product sold in retail settings. Funding to aid scale-up is now the priority, with several leads including:

- Knowledge Transfer Partnership programme and Innovate UK SMART funding.
- Welsh Government SMARTCymru R&D funding support is underway.
- Consultation is continuing with an impact investment bank, which works exclusively with businesses and funds delivering positive social, ethical, and/or environmental impact.



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## References

Silva, N.T., Sá, C.D.S.C.D., Voos, M.C. and Carvalho, R.D.P., 2021. Versão brasileira do Preschool-age Children's Physical Activity Questionnaire (Pre-PAQ). *Fisioterapia e Pesquisa*, 27, pp.436-442.

Golan, M., 2014. Fifteen years of the Family Eating and Activity Habits Questionnaire (FEAHQ): an update and review. *Pediatric obesity*, 9(2), pp.92-101.