Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Behavioural Insights for Public Health Engagement: A Four-Arm School-Level Comparative Study on Parental Registration in FAST Heroes

Jan van der Merwe
University of Macedonia
Maria Baskini
baskini@auth.gr

University of Macedonia
Christos Keramydas
University of Macedonia
Myrto Pyrrou
University of Macedonia
Kalliopi Tsakpounidou
University of Macedonia
Hariklia Proios
University of Macedonia

Research Article

Keywords: FAST Heroes, Digital health engagement, Parental registration, Behavioral insights, Health communication, School-based intervention, Public health education, Stroke preparedness

Posted Date: August 20th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-10455325/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

FAST Heroes is an international school-based stroke education programme that uses child-mediated learning to improve stroke preparedness. Despite its public health impact, parental registration on the programme's digital platform remains low, potentially limiting family engagement and reinforcement. This study evaluated four prompting conditions to increase parental registration and explored variation by settlement category and class size.

Methods

We conducted a prospective, four-arm, school-level comparative intervention study in 37 Greek kindergartens that had implemented FAST Heroes but recorded no parental registrations in the preceding school year (N = 872 pupils). Eligible schools were allocated using a balanced procedure aimed at comparability in pupil numbers and settlement category; the final sample comprised consenting schools, without post-consent reallocation. Conditions comprised a printed letter, an e-mail letter, e-mail plus weekly feedback to teachers, and e-mail plus feedback to teachers and automated chatbot reminders to parents. The primary outcome was parental registration within eight weeks. The primary analysis used mixed-effects logistic regression with a random intercept for school, including prompting condition and settlement category as fixed effects. The condition-by-settlement interaction and class size were explored.

Results

Registration rates were 11.6% with the printed letter, 20.0% with the e-mail letter, 24.1% with e-mail plus teacher feedback, and 7.6% with e-mail plus teacher feedback and chatbot reminders. The overall condition effect was significant (likelihood-ratio $\chi^2(3) = 9.74$, $p = .021$). Compared with the printed letter, adjusted odds were higher with the e-mail letter (OR = 2.85, 95% CI 1.04–7.81, $p = .042$) and e-mail plus teacher feedback (OR = 3.02, 95% CI 1.11–8.22, $p = .032$), but not with the chatbot condition (OR = 0.60, 95% CI 0.17–2.15, $p = .439$). Settlement category was not associated with registration overall (OR = 1.55, 95% CI 0.73–3.30, $p = .271$), although an exploratory condition-by-settlement interaction indicated heterogeneity ($\chi^2(3) = 18.86$, $p < .001$). Class size was not significantly associated with registration.

Conclusions

E-mail-based prompting, particularly when combined with teacher feedback, was associated with higher parental registration than printed communication. E-mail communication with teacher-mediated prompting may support parental uptake of digital public health programmes.

Trial registration: ClinicalTrials.gov, NCT07745582, registered 2026-07-29. Retrospectively registered.

BACKGROUND

Health campaigns remain one of the most used tools in public health practice for influencing behavior, improving awareness and supporting early treatment and management of various diseases [1, 2]. FAST Heroes is a stroke educational project delivered through a cartoon-style, five-lesson adventure designed for kindergartens and primary schools. Each week, pupils meet a different "hero" who personifies one FAST symptom, practice the relevant action (calling the emergency number) and receive a mission to complete with their family (e.g., increasing stroke awareness to the extended family, namely, grandparents) [3]. We recognize that kids enjoy sharing what they learn so that they become "little teachers" in the household, sparking conversations that adults often ignore in traditional health campaigns. Research shows that this child-powered approach not only boosts immediate knowledge in every

generation, but also locks it in for years, an unusually durable result for public-health education [4, 5]. In short, FAST Heroes turns classrooms into community stroke-safety hubs, indicating that a six-year-old can indeed help save a grandparent's life [6].

The campaign is no longer a single-country pilot. Twenty-five countries, adaptation to 11 different emergency numbers and translations for 37 language communities, prove that the five-lesson, child-mediated model travels across cultures. According to Tsakpounidou et al. (2022), knowledge surged immediately after the five-week course [3]. Among the 4,202 participating parents, correct recognition of all three FAST symptoms increased from 48% to 83%, and awareness of the correct ambulance number increased from 51% to 85%. Crucially, the gains translated into intended behavior. At baseline, only 32% of parents said they would "call an ambulance" for every FAST symptom. Post-programme, the percentage figure was 70%, which was more than double the proportion of adults who would take the right action. A separate four-year follow-up shows the effect sticks. Children exposed to FAST Heroes were still 14–81% more likely to answer stroke-preparedness questions correctly than untrained peers were, despite no refresher training in the intervening years [5]. The same applies to grandparents' knowledge retention as well [4].

As the campaign spreads, communities start higher with their baseline stroke awareness knowledge. In the second implementation wave (1,611 new parents, 18 countries), baseline knowledge of all three symptoms had already risen to 69% and climbed to 87% after the course, confirming an uplifting effect as each implementation wave followed the last wave [7]. The numbers are backed by real-life rescues. FAST Heroes' website now lists dozens of "hero stories", children who recognized a grandparent's slurred speech or drooping face, alerted adults and triggered Emergency Medical Services, directly saving lives in Slovakia, Greece, Spain, Bulgaria and beyond [6]. Finally, the programme enjoys near-global acceptance. In five-country feedback surveys, 97% of teachers and 94% of parents agreed that FAST Heroes "could help save lives" and 98% of teachers said they would recommend it to colleagues, critical social capital for sustained scale-up [3]. Taken together, the evidence shows that FAST Heroes scales, sticks and translates classroom fun into life-saving action across entire communities.

Although the FAST Heroes programme has demonstrated measurable population-level benefits, enrollment via its web-based registration portal remains below the desired threshold, and only 11.5% of parents whose children participate in the school-based campaign globally register on the platform. Maximizing online registration is strategically important because the portal consolidates educational resources, reinforces learning and extends stroke-preparedness information to families.

Despite the increasing use of digital health interventions, relatively few studies have reported the proportion of users who actually complete online registration for public health initiatives. Among those that do, engagement with digital public health interventions remains modest. Across diverse contexts, fewer than one in five and often closer to one in ten, individuals invited to participate actually register or engage with such tools [8, 9]. Furthermore, among those who do enroll, the dropout rates frequently range from 8.5% to 76.8%, depending on the population, condition and digital design [10]. These patterns indicate that the main barrier is not awareness, but the failure to convert intention into action and highlight both the challenge of initial uptake and the importance of sustained engagement in digital health promotion efforts.

Registration for a health campaign represents the first step toward active engagement. The literature identifies several principles that explain how campaigns influence behavior and how they can more effectively motivate action. A consistent finding across studies is that perceived credibility is among the strongest determinants of behavioral response. Using structural equation modelling, Alotaibi (2025) demonstrated that campaign credibility directly predicts adherence to infection-control behaviors and indirectly predicts behavior through motivation [1]. When individuals trust

both the message and the source, they are more likely to accept guidance, accurately assess risks and translate awareness into action.

Modern public health campaigns outperform traditional information-based approaches because they integrate behavioral theory, leverage digital tools and embed health-literacy principles to create tailored, accessible and context-sensitive interventions that lead to more meaningful and sustained behavior change [2]. Complementing this, Harris et al. (2019) demonstrated that emotionally rich and action-oriented messages elicit stronger attention, enhanced episodic memory encoding and greater behavioral intent, as supported by electroencephalographic evidence [11]. Together, these findings indicate that credibility, theory-informed design and emotional message framing are central components of campaigns that successfully motivate behavioral change.

Beyond message characteristics, organizational trust further shapes audience engagement in digital environments. Evidence from social-media-delivered campaigns confirms that the perceived trustworthiness of the organization disseminating the content is a key driver of engagement, as demonstrated in the review by Draganidis et al. (2024), which showed that the credibility of the disseminating account repeatedly facilitated engagement in mental-health campaigns [12]. Engagement is also strongly shaped by personal relevance. Harris and colleagues (2019) showed that advertisements triggering personal relevance activate neural pathways associated with self-referential processing, including Brodmann area 10 in the ventromedial prefrontal cortex [11]. Personal relevance is a well-established predictor of deeper information processing and stronger behavioral responses [13].

Additional insights come from Hanson et al. (2024), who demonstrated that digitally delivered, local authority–led health campaigns can generate substantial behavioral engagement, particularly when using targeted, platform-specific and low-barrier messaging [14]. Together, these findings highlight that credibility, emotional engagement, personal relevance and low-friction digital delivery act synergistically to determine whether individuals move from exposure to action in digital public health campaigns.

Visual design plays a critical role in public health engagement. Visual communication tools enhance attention, comprehension, memory retention and ultimately behavioral intention. Traboco et al. (2022) emphasized that well-designed visuals allow complex information to be processed more rapidly and effectively, increasing clarity, reducing cognitive load and improving the likelihood that viewers will act on the information presented [15]. Elements such as color, layout, iconography and narrative structure influence emotional response and perceived relevance, while visually appealing formats are more likely to be shared and discussed within families and communities. In the context of digital health interventions, where attention is scarce, such visual strategies can substantially strengthen message salience and encourage users to transition from passive exposure to active engagement, such as completing an online registration.

Collectively, these findings illustrate that behavioral determinants, such as trust, emotional engagement, visuals, message relevance, cognitive load and social-context cues, may shape whether individuals take the next step from exposure to action, i.e., from receiving campaign messages to completing the online registration process. Digital engagement may further vary by school context and communication infrastructure, suggesting that both individual and environmental factors may influence registration behavior. These behavioral insights are therefore essential for understanding online registration behavior in public health campaigns. Despite these established determinants of engagement, little is known about how such behavioral principles translate into digital registration behavior in real-world public health campaigns, particularly among parents. To address this gap, we conducted a prospective, four-arm, school-level comparative intervention study evaluating four communication strategies embedded within the FAST Heroes school network.

Most health-awareness efforts traditionally target older or more susceptible age groups. However, there is a growing shift toward engaging and educating younger populations to equip them with the knowledge and skills needed to address physical, psychological and community health issues [2]. This shift is aligned with contemporary health-promotion models, which emphasize early intervention and the role of children as active health communicators within their families. For this reason, parents were selected as the primary target audience in the present study, as they represent the key intermediaries through which children's learning is reinforced and translated into family-level action.

Aims

The objective of this study was to identify practical strategies for improving online-platform registration, with a particular focus on parents as the primary target group. To achieve this, we specifically tested how variations in delivery format, messenger, visual design, prompting frequency and school settlement category influence parental registration behavior. We also explored whether parental registration patterns differed by school settlement category and class size. Understanding which approaches most effectively prompt parents to register is essential for designing public health communication that converts awareness into concrete action. Beyond practical relevance, these findings contribute to broader literature by offering insights into the processes underlying successful health campaigns, providing an evidence-based foundation for strengthening future public communication initiatives.

METHODS

Study Design

This study was conducted as a prospective, four-arm, parallel-group, school-level comparative intervention study. Schools were the unit of allocation, and the four prompting conditions were implemented concurrently without crossover. This manuscript was prepared in accordance with the applicable CONSORT reporting items.

Participants and recruitment

We targeted 131 Greek kindergartens that had implemented the FAST Heroes programme during the 2023–2024 school year (September 2023-June 2024) but had recorded no parental registrations on the programme website. Eligibility was intentionally restricted to this predefined subgroup of schools as a targeted sampling strategy to examine whether alternative prompting conditions could increase parental registration in schools with prior exposure to the programme but no parental registration in the preceding school year. Despite this restriction, the invited schools varied in geographical location, school size and school settlement category.

All eligible schools (*n* = 131) were initially allocated at the school level to one of four prompting conditions using a balanced allocation procedure. The allocation aimed to achieve broad comparability across conditions with respect to the total number of pupils assigned to each condition and school settlement category. Schools were then invited to participate in the 2024–2025 school year (September 2024–June 2025). Of these, 37 schools accepted the invitation, provided written informed consent, and were included in the final analytic sample, comprising 872 pupils. No a priori sample-size calculation was performed. All eligible schools were invited, and the analytic sample comprised all schools that consented and participated. Schools that participated retained their initially assigned condition, and no post-consent reallocation was undertaken. As a result, the final distribution of participating schools and pupils reflects differential school participation after the initial allocation. The initial balanced allocation of schools was performed by the FAST Heroes study team. Eligible schools were contacted and enrolled by the same team, which also coordinated

implementation of the assigned prompting conditions. The level of non-participation should be interpreted in light of the study's deliberate targeting of schools that had recorded no parental registrations in the previous year.

Of the 94 eligible schools that were not included in the final analytic sample, 15 had independently re-registered for the 2024–2025 school year and begun implementing the programme before contact by the study team; 1 experienced staff turnover, with the FAST Heroes lead teacher being replaced and the new teacher declining participation; 28 could not be reached; 5 requested further information but became unresponsive after receiving programme details; 6 initially consented but subsequently withdrew before study participation began; and 39 declined participation from the outset. Reasons reported by teachers for declining participation included pre-existing commitments to other projects, guidance from the regional school counsellor toward different thematic areas, classrooms comprising predominantly younger pupils (aged 4–5 years), and insufficient instructional time.

Although eligibility was restricted to schools that had previously implemented FAST Heroes but recorded zero parental registrations, the invited schools represented a geographically and structurally diverse cross-section of Greek public kindergartens. Thus, while the sampling frame was not designed to be statistically representative of the national kindergarten population, its composition reflects typical variation in school size, regional distribution and school settlement category within Greece. As such, although the study primarily targets a particularly challenging subgroup (previously exposed but disengaged schools), the behavioral mechanisms under investigation, i.e. digital prompting, messenger effects and friction reduction, are not specific to these settings and are likely to operate similarly in the broader Greek kindergarten system, even if absolute registration levels differ.

School settlement classification and class size

School settlement category was defined using the population of the settlement in which each school was located, based on the 2021 Greek Population and Housing Census [16]. The classification was operationalized with reference to Greek national statistical practice, which distinguishes urban areas from semi-urban and rural areas using a 10,000-inhabitant threshold [17, 18]. For the purposes of the present analysis, settlements with 10,000 inhabitants or more were classified as urban settlements, whereas settlements with fewer than 10,000 inhabitants were classified as non-urban settlements. The non-urban category therefore combines semi-urban and rural settlements. This binary analytic variable was adopted because a three-category settlement classification would have produced sparse condition-by-settlement-category strata. Settlement-related analyses were treated as exploratory and hypothesis-generating.

Class size was examined as an exploratory class-level factor, given evidence that class size may influence classroom processes and teacher–pupil interactions in early childhood education [21, 22]. In the present study, class size was dichotomised using a cutoff of 15 pupils per class, informed by previous literature on class size in early childhood education [21, 22] and the Greek regulatory framework [23].

Intervention

In the 37 participating schools (*N* = 872 children), four intervention Conditions were tested at a school level to evaluate different methods of prompting parental registration on the FAST Heroes website.

Condition 1 involved the distribution of a printed hard copy of an introductory letter about the programme, which was sent home with the pupils. This Condition included 11 schools with a total of 249 pupils.

In **Condition 2**, the printed letter was replaced with a digital version delivered via e-mail. The e-mail contained the same introductory content and included a direct link for registration. This Condition was implemented in 11 schools, involving

175 pupils.

Condition 3 expanded on Condition 2 by providing weekly updates to teachers, either by phone or e-mail, indicating the number of parents who had registered from each class. Teachers were encouraged to use this feedback to further prompt parents to register. This Condition was applied in 10 schools, with a total of 278 pupils.

Condition 4 built upon Condition 3 by adding an automated chatbot component. The chatbot, a conversational digital tool, delivered reminder messages to parents. It was designed to interpret user input, identify intent and generate appropriate responses. This Condition was implemented in five schools involving 170 pupils.

Table 1 shows the distribution of the participating schools and pupils to the four parent-prompting intervention Conditions.

Some variability in the number and size of participating schools and in school-level characteristics was observed across conditions. The final numbers of participating pupils were Condition 1, $n_1 = 249$; Condition 2, $n_2 = 175$; Condition 3, $n_3 = 278$; and Condition 4, $n_4 = 170$. These distributions reflect differential school participation after the initial balanced allocation. The primary analysis accounted for clustering of pupils within schools; the potential implications of differential participation are considered in the Limitations section.

Table 1
Distribution of participating schools and pupils across the four parent-prompting intervention Conditions.

Condition	Prompt delivered to parents	Additional support	Schools, n (urban / non-urban settlement)	Pupils, n (urban / non-urban settlement)
1. Printed letter	Hard-copy welcome letter with registration instructions	None	11 (4 / 7)	249 (129 / 120)
2. E-mail letter	Identical welcome letter embedded in an e-mail containing a direct registration link	None	11 (4 / 7)	175 (74 / 101)
3. E-mail + feedback to teachers	Same e-mail letter	Weekly class-level registration reports sent to teachers by phone or e-mail so that they could further prompt parents to register	10 (3 / 7)	278 (128 / 150)
4. E-mail + feedback to teachers + chatbot reminder to parents	Same as Condition 3	Automated chatbot reminders sent to parents	5 (3 / 2)	170 (115 / 55)

Note: Urban settlements were defined as settlements with ≥ 10,000 inhabitants. Non-urban settlements were defined as settlements with < 10,000 inhabitants and included both semi-urban and rural settlements.

All materials used in the intervention were intentionally designed to be visually appealing in order to enhance attention, as supported by existing literature [15]. The visual materials employed in this study were developed by Lucan and CTL Communications [19, 20]. All materials were delivered at the programme launch (week 0), while feedback to teachers in Conditions 3 and 4 and chatbot reminders to parents via Viber (a smartphone app) in Condition 4 were provided for five consecutive weeks.

Blinding of schools, teachers, and parents was not feasible because the prompting conditions differed visibly in delivery mode and additional support. The primary outcome was based on electronically recorded parental registrations.

The primary outcome was the proportion of parents who completed online registration within eight weeks of the initial prompt. Registration was compared across the four prompting conditions in the primary analysis, while school settlement category and class size were examined as contextual and exploratory factors. The study ended after completion of the predefined eight-week outcome-assessment period and was not stopped early. No changes were made to the primary outcome after study commencement.

Statistical Analysis

Parental registration was summarized as counts and percentages within each prompting condition, with descriptive 95% confidence intervals calculated using the Wilson method. The primary analysis used mixed-effects logistic regression with a random intercept for school to account for clustering within schools. Prompting condition and school settlement category were included as fixed effects, with Condition 1 and non-urban settlement as the reference categories. Models were estimated by maximum likelihood using the Laplace approximation. The overall effect of prompting condition on parental registration was assessed using a three-degree-of-freedom likelihood-ratio test, and individual condition contrasts and the effect of school settlement category were assessed using one-degree-of-freedom likelihood-ratio tests. Effects were reported as conditional odds ratios (ORs) with Wald 95% confidence intervals.

Secondary unadjusted analyses based on pooled registration counts included an overall Pearson chi-square test with Cramér's V and six pairwise Pearson chi-square tests with Yates continuity correction. Pairwise p values were adjusted as one family of six using the Benjamini–Hochberg procedure. Crude risk ratios with log-method 95% confidence intervals were also calculated. Because these analyses did not account for clustering within schools, they were considered complementary to the primary mixed-effects analysis.

Exploratory analyses examined whether the association between school settlement category and parental registration differed across prompting conditions using a mixed-effects logistic regression model including a prompting condition × school settlement-category interaction and a random intercept for school. The interaction was assessed using a three-degree-of-freedom likelihood-ratio test. Condition-specific urban versus non-urban simple effects were evaluated using one-degree-of-freedom likelihood-ratio tests, with p values adjusted as one family of four using the Benjamini–Hochberg procedure.

Class size was examined exploratorily as ≤ 15 versus > 15 pupils using mixed-effects logistic regression with a random intercept for class and adjustment for prompting condition and school settlement category. A sensitivity analysis modelled class size continuously, with effects expressed per 5-pupil increase. Additional sensitivity analyses repeated the categorical and continuous specifications while accounting for clustering at the school rather than the class level. Statistical tests were two-sided. Analyses were conducted in R using the lme4 package for mixed-effects logistic regression [24, 25].

Ethical Considerations

This study is in agreement with the Committee for Research Ethics of the University of Macedonia (Thessaloniki, Greece) (14/15.06.2020), where the programme's educational content was developed. All procedures conformed to the

ethical standards set out in the 1964 Declaration of Helsinki and its later amendments and all processing adhered to the EU General Data Protection Regulation (GDPR; Regulation (EU) 2016/679). Participation was voluntary at the kindergarten, teacher, and parent levels. All the people involved were reminded that participation could be withdrawn at any time without penalty and that withdrawal would trigger the deletion of any personal data already collected. This study has been registered with ClinicalTrials.gov (registration number NCT07745582).

Use of generative AI in manuscript preparation

During preparation of this manuscript, ChatGPT (OpenAI) was used in selected sections to support language editing and improve clarity of expression. All AI-assisted output was critically reviewed and revised by the authors, who take full responsibility for the final content.

RESULTS

Participant flow

Of 131 eligible schools, 37 (28.2%) provided consent and were included in the final analytic sample (872 pupils); reasons for non-participation among the remaining 94 schools are shown in Fig. 1.

Observed parental registration across prompting conditions

The final analytic sample comprised 37 schools and 872 pupils. Within eight weeks of the initial prompt, 29 parental registrations were recorded among 249 participating pupils in Condition 1 (printed letter; 11.6%, 95% CI [8.2%, 16.2%]), 35 among 175 participating pupils in Condition 2 (e-mail letter; 20.0%, 95% CI [14.7%, 26.5%]), 67 among 278 participating pupils in Condition 3 (e-mail letter plus feedback to teachers; 24.1%, 95% CI [19.4%, 29.5%]), and 13 among 170 participating pupils in Condition 4 (e-mail letter plus feedback to teachers and chatbot reminders to parents; 7.6%, 95% CI [4.5%, 12.6%]). Figure 2 presents the observed parental registration rates and descriptive Wilson 95% confidence intervals by prompting condition.

Primary mixed-effects logistic regression analysis

A mixed-effects logistic regression model with a random intercept for school was used to account for the clustering of observations within schools. Prompting condition and school settlement category were entered simultaneously as fixed effects, with Condition 1 and non-urban settlement serving as the reference categories.

The likelihood-ratio test indicated an overall association between prompting condition and parental registration, $\chi^2(3) = 9.74$, $p = .021$. After adjustment for school settlement category, the odds of parental registration were higher in Condition 2 than in Condition 1, OR = 2.85, 95% CI [1.04, 7.81], $p = .042$. The odds were also higher in Condition 3 than in Condition 1, OR = 3.02, 95% CI [1.11, 8.22], $p = .032$. Condition 4 did not differ significantly from Condition 1, OR = 0.60, 95% CI [0.17, 2.15], $p = .439$.

The association between school settlement category and parental registration, adjusted for prompting condition, was not statistically significant. Compared with non-urban settlements, the estimated odds of parental registration were higher in urban settlements, OR = 1.55, 95% CI [0.73, 3.30], $p = .271$. The complete model results are presented in Table 2.

Table 2
Mixed-effects logistic regression estimates for parental registration.

Predictor	Odds ratio [95% CI]	*p* value
Prompting condition		
Condition 2 vs Condition 1	2.85 [1.04, 7.81]	.042
Condition 3 vs Condition 1	3.02 [1.11, 8.22]	.032
Condition 4 vs Condition 1	0.60 [0.17, 2.15]	.439
School settlement category		
Urban vs non-urban settlement	1.55 [0.73, 3.30]	.271

Note: The model included prompting condition and school settlement category as fixed effects and a random intercept for school. Condition 1 and non-urban settlement were the reference categories. The model was estimated by maximum likelihood using the Laplace approximation. Odds ratios are conditional mixed-effects model estimates, and 95% confidence intervals are Wald intervals obtained by exponentiating the confidence limits on the log-odds scale. Individual p values were obtained from one-degree-of-freedom likelihood-ratio tests comparing the full model with the corresponding nested model. The overall prompting-condition effect was assessed using a likelihood-ratio test, $\chi^2(3) = 9.74$, $p = .021$. The estimated school random-intercept variance was 0.751 (SD = 0.867).

Secondary unadjusted comparisons across prompting conditions

To complement the primary mixed-effects analysis, secondary unadjusted comparisons were conducted using the pooled registration counts to describe the condition-wise registration pattern and to provide the full set of pairwise comparisons between prompting conditions. Because these analyses did not account for clustering of observations within schools, they were interpreted as complementary to, rather than substitutes for, the primary mixed-effects logistic regression analysis.

A Pearson chi-square test indicated an association between prompting condition and parental registration, $\chi^2(3, N = 872) = 27.12$, $p < .001$, with Cramér's V = .18. Across the six pairwise condition comparisons, p values from Pearson chi-square tests with Yates continuity correction were adjusted as one family of six using the Benjamini–Hochberg procedure. Registration was higher in Condition 2 than in Condition 1 (adjusted $p = .039$) and Condition 4 (adjusted $p = .003$), and higher in Condition 3 than in Condition 1 (adjusted $p = .001$) and Condition 4 (adjusted $p < .001$). The comparisons between Condition 1 and Condition 4 (adjusted $p = .289$) and between Condition 2 and Condition 3 (adjusted $p = .367$) were not statistically significant. Crude risk ratios with 95% confidence intervals for all six pairwise prompting-condition comparisons are provided in Supplementary Table S1 (Additional file 1).

Exploratory analyses by school settlement category

Because school settlement category was a pre-existing characteristic rather than an assigned factor, analyses examining whether its association with parental registration differed across prompting conditions were considered exploratory and were interpreted as observed associations rather than causal effects. Figure 3 presents observed parental registration rates with descriptive Wilson 95% confidence intervals by prompting condition and school settlement category.

In the primary main-effects mixed-effects logistic regression model, school settlement category was not significantly associated with parental registration after adjustment for prompting condition, OR = 1.55, 95% CI [0.73, 3.30], p = .271 (Table 2). However, an exploratory mixed-effects logistic regression model including the prompting condition × school settlement category interaction indicated that the association between settlement category and parental registration

differed across prompting conditions, likelihood-ratio $\chi^2(3) = 18.86$, $p < .001$. Given this significant interaction, the pooled settlement estimate from the primary main-effects model should not be interpreted as representing a uniform association across prompting conditions.

Condition-specific simple-effect analyses indicated higher estimated odds of parental registration in urban than in non-urban settlements in Condition 1, OR = 5.91, 95% CI [1.70, 20.48], BH-adjusted p = .007, and Condition 3, OR = 3.90, 95% CI [1.50, 10.17], BH-adjusted p = .015. In Condition 2, the estimated odds were lower in urban than in non-urban settlements, OR = 0.17, 95% CI [0.05, 0.56], BH-adjusted p = .007. No statistically significant settlement-category difference was observed in Condition 4, OR = 1.39, 95% CI [0.26, 7.40], BH-adjusted p = .702. Detailed condition-specific estimates are provided in Supplementary Table S2 (Additional file 1).

Because several condition-by-settlement strata contained few schools and the corresponding confidence intervals were wide, these condition-specific estimates should be regarded as exploratory and interpreted cautiously.

Exploratory class-size analysis

The exploratory class-size analysis included 872 participating pupils from 57 classes across 37 schools. Of the 57 classes, 28 included ≤ 15 pupils and 29 included > 15 pupils. Parental registration occurred for 43 of 288 pupils in classes with ≤ 15 pupils (14.9%) and for 101 of 584 pupils in classes with > 15 pupils (17.3%).

In the primary exploratory class-size model, which included a random intercept for class to account for clustering of pupils within classes and adjusted for prompting condition and school settlement category, there was no statistically significant association between class-size category and parental registration. Compared with classes containing > 15 pupils, classes with ≤ 15 pupils had lower estimated odds of parental registration, although the difference was not statistically significant, OR = 0.65, 95% CI [0.27, 1.57], p = .335. A sensitivity analysis treating class size as a continuous variable yielded a similarly non-significant association, with an OR of 1.16 per 5-pupil increase in class size, 95% CI [0.79, 1.70], p = .444.

We additionally conducted sensitivity analyses in which the categorical and continuous class-size models accounted for clustering at the school rather than the class level; results are presented in Supplementary Table S3 (Additional file 1).

DISCUSSION

This prospective, four-arm school-level comparative intervention study investigated determinants of parental registration on the FAST Heroes public health online platform, focusing on parents as the primary target audience. The review by Bugshan et al. (2022) highlights a shift in health-awareness efforts away from exclusively targeting older or high-risk groups (i.e. in our case grandparents) and towards actively engaging younger populations (i.e. in our case parents) [2]. Within contemporary health-promotion models, educating younger audiences is considered a key strategy, as early involvement helps cultivate long-term awareness and healthier decision-making patterns.

Factors that resulted in higher parental registration levels: a) Digital communication

The results showed that substituting a basic printed hard copy of an introductory letter about the programme with a digital version delivered via e-mail significantly improved parental engagement. The most impactful strategy for increasing online parental registration combined the digital version delivered via e-mail and included weekly updates to teachers, via phone or e-mail, highlighting the number of parents registered from each class.

Factors that resulted in higher parental registration levels: b) Teacher-parent relationship

The study further suggests that school settlement category may moderate the effectiveness of these intervention strategies. For example, in the stand-alone e-mail prompt Condition (Condition 2), schools located in non-urban settlements exhibited comparatively greater responsiveness, potentially reflecting stronger teacher–parent relationships or lower digital saturation. Conversely, the addition of weekly teacher feedback (Condition 3) proved particularly effective in schools located in urban settlements, where greater digital fluency and connectivity may have facilitated prompt completion. The class size did not appear to influence the registration outcomes.

Factors that resulted in higher parental registration levels: c) Visual communication tools

There are limited data on online registration rates in public-health initiatives, with existing studies suggesting that typically only one in ten invited users complete registration [8, 9]. In our study, the baseline condition (Condition 1) produced slightly higher registration rates than the scarce data reported in the literature. One possible explanation is the presence of high-quality visual material, which has been shown to enhance engagement [15]. Even in the absence of additional interventions, the visual design used in Condition 1 may have contributed to increased attention, improved retention and a greater likelihood of acting on the recommended behavior. Traboco et al. (2022) demonstrate that well-designed visual communication tools, such as infographics, can significantly strengthen comprehension, support memory, and potentially influence behavioral change in public-health education [15]. These findings align with the FAST Heroes visual communication strategy used in the materials sent to parents, which employs simple and reader-friendly graphics to facilitate understanding and encourage engagement, namely parental registration on the FAST Heroes website. More broadly, infographics have become central to contemporary science communication and public-health messaging. Traboco et al. (2022) conclude that infographics are highly effective in enhancing understanding, improving recall and promoting behavioral change within scientific and public-health contexts [15].

Factors that resulted in higher parental registration levels: d) Emotional connection

An additional explanation for why even the simple hard-copy introductory letter (Condition 1) produced slightly higher registration rates is that it evoked emotional resonance and offered clear behavioral direction. These elements, according to Harris et al. (2019), are linked to stronger attention, enhanced memory encoding, greater liking and more positive behavioral intentions [11].

The advantages of “low-friction” and personally applicable communication channels

However, when the well-designed hard-copy introductory letter was converted into a digitally delivered version in the subsequent conditions, registration rates increased, with the exception of Condition 4. Overall, Condition 3 had the highest observed parental registration rate. Several factors, grounded in behavioral science, may account for this result. Beyond the use of high-quality visual material, a key differentiating feature of Condition 3 was the use of an e-mail-based welcome letter with embedded registration links, which significantly reduced friction in the registration process. This finding is consistent with evidence from Hanson et al. (2024), who demonstrated that well-targeted, simple digital prompts, particularly those requiring minimal user effort, can significantly increase behavioral follow-through [14]. Prior studies indicate that response rates improve when a call to action is presented in a format requiring minimal effort, such as a clickable link, compared with traditional paper-based formats that necessitate scanning QR codes or

navigating to websites manually [26]]. Thus, Condition 3 benefited from this digital "low-friction" advantage over the hard copy letter used in Condition 1. Evidence from political communication research further supports the importance of explicit relevance and repeated exposure in prompting real-world action. Cushion et al. (2017) demonstrated that audiences often fail to recognize the personal applicability of information when relevance is only implied and that understanding is suggested to improve only after repeated and explicit cues [27]. These findings support the FAST Heroes parental engagement strategy in Condition 3, where when registration prompts were repeatedly delivered through the teachers and framed with clear and explicit calls to action, registration rates increased. By ensuring that parents clearly understand that registration applies directly to them, FAST Heroes aligns with evidence that explicit contextualization and repetition are necessary to convert exposure into participation. Importantly, Condition 3 combined high-quality visuals, evoked emotional resonance and provided clear behavioral direction, while simultaneously reducing friction by enabling the desired action, in our case registration on the online platform through a single click on a button link. Visibility of class-level progress also introduced a form of social comparison, which has been shown to enhance participation through peer-based motivation [28].

Bridging the intention-action gap through behavior-based strategies

The intervention also effectively addressed the well-documented “intention–action gap”, the tendency for individuals to form intentions but fail to act on them owing to psychological, contextual and structural barriers [29, 30]. Key contributors to this gap include the absence of concrete implementation plans, cognitive overload, present bias and insufficient environmental cues to trigger behavior [31]. In addition, the social context plays a crucial role in shaping action, as individuals are less likely to follow through when they perceive inaction among others [32]. Visibility of class-level progress also introduced a form of social comparison, which has been shown to enhance participation through peer-based motivation [33]. By providing a direct, low-effort pathway to action, along with repeated social cues via teacher reminders, Condition 3 helped bridge this gap between intention and behavior.

The superior performance observed in Condition 3 can likely be attributed to the weekly e-mail prompts sent to teachers, who in turn informed parents about their registration progress. In this condition, the use of systematic, weekly teacher feedback likely functioned as a behavioral “nudge,” reinforcing the intended action and turning intentions into actual registration behavior. This is consistent with findings from multiple behavioral insight trials showing that brief, recurring messages significantly increase follow-through [34, 35]. Higher exposure frequency has been consistently associated with greater behavioral change [2, 27], particularly when messages are delivered with consistent timing [12]. By combining regular exposure with a trusted messenger and a low-friction registration pathway, Condition 3 created optimal conditions for greater engagement.

The importance of trustworthy and supportive sources in promoting behavioral change

Source trustworthiness has been shown to drive higher levels of engagement, as evidenced by increased likes, shares, comments, and retweets [12]. FAST Heroes demonstrates strong institutional credibility through its endorsement by internationally recognized organizations, including the Angels Initiative and the World Stroke Organization, and through its development by the University of Macedonia. These credentials were clearly communicated to parents in both the digital and printed versions of the introductory letter.

Such institutional trust enhances the credibility of the health message itself and, as highlighted by Alotaibi (2025), message credibility plays a central role in motivating individuals to take action [1]. Furthermore, the credibility of the messenger, in this case, the teacher, amplified the effectiveness of the intervention. According to the MINDSPACE

framework [28], the source of a message (Messenger) is a critical determinant of the behavioral response. Teachers are generally viewed as trusted authorities by parents and weekly reminders from them added an element of social accountability (for example, “My child’s teacher will know whether I’ve signed up”), encouraging follow-through. Accordingly, Condition 3, which combined strong institutional credibility with the teacher’s role as a trusted messenger, yielded the highest levels of parental registration.

Draganidis et al. (2024) further emphasized that a caring, supportive, relatable and non-judgmental tone enhances audience engagement [12]. Condition 3 incorporated these elements by delivering the digital introductory letter directly to parents and by providing periodic, supportive reminders from teachers to complete the registration process. This combination of credible source cues and an empathetic communication style likely fostered a stronger emotional connection, thereby increasing the likelihood that parents would act on the recommended behavior, i.e. registering on the website.

Understanding high and low performance in Conditions 3 and 4 through the COM-B model

The effectiveness of Condition 3 can also be interpreted through the COM-B model of behavior change [36]. This model posits that behavior is driven by three interacting components, Capability, Opportunity and Motivation. Capability was addressed through clear instructions and a direct pathway to register. Opportunity was facilitated by minimal friction via one-click digital access and Motivation was reinforced through weekly prompts, feedback from a trusted messenger and social accountability. Together, these elements contributed to a registration rate of 24.1%, which was double that of the baseline Condition 1 and the highest among all tested strategies.

Condition 4 yielded the lowest parental registration rates. Interpreted through the COM-B model, this finding appears to be primarily driven by constraints in Opportunity and Motivation, rather than Capability. Specifically, teachers were required to distribute the chatbot activation link via their personal mobile devices, which may have introduced practical and contextual barriers (reduced physical and social opportunity), such as concerns about privacy, boundaries with parents or additional workload. In addition, the use of informal, personal messaging channels may have influenced parents’ perceptions of the intervention, potentially reducing trust, perceived credibility or salience of the message. These factors may also have negatively influenced teachers’ reflective motivation, reducing their willingness to engage with and promote the intervention. As a result, the intended facilitative effect of the chatbot link may have been undermined by both the increased burden placed on teachers and the characteristics of the delivery channel, ultimately limiting its dissemination and impact on parental registration.

In summary, the success of Condition 3 appears to stem from the synergistic integration of low-friction digital delivery, high-trust messengers, strong institutional credibility, well-designed visual communication, a supportive and non-judgmental tone, social comparison and timely behavioral nudges. This multi-component configuration, which simultaneously targeted capability, opportunity and motivation, is consistently shown in the behavioral science literature to outperform single-component interventions in producing the desired behavior.

The role of school settlement category in parental registrations

Although school settlement category was not significantly associated with parental registration overall in the primary main-effects model, exploratory analyses suggested that associations between prompting conditions and parental registration may vary by school settlement category. Because some condition-by-settlement strata included relatively few schools, these exploratory findings should be interpreted cautiously and viewed as hypothesis-generating.

Empirical research and behavioral science literature indicate that parental registration rates on public health and educational websites tend to be higher in urban than in non-urban settings. This disparity can be attributed to a

combination of structural, socioeconomic and psychological factors.

First, urban areas generally offer superior digital infrastructure, including higher-speed internet, greater broadband coverage and more widespread access to digital devices such as smartphones, tablets and computers. These resources facilitate easier interaction with online platforms [37]. Additionally, according to Helsper and Eynon (2013), economic, cultural, social and personal factors affect digital literacy, meaning that these factors impact navigation on online interfaces, completing digital forms and responding to electronic communications [38]. Moreover, urban residents may be more frequently exposed to behavioral prompts and communication efforts, including school updates, e-posters and digital advertisements, due to higher e-mail density [39, 40]. Schools in privileged or urban areas also tend to implement more comprehensive digital communication systems [41], which may contribute to the normalization of online engagement and increase responsiveness to registration efforts.

Socioeconomic status is another major contributing factor. Disparities in education level, income and geographic location are closely linked to inequalities in digital access and use [42]. Furthermore, social norms and peer influence may amplify these effects. In urban communities, online registration may be perceived as standard or expected behavior. As social norms shape individual decision-making, parents may be more likely to register when they perceive that their peers are doing the same [32]. Taken together, these findings suggest that urban contexts are more conducive to digital engagement, not only because of infrastructural advantages but also because of socio-cultural and behavioral dynamics that support and reinforce participation.

On the other hand, non-urban areas demonstrated an advantage in the stand-alone e-mail Condition as per parental registration rates compared to urban areas. The e-mail-only prompt arrived in an environment that differs by setting. Across different sources, people in cities receive an average of 120 e-mails per day [39, 40, 43]. High traffic volumes and “promotions” filters can lead a single unsolicited e-mail to be overlooked.

Additionally, research shows that non-urban areas have stronger social cohesion than their urban counterparts do [44]. Thus, schools in non-urban areas may sustain tighter teacher–parent relationships. A single e-mail bearing the teacher’s name can therefore carry greater social weight in non-urban settings, prompting quicker action. The combined effects of heavier inbox traffic and weaker social ties may have suppressed urban click-through in Condition 2, while leaving non-urban families comparatively more responsive.

The addition of weekly teacher feedback (Condition 3) or chatbot reminders (Condition 4) broke through the urban inbox clutter. Repeated, mobile-friendly nudges match the fast, app-centric communication habits of city parents while also restoring a sense of immediacy and personal relevance. Once attention was recaptured, urban families’ superior connectivity again translated into higher registration rates. By aligning the prompting method with local communication preferences and by recognizing that too much digital traffic can be as exclusionary as too little, health-education campaigns can maximize reach across diverse school communities. Bugshan et al. (2022) highlight the importance of cultural adaptation, which in our case pertains to adjusting communication strategies for urban versus non-urban contexts [2].

Class Size and Parental Registration

In this study, class size did not appear to be clearly associated with parental registration rates in the FAST Heroes programme. Although smaller class sizes are well documented to support better cognitive and social-emotional outcomes [22], their influence may not extend in the same way to parent-facing behaviours such as registration. Factors unrelated to class size, such as communication strategies and barriers to parental involvement, may also play an important role in parents’ decisions to register. In the present exploratory analyses, no statistically significant association with parental registration was observed when class size was examined either categorically (≤ 15 vs > 15

pupils) or as a continuous variable. These findings should be interpreted cautiously and should not be taken to contradict previous evidence concerning the educational benefits of smaller classes.

Limitations and Future Directions

While the findings of the present study offer valuable insights into the behavioral mechanisms that enhance parental registration on public health platforms, several limitations must be acknowledged.

A key limitation concerns the voluntary participation of schools, which may introduce self-selection bias toward settings with greater organizational stability or teacher engagement. Nevertheless, the broader pool of 131 eligible schools encompassed a wide geographical and structural range typical of Greek public kindergarten settings. Consequently, although the 37 participating schools cannot be considered statistically representative, the underlying behavioural processes identified in this study are plausibly generalizable across Greek kindergartens, even if absolute registration levels might differ. The findings should therefore be interpreted as most directly applicable to schools with a similar engagement profile, while still offering cautiously generalizable insights into how digital prompting strategies may influence parental registration behavior within the Greek kindergarten context.

The generalizability of the results may be constrained by contextual factors. The study was conducted within a specific national and educational context, and its outcomes may not directly translate to other cultural or institutional environments. Future research should assess whether similar interventions yield comparable results across diverse socio-cultural settings.

Although the exploratory condition-by-settlement interaction suggested heterogeneity in registration patterns across prompting conditions, the overall association between school settlement category and parental registration was not statistically significant in the primary main-effects model. Not all schools located in non-urban or urban settlements are homogeneous, and factors such as school-level leadership, teacher engagement or community resources may contribute to within-category variability. Although the data could, in principle, be represented at three levels (pupils nested within classes nested within schools), the study included only 37 schools, and many schools contributed a single class. Given the limited number of schools and the relatively sparse within-school class structure, a three-level mixed-effects model was not pursued. A further limitation is that the final number of participating schools differed across prompting conditions after consent, particularly in Condition 4. Because final participation depended on school consent after the initial balanced allocation, the participating schools may not have retained the comparability sought in the original allocation, and residual selection differences between conditions cannot be excluded. The primary analysis accounted for clustering of pupils within schools using mixed-effects logistic regression with a random intercept for school. Class size was examined separately using mixed-effects logistic regression with a random intercept for class, with additional sensitivity analyses accounting for clustering at the school level. Future studies with larger numbers of schools and richer within-school structure could apply three-level mixed-effects models to characterize variability across levels more fully.

The study focused primarily on behavioral outputs (i.e., registration rates) without capturing intermediate cognitive or affective processes, such as parental attitudes, trust or perceived usefulness of the platform. The primary behavioral outcome (i.e., parental registration) was used as an objective indicator of engagement. While additional behavioral constructs (e.g., capability, opportunity and motivation) were not directly measured, the COM-B model was applied to interpret the observed behavior. Future research incorporating qualitative or survey-based methods would provide valuable insight into the underlying psychological mechanisms that facilitate or hinder registration behavior.

The school settlement category analysis should be interpreted cautiously. Settlement category is a pre-existing school characteristic rather than an experimentally assigned factor, and may be confounded with regional, socioeconomic,

infrastructural, and school-level characteristics that were not directly measured. In addition, although the classification was based on Greek national statistical practice and used a 10,000-inhabitant threshold to distinguish urban settlements from semi-urban and rural settlements, the binary analytic variable collapsed semi-urban and rural settlements into a single non-urban category. As a result, it does not capture the full settlement continuum or differences in population density, socioeconomic composition, digital infrastructure, or school–parent communication practices. These findings should therefore be interpreted as exploratory context-related patterns rather than as evidence of causal settlement effects. Future research should use more granular settlement measures, such as separate urban, semi-urban, and rural categories or continuous measures of population density.

The study did not measure long-term engagement or retention on the platform. While registration is a critical first step, future research should investigate whether initial behavioral change translates into sustained participation, learning, or health outcomes over time.

Finally, an important limitation of the present study relates to the design of Condition 4, in which both the intervention tool (chatbot) and the delivery channel (dissemination via teachers' personal mobile devices) were introduced simultaneously. As a result, these two elements are confounded, and it is not possible to disentangle whether the lower parental registration rates were driven by resistance to the chatbot itself or by reduced trust and engagement associated with the informal delivery channel. From a behavioral perspective and informed by the COM-B model, these factors may differentially influence both Opportunity (mode of access and contextual constraints) and Motivation (perceived credibility, trust and willingness to engage). Notably, the chatbot prompt itself has the potential to facilitate registration by simplifying navigation and acting as a direct behavioral cue, eliminating the need for users to search for external links. However, its effectiveness may have been undermined by the delivery approach used in Condition 4. Future research should aim to isolate the effects of intervention components and delivery channels and evaluate the effectiveness of distributing chatbot activation links through alternative, more formal or trusted communication pathways.

Taken together, these limitations highlight opportunities for future work to build on the current findings by refining intervention strategies, addressing equity gaps and evaluating long-term impacts.

CONCLUSIONS

This study demonstrates that goal-oriented communication strategies can markedly enhance parental engagement in online public health initiatives such as FAST Heroes. In particular, integrating low-friction digital tools with trusted intermediaries, high-quality visuals, non-judgmental communication tone, repetitive and behavioral prompts, such as feedback from teachers, significantly increases registration rates. These effects were observed regardless of class size, provided that the prompting methods were aligned with local communication preferences.

Abbreviations

FAST
Face Arms Speech Time
COM-B
Capability, Opportunity, Motivation, Behavior

Declarations

Ethics approval and consent to participate

This study was approved by the Committee for Research Ethics of the University of Macedonia (Thessaloniki, Greece; ref. 14/15.06.2020). This approval covers the FAST Heroes programme, including the educational content development and the associated research procedures under which the present 2024–2025 comparative study was conducted. Written informed consent to participate was obtained from participating schools; participation was voluntary for kindergartens, teachers, and parents, and could be withdrawn at any time without penalty.

Consent for publication

Not applicable

Competing interests

The authors declare that they have no competing interests.

Additional file

Additional file 1 (.docx). Supplementary Tables S1–S3. Crude pairwise comparisons of parental registration across prompting conditions, condition-specific associations by school settlement category, and school-clustered sensitivity analyses of class size.

Funding

This work was supported by the Boehringer Ingelheim and Angels Initiative (Grant Number 695751, 2023). The funder was not involved in the study design, collection, analysis, interpretation of data, the writing of this article or the decision to submit it for publication. All authors declare no other competing interests.

Author Contribution

JM: Writing – review & editing, Writing – original draft, Methodology, Formal analysis, Conceptualization. MB: Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Conceptualization. KT: Writing – review & editing, Supervision, Methodology, Conceptualization. MP: Writing – review & editing. Supervision, Methodology, Conceptualization. CK: Formal analysis, Methodology, Writing – original draft. HP: Writing – review & editing, Supervision, Methodology, Conceptualization.

All authors read and approved the final manuscript.

Acknowledgments

Not applicable.

Data Availability

Data are available from the authors upon reasonable request and with the permission of the corresponding author.

References

1. Alotaibi K. Perceived Credibility of Public Health Campaigns and Its Impact on Infection Control Behaviors: Mediating Roles of Health Literacy and Motivation. J Multidiscip Healthc. 2025;18:3153–63. https://doi.org/10.2147/JMDH.S520357.
2. Bugshan WM, Qahtani SJ, Al, Alwagdani NA, Alharthi MS, Alqarni AM, Alsuat HM, et al. Role of Health Awareness Campaigns in Improving Public Health:A Systematic Review. Int J Life Sci Pharma Res. 2022. https://doi.org/10.22376/ijpbs/lpr.2022.12.6.L29-35.
3. Tsakpounidou K, van der Merwe J, Klinke ME, Webb C, Ouriques Martins SC, Proios H. FAST Heroes: Results of Cross-Country Implementation of a Global School-Based Stroke Education Campaign. Front Public Health. 2022;10. https://doi.org/10.3389/fpubh.2022.849023.
4. Orologa E, Baskini M, Tsakpounidou K, Keramydas C, Proios H. Post-implementation knowledge retention of stroke: the lasting influence of FAST Heroes. Front Public Health. 2024;12. https://doi.org/10.3389/fpubh.2024.1400409.
5. Baskini M, Tsakpounidou K, Van der Merwe J, Keramydas C, Proestopoulos M, Proios H. Is stroke knowledge retained? Four-year longitudinal data of FAST Heroes campaign. Front Commun (Lausanne). 2023;8. https://doi.org/10.3389/fcomm.2023.1264423.
6. FAST Heroes. Campaign Impact. https://us-en.fastheroes.com/campaign-impact/. Accessed 7 Jul 2026.
7. van der Merwe J, Tsakpounidou K, Baskini M, Webb C, Keramydas C, Martins SCO, et al. Continuity and Change in Baseline Stroke Knowledge across the world: Second Wave of FAST Heroes campaign implementation. J Stroke Cerebrovasc Dis. 2023;32:107426. https://doi.org/10.1016/j.jstrokecerebrovasdis.2023.107426.
8. Stassen G, Grieben C, Froböse I, Schaller A. Engagement with a Web-Based Health Promotion Intervention among Vocational School Students: A Secondary User and Usage Analysis. Int J Environ Res Public Health. 2020;17:2180. https://doi.org/10.3390/ijerph17072180.
9. Batterham P, Gulliver A, Sunderland M, Farrer L, Kay-Lambkin F, Trias A, et al. Factors Influencing Community Participation in Internet Interventions Compared With Research Trials: Observational Study in a Nationally Representative Adult Cohort. J Med Internet Res. 2023;25:e41663. https://doi.org/10.2196/41663.
10. Hernández-Rodríguez J-C, García-Muñoz C, Ortiz-Álvarez J, Saigí-Rubió F, Conejo-Mir J, Pereyra-Rodriguez J-J. Dropout Rate in Digital Health Interventions for the Prevention of Skin Cancer: Systematic Review, Meta-analysis, and Metaregression. J Med Internet Res. 2022;24:e42397. https://doi.org/10.2196/42397.
11. Harris JM, Ciorciari J, Gountas J. Consumer Neuroscience and Digital/Social Media Health/Social Cause Advertisement Effectiveness. Behav Sci. 2019;9:42. https://doi.org/10.3390/bs9040042.
12. Draganidis A, Fernando AN, West ML, Sharp G. Social media delivered mental health campaigns and public service announcements: A systematic literature review of public engagement and help-seeking behaviours. Soc Sci Med. 2024;359:117231. https://doi.org/10.1016/j.socscimed.2024.117231.
13. Cacioppo JT, Cacioppo S, Petty RE. The neuroscience of persuasion: A review with an emphasis on issues and opportunities. Soc Neurosci. 2018;13:129–72. https://doi.org/10.1080/17470919.2016.1273851.
14. Hanson K, Degas A-M, Green D, Al-Hosri A, Vandrevala T. Online public health promotion at the local level: An evaluation of four local authority-led marketing campaigns. Digit Health. 2024;10. https://doi.org/10.1177/20552076231220151.
15. Traboco L, Pandian H, Nikiphorou E, Gupta L. Designing Infographics: Visual Representations for Enhancing Education, Communication, and Scientific Research. J Korean Med Sci. 2022;37. https://doi.org/10.3346/jkms.2022.37.e214.
16. Hellenic Statistical Authority (ELSTAT). Results of the 2021 Population and Housing Census: resident population. Available from: https://www.statistics.gr/en/2021-census-pop-hous-results. Accessed 9 Jul 2026. Hellenic Statistical Authority. 2023.

17. Hellenic Statistical Authority (ELSTAT). Labour Force Survey, 2018: Single Integrated Metadata Structure (SIMS). Available from: https://www.statistics.gr/en/statistics/-/publication/SJO01/2018-Q1. Accessed 9 Jul 2026. 2019.
18. Papadopoulos AG, Baltas P. Rural Depopulation in Greece: Trends, Processes, and Interpretations. Geographies. 2023;4:1–20. https://doi.org/10.3390/geographies4010001.
19. Lucan, Lucan. Jul. https://www.lucan.tv/. Accessed 7 2026.
20. CTL Communications. CTL Communications. https://ctlcomms.com/. Accessed 7 Jul 2026.
21. Mosteller F. The Tennessee study of class size in the early school grades. Future Child. 1995;5:113–27.
22. Blatchford P, Bassett P, Brown P. Examining the effect of class size on classroom engagement and teacher–pupil interaction: Differences in relation to pupil prior attainment and primary vs. secondary schools. Learn Instr. 2011;21:715–30. https://doi.org/10.1016/j.learninstruc.2011.04.001.
23. Hellenic Republic. Law 4692/2020: Upgrading the School and Other Provisions. 2020;Series A, No. 111 Article 50, paragraph 1.
24. Bates D, Mächler M, Bolker B, Walker S. Fitting Linear Mixed-Effects Models Using lme4. J Stat Softw. 2015;67. https://doi.org/10.18637/jss.v067.i01.
25. R Core Team. R: A language and environment for statistical computing (https://www.R-project.org/). 2026.
26. Tai X, Smith AM, McGeer AJ, Dubé E, Holness DL, Katz K, et al. Comparison of response rates on invitation mode of a web-based survey on influenza vaccine adverse events among healthcare workers: a pilot study. BMC Med Res Methodol. 2018;18:59. https://doi.org/10.1186/s12874-018-0524-8.
27. Cushion S, Lewis J, Kilby A. Why context, relevance and repetition matter in news reporting: Interpreting the United Kingdom's political information environment. Journalism. 2020;21:34–53. https://doi.org/10.1177/1464884917746560.
28. Cabinet Office Behavioural Insights Team. Applying behavioural insight to health. https://assets.publishing.service.gov.uk/media/5a78b4fce5274a2acd1892bd/403936_BehaviouralInsight_acc.pdf. Accessed 7 Jul 2026. London; 2010.
29. Gollwitzer PM. Implementation intentions: Strong effects of simple plans. Am Psychol. 1999;54:493–503. https://doi.org/10.1037/0003-066X.54.7.493.
30. Baumeister RF, Bratslavsky E, Muraven M, Tice DM. Ego depletion: Is the active self a limited resource? J Pers Soc Psychol. 1998;74:1252–65. https://doi.org/10.1037/0022-3514.74.5.1252.
31. Wood W, Neal DT. A new look at habits and the habit-goal interface. Psychol Rev. 2007;114:843–63. https://doi.org/10.1037/0033-295X.114.4.843.
32. Cialdini RB, Goldstein NJ. Social Influence: Compliance and Conformity. Annu Rev Psychol. 2004;55:591–621. https://doi.org/10.1146/annurev.psych.55.090902.142015.
33. Bergman P, Chan EW. Leveraging Parents through Low-Cost Technology. J Hum Resour. 2021;56:125–58. https://doi.org/10.3368/jhr.56.1.1118-9837R1.
34. Kraft M, Rogers T. The Underutilized Potential of Teacher-to-Parent Communication: Evidence from a Field Experiment (October 20, 2014). HKS Working Paper No. RWP14-049. SSRN Electronic Journal. 2014. https://doi.org/10.2139/ssrn.2528688
35. Mayer SE, Kalil A, Oreopoulos P, Gallegos S. Using behavioral insights to increase parental engagement: The Parents and Children Together (PACT) intervention. Cambridge, MA; 2015.
36. Michie S, van Stralen MM, West R. The behaviour change wheel: A new method for characterising and designing behaviour change interventions. Implement Sci. 2011;6:42. https://doi.org/10.1186/1748-5908-6-42.

37. van Deursen AJ, van Dijk JA. The digital divide shifts to differences in usage. New Media Soc. 2014;16:507–26. https://doi.org/10.1177/1461444813487959.
38. Helsper EJ, Eynon R. Distinct skill pathways to digital engagement. Eur J Commun. 2013;28:696–713. https://doi.org/10.1177/0267323113499113.
39. Singh S. How many emails are sent per day? (2025 statistics). Available from: https://www.demandsage.com/how-many-emails-are-sent-per-day/. Accessed 7 Jul 2025. DemandSage. 2025.
40. Microsoft Corporation. Breaking down the infinite workday. Available from: https://www.microsoft.com/en-us/worklab/work-trend-index/breaking-down-infinite-workday. Accessed 7 Jul 2025. WorkLab. 2025.
41. Heßmer A, Schäfer S. Digitalization of social infrastructure in left-behind-places – Empirical example of schools in Thuringia. Ger Digit Geogr Soc. 2025;8:100118. https://doi.org/10.1016/j.diggeo.2025.100118.
42. Yu J, Bekerian DA, Osback C. Navigating the Digital Landscape: Challenges and Barriers to Effective Information Use on the Internet. Encyclopedia. 2024;4:1665–80. https://doi.org/10.3390/encyclopedia4040109.
43. Radicati Group. Email statistics report, 2021–2025. Executive summary. Available from: https://www.radicati.com/wp/wp-content/uploads/2020/12/Email-Statistics-Report-2021-2025-Executive-Summary.pdf. Accessed 7 Jul 2025. 2025.
44. Sood R, Entenman J, Kitt-Lewis E, Lennon RP, Pinto CN, Moss JL. We are all in this together: Rurality, Social cohesion, and COVID-19 prevention behaviors. J Rural Health. 2024;40:154–61. https://doi.org/10.1111/jrh.12781.

Figures

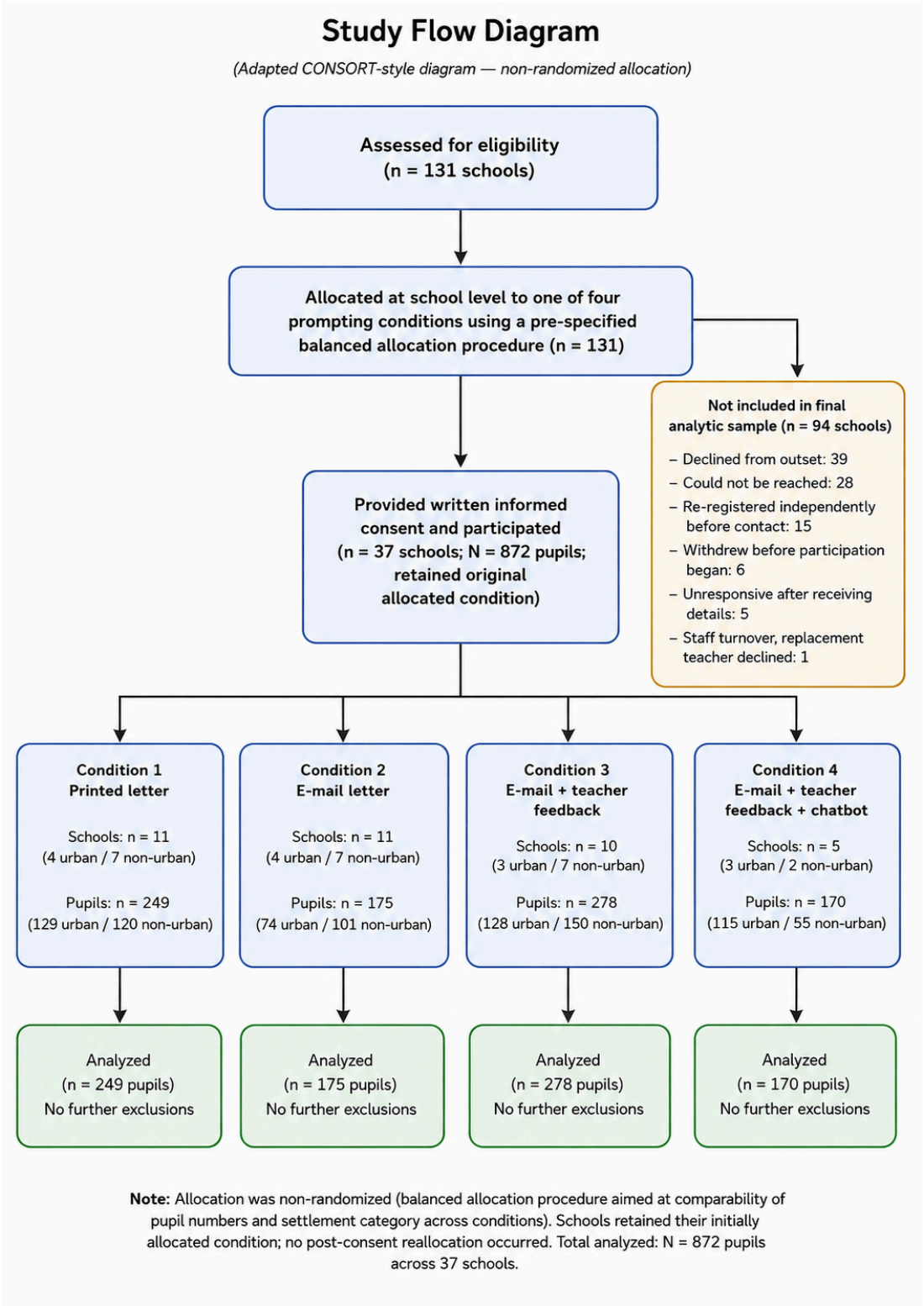


Figure 1

Study flow diagram, showing school eligibility, allocation, non-participation, and the final analysed sample by prompting condition.

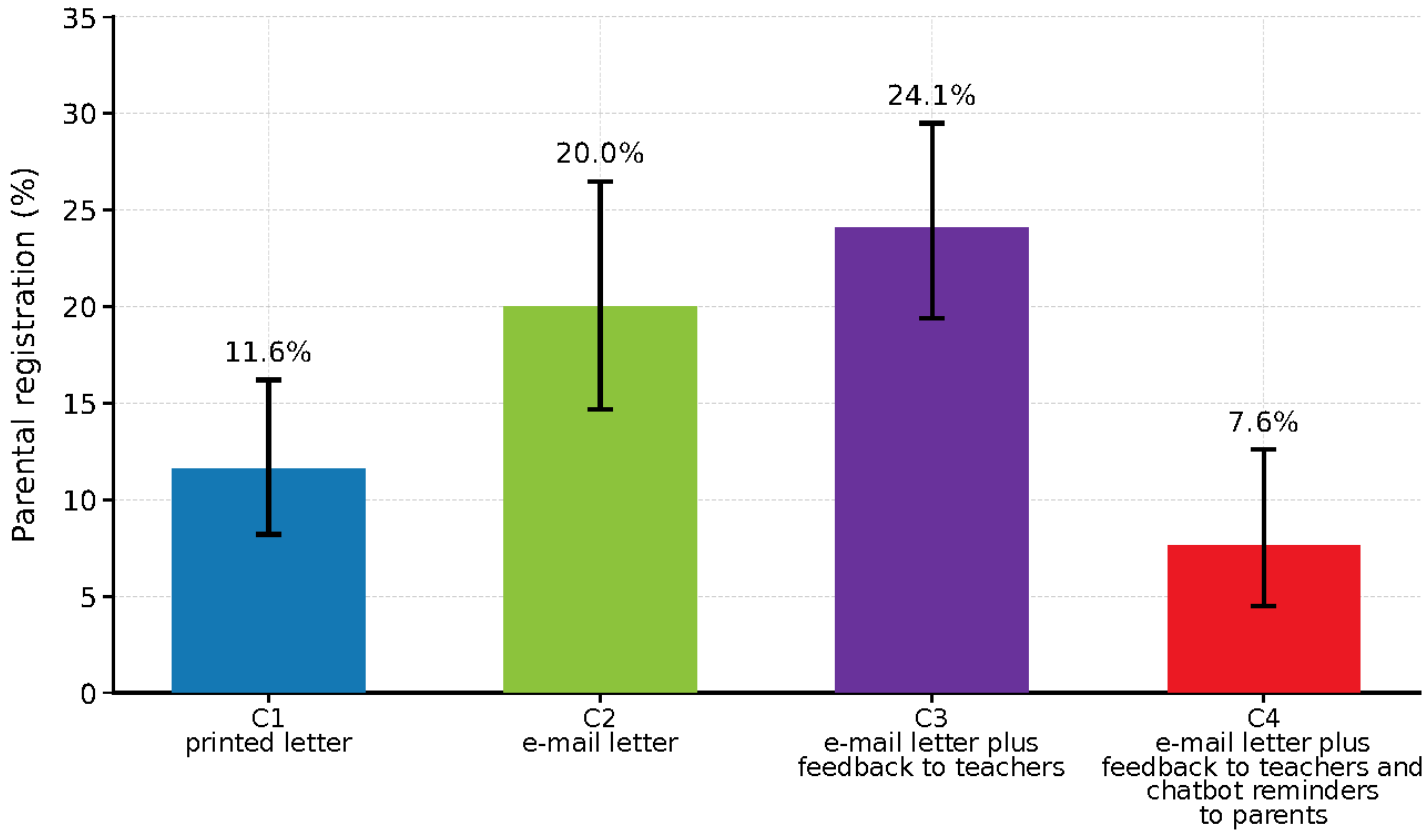


Figure 2

Observed parental registration rates by prompting condition, with descriptive Wilson 95% confidence intervals.

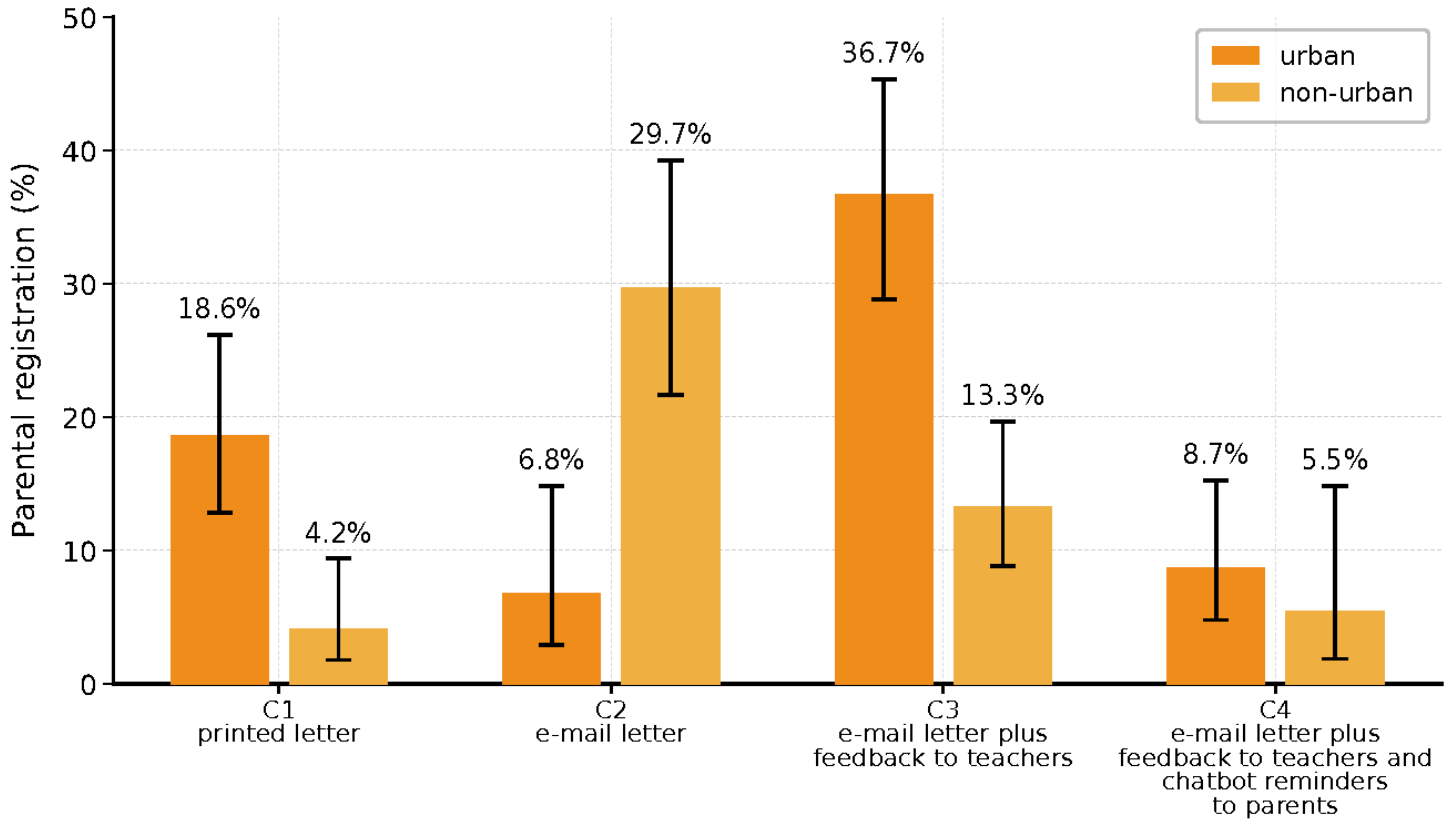


Figure 3

Parental registration rates by prompting condition and school settlement category with Wilson 95% confidence intervals.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Additionalfile1.docx
- Additionalfile2CONSORTChecklistFASTHeroes.docx