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Effectiveness of an experiential on-site education intervention on food safety knowledge, attitude and practices among street food vendors in Nairobi's informal settlements

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ABSTRACT

Background

Millions of people in low- and middle-income countries rely on street food, particularly in rapidly expanding urban informal settlements. However, unsafe food handling and poor sanitation pose significant health risks, as street food vendors (SFVs) often lack adequate training and infrastructure. Despite their role in local food systems and livelihoods, support for improving food safety is limited. The study aimed to assess the effectiveness of a context-specific education and support supervision intervention on food safety knowledge, attitudes, and practices with regard to the causes of food-borne illnesses and their symptoms, food contaminants and hygiene practices in food handling and storage, food preparation, and preservation among SFVs in Nairobi's informal settlements.

Methods

This study developed a context-specific education and support supervision intervention to improve food safety knowledge, attitudes, and practices among SFVs in Nairobi's two informal settlements (Korogocho and Viwandani). Food vendors in the intervention area received food safety training and support supervision from public health officers. We used a quasi-experimental design, with a checklist and a questionnaire, to assess 181 (intervention = 100; control = 81) SFVs over a period of 4 months. We used propensity score matching (PSM) to construct a comparable control group based on baseline characteristics. We estimated the intervention's effect using a difference-in-differences approach.

Results

The average age of the vendors was 41.7 years; most were female (85.6%), married (64.1%), had completed primary education (59.1%), and had been vending for over four years. Using PSM, 108 vendors (54 in each arm) were successfully matched. Compared to the control arm, the intervention arm showed significant improvements in attitudes ($\beta = 0.41$, 95% CI = 0.01-0.80, $P = 0.044$) and practices ($\beta = 2.67$ 95% CI = 1.89-3.45, $P < 0.001$), but no significant change in knowledge.

Conclusion

The intervention improved food vendors' attitudes and practices in food handling and safety, indicating that training paired with supportive supervision can translate knowledge into practice. Scaling up this approach, through institutionalized PHO-led on-site training and supervision for street food vendors, is recommended to strengthen food safety and protect public health.

Keywords: Street food vendors, food safety, food handling, hygiene and sanitation, informal settlements

INTRODUCTION

Ensuring food safety is fundamental to safeguarding public health and promoting social development. However, approximately 600 million people worldwide suffer from foodborne diseases each year, leading to around 480,000 deaths — most of which occur in low- and middle-income countries (WHO, 2024). These figures highlight a pressing, but often overlooked, public health challenge that disproportionately affects the world's most vulnerable populations.

Historically, food safety has been addressed mainly as a trade and market access issue. Significant resources have been invested in aligning national regulations with international standards and ensuring compliance with the trade requirements of high-income importing nations, particularly those with stringent regulations. However, in many developing countries, food safety efforts have primarily focused on exports, while domestic markets have received far less attention. As a result, many countries face challenges in effectively managing food safety risks, as their regulatory systems struggle to keep pace with shifting dietary patterns and demographic changes (Henson et al., 2023; Unnevehr, 2022; Mekonnen et al., 2022; Jaffee et al., 2018)

One significant consequence of this gap in food safety regulation is the rapid expansion of street food vendors (SFVs) in urban areas. As urban populations grow, the demand for affordable, ready-to-eat meals has increased, making street food a vital source of sustenance for many city dwellers (Henson et al., 2023; Mwove et al., 2020; Moussavi et al., 2016). Beyond offering convenience and affordability, street food enterprises play a vital role in the economy, help preserve cultural and social traditions, and contribute to meeting people's nutritional needs (Mwove et al., 2020; Hill et al., 2019). Furthermore, the low capital investment required to start a street food business makes it an accessible livelihood option for many individuals (Henson et al., 2023; Rane, 2011).

Informal street food vending provides affordable and accessible meals to millions in urban areas in low- and middle-income countries, serving both as a source of livelihood and a key component of food security. However, the unregulated nature of the sector poses major public health risks. SFVs often lack formal training in food hygiene and sanitation and typically operate in settings with minimal regulatory oversight (Henson et al., 2023; Mwove et al., 2020; Alimi, 2016). These conditions contribute to compromised food safety practices, which in turn

increase the risk of foodborne illness outbreaks (Okojie & Isah, 2014; WHO, 2015; Cortese et al., 2016).

Evidence suggests that training SFVs in food hygiene and safety can lead to improved knowledge and safer food handling practices (Choudhury et al., 2011). A lack of awareness remains a critical factor driving unsafe behaviors, with untrained vendors frequently demonstrating poor sanitation and food handling practices (Mwove et al., 2020; Okojie & Isah, 2019). By equipping SFVs with knowledge on safe food preparation, handling, storage, and service, such interventions can help bridge existing knowledge gaps, change attitudes, enable good practices, and reduce the burden of foodborne diseases.

In Nairobi's informal settlements of Korogocho and Viwandani, rapid urbanization, overcrowding, and limited access to home cooking facilities have contributed to a growing dependence on street food (Kimani-Murage et al., 2019). However, the lack of cold chain systems, clean water, and basic sanitary infrastructure at vending sites poses a major threat to consumer health. While targeted training and low-cost infrastructural improvements such as handwashing stations or simple food preservation equipment show promise in enhancing food safety, the effectiveness and adaptability of such interventions within informal settlement contexts remain poorly understood.

This study implemented a tailored education-based training intervention designed to improve food safety knowledge, attitude and practices among SFVs in Korogocho and Viwandani. The intervention aimed to improve the safety and quality of street-vended food by educating vendors and enhancing their skills in food handling, hygiene, and sanitation, alongside providing supportive supervision. The key focus areas included food safety, proper food handling, and best practices for water, sanitation, and hygiene.

METHODOLOGY

Study design and settings

This was a mixed-method quasi-experimental study using a controlled before-and-after design. Quantitative data was collected through baseline and end line surveys on street food vendors' socio-demographic characteristics, and their knowledge, attitudes, and practices related to food safety. The study was conducted in the informal settlements of Mathare, Korogocho and Viwandani in Nairobi. The slums are densely populated with more than 60,000 inhabitants per

square km and are characterized by poor housing, lack of basic infrastructure, violence, insecurity, high levels of unemployment and poverty, food insecurity, and poor health and nutrition indicators.

Participants and sampling procedure

Participants were street food vendors operating in the three informal settlements, selected through stratified simple random sampling, with each settlement constituting a stratum. We sampled from each informal settlement separately. To ensure self-weighting, the sample size was allocated in proportion to the population of each informal settlement. Korogocho and Viwandani were the ‘intervention sites’ while Mathare was the ‘comparison site.’

The intervention

The intervention focused on improving the safety and quality of street food among food vendors in the intervention sites: Korogocho and Viwandani informal settlements in Nairobi. This involved sensitization, capacity strengthening through training food vendors and supportive supervision on food safety, food handling, water, hygiene and sanitation. The project partnered with the Public Health Officers (PHOs) from Nairobi City County Government, who provided the technical expertise and personnel to implement these activities.

Before the rollout of the intervention, a Street Food Vendors’ Manual was developed through a partnership between the African Population and Health Research Center (APHRC), the University of Nairobi, and the Nairobi City County Public Health Department. The manual designed for use by public health officers in engaging street food vendors, aimed at creating awareness of the causes of food-borne illnesses and their symptoms, food contaminants and hygiene practices in food handling and storage, food preparation, and preservation. It was prepared for easy understanding of the food safety issues, and the control measures applicable in street food preparation and vending, informed by international, regional and national guidelines and legal frameworks.

A selected team of 10 PHOs was trained on the use of the manual as reference material and on engaging street food vendors. The training emphasized the need to engage the vendors in a supportive manner to help them improve their food safety, handling, hygiene and sanitation practices, as opposed to the traditional ‘policing’ approach.

The PHOs engaged the street food vendors in the intervention sites over a four-month period. The intervention involved PHOs conducting on-site visits and one-on-one sessions with each vendor at their workstations. This was a departure from the commonly used ‘classroom’ or ‘workshop’ model of capacity strengthening. Each PHO was allocated a particular group of vendors with whom they routinely engaged. During these engagements, the vendors participated in experiential capacity strengthening focused on food safety and handling, water, hygiene and sanitation. They were also sensitized on the public health implications of their work in the community and received supportive supervision.

a) Sample size

All vendors in the control and intervention sites were listed, and a total of 181 vendors were randomly selected to participate in the study (Comparison arm, n=81; intervention arm, n=100).

Data Collection

a) Field data collection

Baseline and endline data on street vendors’ knowledge, attitude and practices related to food safety, as well as their socio-demographic characteristics, were collected (Baseline: between July 2021 – September 2021; Endline: February 2024 -April 2024), using a standardized interviewer-administered questionnaire (Supplementary File 1).

Training of field interviewers

Experienced field interviewers with a good understanding of the study settings were recruited and trained for five days to conduct the baseline and endline surveys, respectively. The training focused on data collection methods and procedures, research ethics, and obtaining informed consent, as well as the use of tablet computers for data collection. Mock data collection sessions were conducted during the training. The final training day before the baseline survey was dedicated to pre-testing the data collection tool. Feedback from the pretest was used to refine the questionnaire.

b) Management of data quality during fieldwork

The questionnaire was programmed in Survey CTO and uploaded to tablet computers. To ensure the validity of the data, validation rules, constraints, and skip logic were embedded in the questionnaire within Survey CTO platform. The research team monitored the quality of the incoming data and provided feedback to field interviewers in case of any issues.

Measures

Vendor knowledge of food hygiene was measured using 10 Yes/No/Don't Know items covering topics such as food-borne illnesses, awareness of pathogens, and food preparation. Each item was dichotomized, assigning a score of 1 for correct responses and 0 for incorrect or "Don't know" answers. The total knowledge score was computed by summing the item scores, with higher scores indicating better knowledge.

Food safety attitude was measured using a 5-point Likert scale, where vendors rated their level of agreement (from strongly agree to strongly disagree) on 10 items. The items included willingness to learn about food safety, the use of protective and appropriate clothing, and issues related to food storage and handling. Each item was then dichotomized: agree or strongly agree responses were scored 1, and is agree, uncertain, or strongly disagree responses were scored as 0. A composite attitude score was obtained by summing the individual item scores, with higher scores indicating a more positive attitude towards food safety.

Vendors' practices were assessed using 11 Yes/No items covering actions such as washing hands before and after touching food, wearing protective clothing, covering food, and smoking while working. Negatively phrased items were reverse-coded. Each item was coded as 1 for "Yes" and 0 for "No," and a composite score was then calculated by summing the item scores. Higher composite scores indicated better food safety practices. Socio-demographic variables included the highest level of education attained (no education, primary, secondary and above), marital status (married/living together, divorced/separated, widowed, and never married), vending years (<4 years, ≥ 4 years), sex (male, female) and age (continuous).

c) Ethical considerations

This study was conducted in accordance with local and international ethical guidelines, specifically the principles outlined in the Helsinki declaration regarding research involving human subjects. Ethical approval was obtained from the AMREF Ethical and Scientific Review Committee (Number P919-2020). A research permit was obtained from the National Commission for Science, Technology, and Innovation. Participants provided written informed consent prior to participation.

Statistical Analysis

We combined propensity score matching (PSM) and Difference-in-Differences (DiD), analyzed through a fixed effects linear regression model, to obtain unbiased estimates of the impact of the intervention on the three outcomes of interest (Knowledge, Attitudes, and Practices). PSM was used to construct a comparison group of vendors with similar observable characteristics and pre-intervention outcomes as those in the intervention group. This approach controlled for imbalances observed in the distribution of covariates between the intervention and control groups. The PSM model is presented as below (Heckman et al., 1997);

$$Y = E(Y_{1i|T=1} - Y_{1i|T=0})|P(X_{0i}) - E(Y_{0i|T=1} - Y_{0i|T=0})|P(X_{0i})$$

Where Y_{1i} and Y_{0i} represents the outcome after the intervention and before the intervention for vendor i , respectively, $T_i = 1$ indicates vendor i is in the experimental group, $T_i = 0$ indicates vendor i is in the control group, $P(X_{0i})$ and indicates the probability of treatment assignment conditioned on the observed pre-intervention characteristics. Our final combined PSM and DiD model used nearest neighbor matching (NNM) based on propensity scores to estimate the Average Treatment Effect (ATE). For each treated vendor, the model selected the one control vendor with the nearest propensity score. The estimation model is as presented in the equation below (Valentelyte et al., 2022);

$$Y^{(PSMDiD)} = \frac{1}{N_{T1}} \sum_{i \in T1 \cap S} \left[(Y_{i,t+1}^1 - Y_{i,t}^0) - \sum_{j \in T0 \cap S} w_{ij} (Y_{j,t+1}^0 - Y_{j,t}^0) \right]$$

Where T_1 and T_0 represent the treatment and the comparison groups respectively, the nearest neighbor matching weights, and S is the area of common covariate support.

To estimate the impact of the intervention, the propensity scores were first calculated based on our list of covariates using logistic regression. The vendors in the treatment arm were then matched with those in control arm based on the estimated propensity score using a caliper of 0.25 of the standard deviation of the logit of the propensity score. DiD estimation was then used to compare the average changes in knowledge, attitudes, and practices between the treated and matched controls, using an interaction term

between time (pre-intervention vs. post-intervention) and the groups (experimental vs. control). This approach enabled us to isolate the effect of the intervention by comparing the within vendor-change over time for the treated group against the same change for the matched comparison group.

RESULTS

A total of 181 street food vendors were surveyed, comprising 81 from the control group and 100 from the experimental group, before and after the intervention. Table 1 shows the demographic characteristics of the respondents. Their mean (SD) age was 41.7 (11.2) years. A majority were female (85.6%), married (64.1%), had completed primary education (59.1%), and had been vending for over four years (61.3%). No statistically significant differences were observed between the two groups across any of the demographic variables.

Table 1: Respondent characteristics (n =181)

Variables	Experimental Group (n =100)	Control group (n =81)	Total (n =181)	P-value
Age, Mean (SD)	40.8 (11.7)	41.4 (11.5)	41.7 (11.2)	0.730 ^a
Gender, n (%)				
Male	13 (13)	13 (16)	26 (14.4)	0.671 ^b
Female	87 (87)	68 (84)	155 (85.6)	
Marital status, n (%)				
Married/living together	66(66)	50(61.7)	116(64.1)	0.261 ^b
Divorced/separated	19(19)	11(13.6)	30(16.6)	
Widowed	10(10)	10(12.3)	20(11)	

Never married	5(5)	10(12.3)	15(8.3)	
Education level, n (%)				
No formal education	12(12)	17(21)	29(16.0)	0.258 ^b
Primary	61(61)	46(56.8)	107(59.1)	
Secondary and above	27(27)	18(22.2)	45(24.9)	
Vending years, n (%)				
< 4 years	44(44)	26(32.1)	70(38.7)	0.069 ^b
4+ years	56(56)	55(67.9)	111(61.3)	

Note. ^a: *t*-Test; ^b: Fisher's exact test.

Table 2 presents the mean scores of the knowledge, attitudes and food safety practices among the SFVs in the control and intervention arms. There were statistically significant differences across the three indicators in both the pre and post intervention surveys. At pre-intervention, the street food vendors in the control arm had higher knowledge and practice scores compared to those in the intervention arm. In contrast, vendors in the intervention arm had significantly higher attitude scores than those in the control arm. The *p* values shown in the last column of **Table 2** were obtained from paired *t*-tests, highlighting the pre-intervention vs. post-intervention change within the experimental or control arms.

Table 2. Comparison of vendor knowledge, attitude and practices between Experimental and comparison groups before and after the intervention.

Variables	Pre-intervention	Post-intervention	P-value (Pre vs. Post)
<i>Attitude</i>			
Experimental Group	9.75(0.48)	9.63(0.63)	0.122 ^b

Control Group	9.41(0.89)	9.14(0.96)	0.070 ^b
P-value (Exp vs. Control)	0.001 ^{a, *}	0.014 ^{a, *}	
<i>Knowledge</i>			
Experimental Group	6.47(1.80)	7.51(1.42)	0.000 ^{b, *}
Control Group	7.48(1.68)	6.93(1.73)	0.001 ^{b, *}
P-value (Exp vs. Control)	0.000 ^{a, *}	0.000 ^{a, *}	
<i>Practices</i>			
Experimental Group	8.20 (1.87)	9.63(0.63)	0.000 ^{b, *}
Control Group	8.93(1.90)	9.22(1.31)	0.000 ^{b, *}
P-value (Exp vs. Control)	0.011 ^{a, *}	0.000 ^{a, *}	

Table note. Data are mean (SD). ^a: Independent-sample t-test; ^b: Paired-sample t-test; * $p < 0.05$.

The results of the PSM (**Table 3**) indicate that 54 vendors in the intervention arm were successfully matched to 54 in the control arm. The standard mean differences (SMD) for all the variables used for matching were less than 0.2 units after matching.

Table 3. Comparison of control and intervention arms

	Before Matching			After Matching		
	Control (n=81)	Intervention(n=100)		Control(n=54)	Intervention(n=54)	
Variable	mean (SD) or n (%)	mean (SD) or n (%)	SMD	mean (SD) or n (%)	mean (SD) or n (%)	SMD
Baseline knowledge score	7.84(1.68)	6.47(1.80)	0.787*	7.43 (1.50)	7.50 (1.27)	0.053
Baseline attitudes score	9.41(0.89)	9.75(0.48)	0.479*	9.63 (0.71)	9.69 (0.51)	0.090
Baseline practices score	8.93(1.90)	8.20(1.87)	0.386*	8.69 (2.02)	8.39 (1.90)	0.151

Gender			0.086		0.053
Male	13(16)	16(13)	8(14.81)	7(12.96)	
Female	68(84)	84(87)	46(85.19)	47(87.04)	
			0.052		0.069
age	41.37(11.49)	40.77(11.73)	41.61(11.45)	40.80(12.16)	
Highest level of formal education			0.216*		0.151
No formal education	17(21)	21(12)	7(12.96)	8(14.81)	
Primary	46(56.8)	56.8(61)	32(59.26)	35(64.81)	
Secondary and above	18(22.2)	22.2(27)	15(27.78)	11(20.37)	

**SMD (Standard Mean Differences); SMD >0.2 indicate serious imbalance between the two arms*

DiD results showed that the mean attitude (coef. = 0.41, 95% CI = 0.01-0.80, p-value = 0.044) and practices' (coef. = 2.67, 95%CI = 1.89-3.45, p-value <0.001) scores improved significantly from the pre- to the post-intervention period in the intervention arm group compared to the control arm (**Table 4**). No change was observed in the mean knowledge score between the two arms when comparing before and after the intervention.

Table 4. DiD model for Vendor Knowledge, Attitudes and Practices, N =104

Outcome	Estimated treatment Effect	RSE	p-value	[95%CI]	
Attitudes	0.41	0.200	0.044*	0.011	0.803
Knowledge	0.48	0.387	0.216	-0.285	1.248
Practices	2.67	0.394	<0.001*	1.886	3.447

Note. *CI* confidence interval, *DiD* Difference in Differences. * $p < 0.05$, RSE - Robust clustered standard errors to account for serial correlation.

DISCUSSION

This study demonstrates that the facilitative, on-site education intervention significantly improved the attitudes and food safety practices of SFVs, effectively bridging the long-standing "knowledge-practice gap." The success of this model can be attributed to its departure from the traditional, enforcement-oriented paradigm often utilized by Public Health Officers (PHOs) (Sarfo, 2025). By shifting from a "policing" role to a supportive, mentorship-based approach, the intervention utilized the not merely as a didactic resource, but as a framework for real-time, meaningful experiential learning. This approach allowed for personalized feedback and corrective guidance at the vendor's actual workstation, a stark contrast to the often disconnected nature of classroom-based or workshop-style training. Our findings are consistent with existing evidence in developing contexts which identifies facilitative, on-site engagement as a more sustainable strategy for long-term health behavior change (Karunapema, 2021; Wickrematilake et al., 2022).

The observed disconnect between high baseline knowledge and sub-optimal practices in the control group suggests that knowledge acquisition alone is an insufficient driver of behavioral change in this sector. While vendors possessed adequate foundational knowledge, they often struggled to operationalize this into daily practice. The intervention succeeded by creating a cognitive and social environment that facilitated this translation. This is consistent with the Theory of Planned Behavior, which posits that while knowledge is a prerequisite, behavioral intention and subsequent action are deeply influenced by attitudes and perceived control (Ajzen, 1991).

Moreover, our approach leveraged cognitive dissonance (Festinger, 1956) as a tool for change. Through collaborative engagement, PHOs introduced new perspectives on food safety that challenged established, albeit unsafe, habits. By highlighting the discrepancy between current practices and the health risks they posed to their community, the intervention created a state of discomfort that motivated vendors to adopt the safer practices outlined in our standardized training manual.

Social norms and peer influence further reinforced these improvements (Cialdini & Goldstein, 2004). Because the intervention was delivered on-site, it fostered a shared standard of hygiene among vendor clusters. As vendors observed their peers adopting safer handling techniques,

the "normative" behavior in the informal settlement began to shift. This peer-driven reinforcement is a crucial, often overlooked, dimension of food safety interventions in densely populated urban settlements.

Finally, the lack of significant improvement in knowledge scores, despite significant gains in practice, supports the hypothesis that food safety interventions in informal urban settings have reached a saturation point regarding basic information delivery. When baseline knowledge is already high, as observed here, additional "knowledge-transfer" sessions offer diminishing returns. Future interventions should therefore prioritize this "behavioral activation" model: focusing less on lecturing vendors on *what* they should do, and more on facilitating *how* and *why* they can realistically adapt their established work routines to align with safety standards. This shift from didactic training to supportive supervision is essential for mitigating the burden of foodborne illnesses in the rapidly expanding informal food sector.

The strength of this study is in using a controlled pre- post design with random selection of participants, which reduced bias. To ensure the robustness of our results, we utilized propensity score matching (PSM) to correct for baseline imbalances between the intervention and control arms. This methodological rigor allowed for a more precise estimation of the intervention's impact, confirming that the observed improvements in attitudes and practices—specifically the significant Difference-in-Differences (DiD) estimates—are attributable to the intervention rather than pre-existing differences. However, the generalizability of this study may be limited to similar contexts.

CONCLUSION AND RECOMMENDATION

The study findings indicate that while SFVs generally possess a strong baseline knowledge of food safety, a critical gap remains in their ability to translate this information into positive attitudes and consistent safe practices. This research demonstrates that the most effective way to bridge this disconnect may not be through traditional enforcement, but rather through an education-based intervention that prioritizes experiential learning through facilitative, on-site support. By utilizing Public Health Officers (PHOs) to provide one-on-one, experiential

learning and continuous supportive supervision directly at the vendors' workstations, the intervention successfully fostered improved attitudes and safer food handling behaviors.

Given the efficacy of this approach, we strongly recommend the adoption and scale-up of this model in comparable settings. Specifically, the government should institutionalize a PHO-led, on-site food safety training and supervision program that prioritizes experiential learning over traditional regulatory policing. This program should leverage standardized resources to ensure consistency across all training efforts, specifically by utilizing the as the primary reference material for all PHOs. Implementing this sustainable framework offers a viable pathway to mitigating foodborne illnesses, increasing public awareness of safe handling standards, and ultimately promoting better health outcomes within informal urban settlements.

Declarations

Clinical trial number: not applicable.

Ethical approval and consent to participate

This study was conducted in accordance with local and international ethical guidelines, specifically the principles outlined in the Helsinki declaration regarding research involving human subjects. Ethical approval was obtained from the AMREF Ethical and Scientific Review Committee (Number P919-2020). A research permit was obtained from the National Commission for Science, Technology, and Innovation. Participants provided written informed consent prior to participation.

Consent for publication

All the authors approved the manuscript for submission and publication.

Availability of data and materials

The data set for this project will be made freely available in an open repository - the APHRC [Microdata Portal](#), operating under the CC-BY-4.0 license. The data will be made available once a direct request is made on the platform and institutional approval obtained.

Competing interests

No competing interests were disclosed.

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Authors' contribution

DO: Conceptualization, contribution to methodology, project administration and coordination, data collection supervision, data analysis, leadership in drafting manuscript, review and editing.

AM: Project administration, contribution methodology, review and editing of manuscript.

DO: Contribution to methodology, data analysis, drafting of manuscript, review and editing.

MG: Contribution to drafting of manuscript, review and editing.

CW: Contribution to methodology, review of manuscript

DA: Contribution to methodology, review of manuscript

DWMK: Project administration, review of manuscript

MM: Project administration, review of manuscript

SK: Project administration, review of manuscript

GOA: Project administration, review of manuscript

EKM: Grant acquisition, conceptualization, contribution to methodology, project management, review and editing of manuscript.

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