

Knowledge Socialization and COVID-19 Prevention Among Senior Secondary School Students in Mesuji Regency

Vikto Agus Wibowo^{1*}, Happy Komikesari²

UIN Raden Intan Lampung, Lampung, Indonesia^{1,2}

viktoagus25@gmail.com^{1*}



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Abstract

Purpose: This study examines the design, implementation, and outcomes of a COVID-19 knowledge socialization program conducted by a university community service team at a senior secondary school in a green-zone area, focusing on its impact on student health protocol adherence and awareness of traditional herbal immune-support practices.

Methodology: A qualitative service-learning evaluation design was applied. A single two-hour socialization session was delivered to thirty students at SMAN 2 Way Serdang, Mesuji Regency, on 23 July 2020, covering viral biology, external prevention measures, and empon-empon herbal immune support. A structured Google Form questionnaire capturing pre- and post-session health protocol compliance was completed by fifteen respondents.

Results: Before the intervention, 80% reported compliance and 20% occasional adherence. After the session, 33% increased compliance, 47% remained unchanged, one became consistent, and two improved slightly.

Conclusions: A single in-person socialization session combining biomedical and herbal health education can improve health protocol adherence and knowledge among adolescents in green-zone schools.

Limitations: The study is limited by a small self-selected sample, one session, self-reported data, and no control group, limiting generalizability and causal inference.

Contributions: This study presents a low-resource, replicable model for adolescent pandemic risk communication integrating biomedical and traditional health knowledge.

Keywords: *Community Health Education, COVID-19 Prevention, Health Protocol Compliance, Herbal Immune Support, Secondary School Students*

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1. Introduction

The emergence of Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) and the subsequent global pandemic of Coronavirus Disease 2019 (COVID-19) disrupted virtually every dimension of social organization across Indonesia and the wider world, simultaneously affecting economic activity, formal education, industrial production, employment, and household stability on a scale without precedent in modern Indonesian history. The virus was first identified in Wuhan, China, where metagenomic analysis identified a novel betacoronavirus as the probable etiological agent

behind an unusual cluster of pneumonia cases, and the World Health Organization formally declared COVID-19 a pandemic in March 2020 after its rapid international spread across more than 110 countries ([Zu et al., 2020](#); [Bogoch et al., 2020](#)). The Indonesian government's response evolved across multiple phases, progressing from large-scale social restrictions, partial lockdowns, physical and social distancing mandates, and mobility limitations toward a graduated reopening framework termed the new normal era, during which President Joko Widodo explicitly communicated that the population would need to learn to coexist with the virus under continued and rigorous health protocol compliance rather than treating the new normal designation as a signal that the pandemic had ended ([Pradana, Casman, & Nur, 2020](#)).

The foundational biology of SARS-CoV-2 provides essential context for understanding why certain protective behaviors are effective and why public education about those behaviors is indispensable. The coronavirus responsible for COVID-19 is a spherical particle of approximately 125 nanometers, composed of four principal structural proteins, the spike (*S*) protein, membrane (*M*) protein, nucleocapsid (*N*) protein, and envelope (*E*) protein, that jointly determine how the virus attaches to, enters, and replicates within host cells ([Purwanto, 2020](#); [Hu et al., 2021](#)). Entry into the human body occurs primarily through the respiratory and digestive mucosa, and person-to-person transmission occurs predominantly through respiratory droplets expelled during coughing, sneezing, speaking, or breathing in close proximity, as well as through contact with contaminated surfaces and shared utensils ([Meyerowitz, Richterman, Gandhi, & Sax, 2021](#)). Clinical presentations range from asymptomatic infection through mild fever, cough, fatigue, and anosmia to severe pneumonia characterized by bilateral ground-glass opacification and, in the most severe cases, acute respiratory distress syndrome requiring mechanical ventilation ([Zu et al., 2020](#)).

National health protocol guidance in Indonesia mandated a cluster of combined preventive behaviors, widely summarized as the 5M protocol (*Memakai masker, Mencuci tangan dengan sabun dan air mengalir, Menjaga jarak, Menghindari kerumunan, dan Mengurangi mobilitas*), encompassing mask wearing, hand washing, maintaining distance, limiting mobility, and avoiding crowds. Despite clear official guidance, compliance with these protocols was inconsistent across the population, and research conducted in both the Indonesian and international contexts consistently identified uneven understanding of the scientific rationale underlying specific preventive measures as a central barrier to sustained adherence, particularly among adolescents and young people who may underestimate their personal risk and overestimate the adequacy of partial compliance ([Bhagavathula et al., 2020](#); [Zhong et al., 2020](#)). This compliance gap had structural implications once educational authorities permitted limited face-to-face instruction to resume in designated green-zone areas, since schools became one of the remaining settings in which groups of adolescents gathered regularly in indoor spaces, creating a specific need for targeted, in-person health education capable of reaching students directly rather than relying solely on broadcast messaging from institutional or government channels.

Alongside externally oriented protective measures such as masking and hand hygiene, Indonesian pandemic health communication prominently incorporated guidance on strengthening internal immune resilience through nutritional and traditional herbal practices, reflecting the country's deep-rooted jamu tradition and the recognition that immune status influences susceptibility to severe outcomes. Traditional Indonesian herbal preparations made from rhizomes including ginger (*Zingiber officinale*), turmeric (*Curcuma longa*), and galangal (*Alpinia galanga*), collectively referred to as empon-empon, were formally recommended by Indonesian botanical and pharmacological research institutions as complementary immune-supporting practices alongside biomedical prevention ([Pusat & Gagas, 2020](#)). Contemporary pharmacological research has since provided a credible scientific foundation for this recommendation through documentation of curcumin's antiviral, anti-inflammatory, and immunomodulatory activity against SARS-CoV-2 in laboratory and clinical settings ([Bormann et al., 2021](#); [Zupin et al., 2022](#)), lending the traditional practice an evidence base that can be communicated to adolescent audiences as science-backed rather than merely anecdotal.

It was within this context that a university-affiliated community service team from Universitas Islam Negeri Raden Intan Lampung, operating under the Kuliah Kerja Nyata Dari Rumah (KKN-DR) 2020

framework, conducted a direct socialization activity at SMAN 2 Way Serdang, located in Hadi Mulyo Village, Way Serdang Subdistrict, Mesuji Regency, Lampung Province, in July 2020. Mesuji Regency had been designated a green zone under the national risk-stratification framework, permitting limited face-to-face instruction under strict health protocol conditions. The socialization session delivered structured information on COVID-19 biology, transmission, and prevention, combining conventional biomedical protective measure instruction with traditional empon-empon herbal preparation knowledge, to thirty senior secondary school students, and subsequently collected self-reported compliance data through a structured questionnaire to evaluate the behavioral impact of the session.

The novelty of this study lies in its documented integration of biomedical pandemic prevention content with culturally grounded traditional herbal immune-support education within a single structured service-learning socialization session targeted at Indonesian adolescent secondary students during active pandemic conditions, a combination design that had not been previously evaluated and reported in the Indonesian school-based health education literature at the time of delivery. The purposes of this study are threefold: first, to describe the design, content, and delivery of the COVID-19 knowledge socialization activity conducted at SMAN 2 Way Serdang; second, to evaluate the resulting shift in student-reported health protocol and herbal preparation compliance using pre- and post-session questionnaire data; and third, to draw practical and theoretical lessons for future community-based health education efforts targeting adolescent populations in resumed face-to-face learning environments during ongoing or future respiratory disease outbreaks.

2. Literature Review

2.1 SARS-CoV-2 Biology, Transmission, and Clinical Manifestation

A precise understanding of SARS-CoV-2's biological characteristics is the indispensable foundation for rational prevention messaging, since protective behaviors cannot be reliably motivated by appeal to authority alone but require a lay-accessible explanation of the mechanism the behavior is designed to interrupt. The virus belongs to the Betacoronavirus genus and is characterized by its spherical morphology with a diameter of approximately 125 nanometers, visualized through cryo-electron microscopy ([Purwanto, 2020](#)). Its outer membrane is studded with spike glycoprotein trimers that mediate binding to Angiotensin-Converting Enzyme 2 (ACE2) receptors on respiratory epithelial cells, an interaction confirmed through structural biology and cryo-EM studies as the primary viral entry mechanism ([Walls et al., 2020](#); [Hu et al., 2021](#)). The four principal structural proteins, the spike (*S*), membrane (*M*), nucleocapsid (*N*), and envelope (*E*) proteins, each contribute to viral assembly, entry, and immune evasion, and their structural characterization has directly informed vaccine design and neutralizing antibody research across the pandemic ([Hu et al., 2021](#)).

Transmission dynamics research established early in the pandemic and refined over subsequent years that SARS-CoV-2 spreads primarily through respiratory droplets and aerosols generated during breathing, speaking, coughing, and sneezing, with short-range droplet transmission dominating in face-to-face interactions at distances below one to two meters and longer-range aerosol transmission posing significant risk in poorly ventilated enclosed spaces with sustained high occupancy ([Morawska & Milton, 2020](#); [Meyerowitz et al., 2021](#)). Fomite transmission, through contaminated surfaces and shared objects including utensils, has been documented at lower relative risk than respiratory transmission but remains a plausible pathway justifying hand hygiene following surface contact ([Meyerowitz et al., 2021](#)). The range of clinical presentations documented in large-scale case series spans the full spectrum from asymptomatic infection and mild-to-moderate respiratory illness through pneumonia with bilateral ground-glass opacification, as documented extensively in radiological case reports from early in the pandemic ([Zu, Jiang, Xu, Chen, Ni, Lu, & Zhang, 2020](#)), to severe acute respiratory distress syndrome, multi-organ failure, and death in a small but significant proportion of infections.

Figure 1 shows the city of Wuhan, China, where SARS-CoV-2 was first identified in late 2019, providing geographic context for the virus's origin and the early epidemiological investigations that established its human transmissibility.



Figure 1. Wuhan City, Hubei Province, China: Location of the first Identified SARS-CoV-2 cluster

Figure 1 shows Wuhan, the Hubei provincial capital where the first cluster of SARS-CoV-2 infections was identified in late 2019. Early epidemiological investigation in this city provided the initial evidence that a novel coronavirus was causing human-to-human transmissible respiratory illness, triggering the global response documented in this study's intervention context. The geographic specificity of the pandemic's origin became an important element of the socialization curriculum, providing students with a concrete epidemiological narrative that contextualizes the rapid global spread observed subsequently.

Figure 2 illustrates the radiological presentation of COVID-19 pneumonia in a confirmed case, demonstrating the characteristic bilateral ground-glass opacification that distinguishes moderate-to-severe COVID-19 from other respiratory illnesses and that serves as a visual anchor for explaining the clinical urgency of prevention to lay audiences.

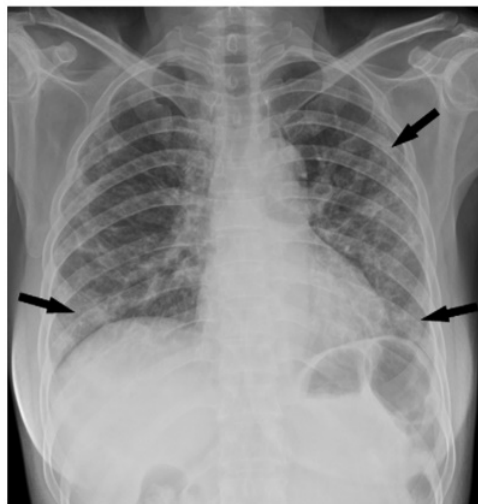


Figure 2. Chest radiograph of a 53 year old female patient with confirmed COVID-19 pneumonia

Figure 2 presents the chest radiograph of a 53 years old female patient who experienced fever and cough for five days, demonstrating the characteristic bilateral patchy infiltrates and ground-glass opacities associated with COVID-19 pneumonia. This clinical image was used during the socialization session to provide students with a concrete visual representation of the disease's respiratory impact, helping bridge the gap between abstract knowledge about symptoms and a tangible understanding of what COVID-19 infection can produce in the lungs. Research on health risk communication has established that concrete visual representations of disease outcomes are more effective than verbal description alone in motivating preventive behavior among adolescent audiences ([Baig, Jameel, Alzahrani, Mirza, Baig, Gazzaz, & Ahmed, 2020](#)).

2.2 Vulnerable Populations and Risk Communication to Adolescents

Identifying and communicating about high-risk population subgroups is an essential component of tailored pandemic health education, particularly when the target audience, as in the case of secondary school students, may have the implicit perception that youth is protective against severe outcomes. Research conducted in the Indonesian context using Discourse Network Analysis identified chronic disease, advanced age, male sex, and tobacco or vaping use as the primary demographic and behavioral risk amplifiers associated with the most severe documented COVID-19 outcomes domestically, with blood type A additionally identified as a candidate biological risk factor in some early analyses ([Siagian, 2020](#)). International epidemiological meta-analyses similarly identified diabetes mellitus, hypertension, cardiovascular disease, chronic respiratory disease, chronic kidney disease, and obesity as the most consistently documented comorbidities associated with increased hospitalization and mortality risk ([Singh, Gupta, Ghosh, & Misra, 2020](#); [Wiersinga, Rhodes, Cheng, Peacock, & Prescott, 2020](#)).

Communicating these risk gradients to adolescent students serves two distinct pedagogical purposes. First, it helps students accurately locate themselves within the risk landscape, avoiding both complacent underestimation of the virus's seriousness, which might reduce protective motivation, and unwarranted panic about personal severe-outcome risk, which might paradoxically reduce engagement with prevention messaging by framing it as futile. Second, and perhaps more importantly in a school-based community health context, it motivates altruistic protective behavior by helping students understand that they may be asymptotically infected or mildly affected while still posing transmission risk to older, chronically ill, or otherwise vulnerable household members and community contacts. Health literacy research consistently finds that other-protective motivation, derived from understanding one's role as a potential transmitter to vulnerable others, is a more durable driver of consistent behavioral compliance among young people than self-protective motivation alone ([Li, Cui, Kaminga, Cheng, & Xu, 2021](#)).

2.3 External Protective Measures: Masks, Hand Hygiene, and Physical Distancing

The evidence base supporting the combined use of face masks, hand hygiene, and physical distancing as community transmission-reduction measures was progressively assembled and refined across the first two years of the pandemic, with systematic reviews and meta-analyses providing the most rigorous and comprehensive summaries. [Chu, Akl, Duda, Solo, Yaacoub, and Schunemann \(2020\)](#), in a landmark systematic review and meta-analysis published in *The Lancet* synthesizing 172 observational studies across 16 countries, found that physical distancing of one or more meters was associated with a significant reduction in transmission risk, that face mask use reduced risk by approximately 85%, and that these protective effects were independent and additive, such that the combined use of distancing, masks, and eye protection produced greater protection than any single measure alone. [Howard, Huang, Li, Tufekci, and Zdimal \(2021\)](#) reached complementary conclusions in their evidence review of face masks, documenting that community mask wearing consistently reduced respiratory virus transmission when widely adopted, with the protective magnitude dependent on mask type, coverage consistency, and environmental ventilation conditions.

The virucidal mechanism of alcohol-based hand sanitizers, which inactivate SARS-CoV-2 by dissolving the viral lipid envelope at ethanol or isopropanol concentrations of approximately 60 to 80 percent, is well established in the pharmacological literature and provides the scientific rationale for incorporating hand hygiene into community prevention protocols ([Price, Cui, Xie, Gao, Li, & Watt, 2021](#)). However, the extended, high-frequency hand sanitizer use required during the pandemic also exerts a cumulative dermatological impact through gradual depletion of the skin's natural sebum and lipid barrier, exposing the dermal microenvironment to opportunistic microorganism colonization over time ([Sari & Isadiartuti, 2006](#)). This trade-off provides the practical motivation for presenting red betel leaf (*Piper crocatum*) extract-based antiseptic gel formulations as a complementary or alternative option for populations using sanitizer at high frequency, as plant-derived formulations incorporating astringent phenolic compounds may produce less cumulative skin disruption while maintaining adequate virucidal activity ([Sari & Isadiartuti, 2006](#)). Behavioral intervention research targeting primary school students found that structured hand hygiene programs combining environmental

modification with direct educational sessions produced measurable improvement in handwashing practice at critical moments, reinforcing the practical behavioral pathway from targeted education to real-world hygiene compliance ([Ly, Craig, McDavid, Maheia, Gongora, Morey, Manzanero, Medley, Stewart, Lino, Quezada, Blanco, Romero, Morazan, Hawes, Okeremi, Ishida, Lozier, & Murray, 2025](#)).

2.4 Internal Immune Support: Empon-Empon and Curcumin Pharmacology

Traditional Indonesian jamu preparations, and the empon-empon rhizome formulation in particular, occupy a culturally prominent and increasingly science-supported role in Indonesian pandemic health messaging. Empon-empon, a term derived from Javanese meaning root or rhizome, refers to preparations made from ginger, turmeric, galangal, kaempferia, cinnamon, and lemongrass, which have been used in Javanese, Sundanese, and Balinese traditions as both culinary flavoring and restorative health preparations for centuries. The pharmacological relevance of empon-empon to COVID-19 resistance was formalized in Indonesian public health guidance through publications from the Center for Tropical Biopharmaca Studies at Bogor Agricultural University, which drew on curcumin's documented immunostimulatory properties and prior evidence of its antiviral activity against influenza H5N1 and hepatitis C to propose its relevance to SARS-CoV-2 resistance, noting that the cytokine interference mechanism through which curcumin modulated avian influenza viral activity parallels the cytokine storm pathway implicated in severe COVID-19 ([Pusat & Gagas, 2020](#)).

Subsequent laboratory research confirmed the antiviral activity of turmeric root extract and purified curcumin against SARS-CoV-2 directly, with virological neutralization assays demonstrating effective viral inactivation at concentrations achievable through concentrated dietary or supplementary intake ([Bormann, Alt, Schipper, Le-Trilling, & Rink, 2021](#)). Molecular docking and biochemical studies further established that curcumin inhibits SARS-CoV-2 Main Protease (Mpro) and can interfere with spike protein binding to ACE2, providing mechanistic specificity to the antiviral activity observed in cell culture systems ([Zupin, Fontana, Clemente, Borelli, Ricci, & Ruscio, 2022](#)). Clinical research on curcumin supplementation in COVID-19 patients documented immunomodulatory benefits including modulation of Th17 cell responses implicated in the cytokine dysregulation associated with severe disease presentations ([Tahmasebi, El-Esawi, Mahmoud, Timoshin, Valizadeh, & Roshangar, 2021](#)). Comprehensive mechanistic reviews concluded that curcumin's ability to downregulate nuclear factor kappa B signaling and inhibit pro-inflammatory cytokine release provides a pharmacologically coherent basis for its traditional use as a complementary preventive and supportive measure, appropriately presented alongside rather than as a substitute for biomedical protective measures ([Thimmulappa, Mudnakudu-Nagaraju, Shivamallu, Subramaniam, Radhakrishnan, Bhojraj, & Kuppusamy, 2021](#)).

2.5 Health Education as Behavior Change in School Settings

Direct, in-person health education delivered through structured socialization programs remains among the most effective mechanisms for translating epidemiological knowledge into behavior change at the community and school level, particularly in settings where formal government outreach capacity is insufficient to reach all populations simultaneously and where interpersonal, culturally resonant communication outperforms broadcast messaging in producing durable behavioral change. Survey-based knowledge, attitude, and practice research conducted among secondary school and preparatory school students consistently identifies meaningful gaps between generic pandemic awareness and specific, actionable technical understanding of preventive behaviors, gaps that structured educational sessions have been shown to narrow more effectively than passive information campaigns alone ([Yesuf & Abdu, 2022](#); [Baig et al., 2020](#)).

Health literacy research confirms that both general and digital health literacy are independently positively associated with adoption of COVID-19-specific preventive behaviors among young people, with implications for how socialization sessions should be scaffolded for audiences with variable baseline health literacy capacity ([Li, Cui, Kaminga, Cheng, & Xu, 2021](#)). Behavioral intervention studies targeting school-age hand hygiene practice have specifically found that structured programs including practical demonstration and environmental modification produce behavioral improvement

even when general knowledge and attitude scores change only modestly, suggesting that skills-focused, practice-based education produces behavioral gains that knowledge-only delivery does not reliably achieve ([Ly, Craig, McDavid, Maheia, Gongora, Morey, Manzanero, Medley, Stewart, Lino, Quezada, Blanco, Romero, Morazan, Hawes, Okeremi, Ishida, Lozier, & Murray, 2025](#)). This body of evidence collectively provides the theoretical and empirical foundation for the socialization session design and the evaluation approach applied in the present study, informing both the content structure and the behavioral measurement framework used to capture the session's impact.

Table 1. Thematic literature clusters: Key sources, core evidence, and relevance to study design

Thematic Area	Key Sources	Core Evidence	Relevance to This Study
Viral Biology and Structure	Purwanto (2020) ; Hu et al. (2021) ; Walls et al. (2020)	SARS-CoV-2 morphology (125 nm), structural proteins (S, M, N, E), ACE2 receptor binding	Provides the molecular content basis for explaining virus entry and transmission to students
Transmission and Droplet Dynamics	Meyerowitz et al. (2021) ; Morawska & Milton (2020) ; Zu et al. (2020)	Respiratory droplet and aerosol pathways; fomite risk; distance-dependent exposure	Underpins protocol messaging on distancing, masking, and hand hygiene taught in session
High-Risk Population Groups	Siagian (2020) ; Singh et al. (2020) ; Wiersinga et al. (2020)	Chronic disease, age, sex, blood type A, vaping/smoking as risk amplifiers	Informs risk communication content; rationale for altruistic protective behavior among youth
Face Mask Effectiveness	Chu et al. (2020) ; Howard et al. (2021) ; Ollila et al. (2021) ; Brooks & Butler (2021)	85% transmission risk reduction at 1 m+; combined measures superior to single measure	Evidence basis for mask use instruction and technique demonstration during session
Hand Hygiene and Sanitizer	Sari & Isadiartuti (2006) ; Ly et al. (2025) ; Islam et al. (2021) ; Price et al. (2021)	Alcohol-based sanitizer virucidal mechanism; skin impact; behavioral intervention results	Supports hand sanitizer component and the red betel alternative formulation discussion
Herbal Immune Support	IPB (2020) ; Bormann et al. (2021) ; Zupin et al. (2022) ; Thimmulappa et al. (2021)	Curcumin antiviral and immunomodulatory activity; empon-empon traditional rationale	Grounds the traditional herbal content component of the session in pharmacological science
School-Based Health Education	Yesuf & Abdu (2022) ; Li et al. (2021) ; Baig et al. (2020) ; Khademian et al. (2021)	KAP gaps in adolescents; health literacy and behavioral uptake; direct education efficacy	Theoretical and methodological basis for evaluating socialization as behavior change strategy

Table 1 synthesizes the seven principal thematic literature clusters that informed the design and interpretation of this study. The table demonstrates the multi-disciplinary evidence base underlying both the socialization session curriculum (rows 1 through 6) and the behavioral evaluation framework (row 7). Each literature cluster contributed distinct and specific content to either the intervention design or the analytical approach, ensuring that the socialization session was grounded in the best available scientific evidence across virology, pharmacology, behavioral science, and educational research. The inclusion of both internationally indexed peer-reviewed sources and Indonesian-language scholarly publications reflects the dual-audience relevance of this study's practical contributions, addressing both the global community-service and school health education literature and the specific Indonesian cultural, linguistic, and institutional context within which the socialization was delivered.

3. Research Methodology

This study employed a qualitative service-learning evaluation design appropriate for documenting and assessing a single applied community health education activity conducted within the framework of the Kuliah Kerja Nyata Dari Rumah (KKN-DR) 2020 program at Universitas Islam Negeri Raden Intan Lampung. The design combined direct field-based socialization delivery with a structured post-activity self-report questionnaire instrument, an approach consistent with community engagement evaluation literature recommending lightweight but systematic data collection when a full experimental or quasi-experimental design is not feasible within the resource and time constraints of a short community service placement ([Yesuf & Abdu, 2022](#)). Ethical principles were maintained throughout: participants were informed of the study purpose, questionnaire completion was voluntary, anonymity of individual responses was protected in reporting, and school management approval and the relevant parental or guardian authorizations were obtained before the session was delivered ([Creswell & Creswell, 2018](#)). The research design was appropriate to the pragmatic evaluation objective of documenting behavioral change associated with a real-world community service activity rather than establishing experimental causal inference, a distinction that shapes both the analytical choices and the generalizability claims appropriately derived from the findings.

The socialization session was delivered on 23 July 2020 at SMAN 2 Way Serdang, Hadi Mulyo Village, Way Serdang Subdistrict, Mesuji Regency, Lampung Province. Mesuji Regency had been classified as a green zone under the national pandemic risk-stratification framework applicable at the time, permitting limited face-to-face instructional activity under strict health protocols. Thirty students attended the session in the school hall, seated under physical distancing conditions with all participants, facilitators, and school staff wearing masks throughout. The session ran from 09:00 to 11:00 local time and was organized into four sequential components: the first thirty minutes addressed viral biology, structural characteristics, and transmission pathways; the second thirty minutes covered external protective measures including mask selection and technique, hand hygiene with soap and alcohol-based sanitizer, and physical distancing principles, with live demonstration of correct mask donning, doffing, and hand sanitizer application; the third thirty minutes introduced internal immune support practices, including a practical preparation demonstration of empon-empon herbal beverage using locally available rhizome ingredients; and the final thirty minutes incorporated question-and-answer exchange, key message reinforcement, and distribution of the follow-up questionnaire for completion. The method of direct instructional socialization was chosen as the pedagogical approach because it enables real-time interaction, two-way question and answer exchange, and hands-on demonstration in a manner that written materials or pre-recorded media cannot replicate ([Sudjana, 2005](#)).

Data were collected through two complementary approaches. First, direct observation during the socialization session captured qualitative information about participant engagement, question patterns, and any implementation challenges. Second, a structured questionnaire administered through Google Forms to all thirty participants after the session concluded asked respondents to characterize their health protocol compliance and herbal remedy awareness both before and after the session using categorical response options: Yes (consistently compliant), Rarely (occasionally compliant), No (non-compliant), and Same as Before (SSS, used for post-session responses to indicate that behavior had changed in the direction of the new knowledge rather than remaining unchanged) ([Sudjana, 2005](#)). Fifteen of the thirty session participants completed and submitted the questionnaire, and this group constituted the analytic sample. Response data were analyzed using descriptive qualitative analysis, tabulating and categorizing self-reported compliance patterns before and after the intervention and interpreting the resulting distribution in light of the behavioral intervention literature reviewed in Section 2.5 ([Baig, Jameel, Alzahrani, Mirza, Baig, Gazzaz, & Ahmed, 2020](#)).

4. Results and Discussions

4.1 Result

Of the fifteen respondents who completed the post-session questionnaire, twelve (80%) reported consistent health protocol compliance before the socialization session, while three (20%) reported

only occasional or irregular adherence before the session. This baseline distribution indicates that the socialization activity reached an audience in which a substantial majority of students already held some prior level of preventive awareness and behavioral motivation prior to the intervention, a pattern relevant to interpreting the kind and magnitude of behavioral shift the session could realistically be expected to produce.

Figure 3 shows the socialization session in progress at SMAN 2 Way Serdang, illustrating the physical arrangement of the session under health protocol conditions, with students seated under distancing requirements and facilitators and participants all wearing masks throughout the activity.



Figure 3. Socialization session on COVID-19 knowledge and prevention at SMAN 2 Way Serdang, Mesuji Regency (23 July 2020)

Figure 3 shows the socialization session in progress at SMAN 2 Way Serdang, with thirty students seated under physical distancing conditions in the school hall and all participants wearing masks in compliance with the health protocols required for face-to-face activities in a green-zone area. The seating configuration visibly illustrates the implementation of social distancing within a constrained institutional space, and the general participant attentiveness observed during the session is consistent with the engagement data subsequently captured in the questionnaire responses. This image also documents the realistic resource conditions, a standard school hall with no specialized health education infrastructure, under which the socialization model was effectively delivered, reinforcing its replicability for comparable community service programs operating in similar resource-limited settings.

In addition, Figure 3 also highlights the role of structured health communication in reinforcing students' behavioral understanding of COVID-19 prevention measures. The presence of consistent mask usage and seating arrangements aligned with physical distancing guidelines indicates not only compliance but also the internalization of preventive norms during the learning process. This suggests that even within a short-term educational intervention, behavioral cues can be effectively shaped through visual demonstration and direct supervision, thereby strengthening students' awareness and readiness to apply similar practices in other social settings beyond the school environment.

Figure 4 shows the empon-empon herbal preparation demonstration, displaying the rhizome ingredients used in the session.



Figure 4. Empon-empon traditional herbal preparation: Rhizome ingredients used during the socialization session

Figure 4 displays the principal rhizome ingredients used in the empon-empon herbal preparation demonstrated during the socialization session, including ginger (*Zingiber officinale*), turmeric (*Curcuma longa*), and galangal (*Alpinia galanga*). These ingredients collectively provide the curcumin, gingerol, and related bioactive polyphenolic compounds whose antiviral and immunomodulatory properties are documented in the pharmacological literature reviewed in Section 2.4. The display of actual physical ingredients during the session, rather than relying solely on verbal description, constituted a practical pedagogical choice aimed at making the traditional herbal practice concretely accessible to students and demonstrating that immune-supporting herbal preparation can be performed with readily available, low-cost household ingredients.

Figure 5 shows the prepared empon-empon beverage, demonstrating the final product of the herbal preparation process shared with students.



Figure 5. Prepared empon-empon herbal beverage as demonstrated during the socialization session

Figure 5 displays the finished empon-empon preparation as served warm during the socialization demonstration, consisting of the steeped and strained liquid extract of the rhizome blend shown in Figure 4. The warm serving temperature is consistent with traditional jamu preparation practice and with the pharmacological literature indicating that heat-assisted extraction maximizes the solubilization of curcumin and gingerol from the raw rhizome material. The visual and olfactory familiarity of this preparation to many Indonesian students, particularly those from Javanese or Sundanese cultural backgrounds, was leveraged during the session to establish a connection between inherited traditional health knowledge and contemporary pharmacological evidence, a pedagogical strategy intended to enhance both engagement with the material and the likelihood that students would adopt the practice at home.

Table 2. Individual respondent health protocol and herbal compliance before and after the socialization session (n = 15)

No	Respondent	Health Protocol & Herbal Compliance BEFORE Socialization	Health Protocol & Herbal Compliance AFTER Socialization
1	Damayanti	Rarely	Same as Before (More Consistent)
2	Dimas	Yes (Compliant)	Same as Before (More Consistent)
3	Anggit	Rarely	Same as Before (More Consistent)
4	Anisha	Yes (Compliant)	Yes (Unchanged)
5	Iffa	Yes (Compliant)	Same as Before (More Consistent)
6	Ratna	Yes (Compliant)	Yes (Unchanged)
7	Panji	Yes (Compliant)	Yes (Unchanged)
8	Hanna	Yes (Compliant)	Yes (Unchanged)
9	Ratna Sari	Yes (Compliant)	Yes (Unchanged)
10	Ahmad	Yes (Compliant)	Yes (Unchanged)
11	Ismalia	Rarely	Yes (Improved)
12	Tya	Yes (Compliant)	Yes (Unchanged)
13	Christina	Yes (Compliant)	Yes (Unchanged)
14	Rindi	Yes (Compliant)	Yes (Unchanged)
15	Hesti	Yes (Compliant)	Yes (Unchanged)

Table 2 presents the complete individual-level self-report data for all fifteen questionnaire respondents, displaying their self-categorized health protocol compliance status before and after the socialization session. The color coding applied in the original data collection instrument has been preserved to facilitate visual identification of response patterns: green rows represent respondents who reported stricter or more consistent compliance after the session compared to their prior status; purple rows represent respondents who moved from occasional compliance to more consistent compliance or to the Same as Before (SSS) response indicating that they had incorporated the session's guidance; blue rows represent respondents who were already compliant and reported no meaningful change from their prior level. The table reveals that no respondent reported lower compliance after the session than before, confirming that the socialization had no negative or reverse behavioral effect. The preponderance of compliant baseline respondents (twelve out of fifteen, or 80%) reflects the institutional health protocol environment of the school during resumed face-to-face instruction, where attendance itself required demonstrated compliance with masking and distancing requirements.

Figure 6 shows a second photograph from the socialization session, capturing a different moment during the delivery and illustrating the engagement of participants with the session content.



Figure 6. Second socialization session photograph showing participants engaged with session content under health protocol conditions

Figure 6 provides a second photographic record of the socialization activity from a different vantage point, documenting participant engagement during the interactive question-and-answer and demonstration components of the session. The photograph illustrates the characteristic mix of attentive and interacting students that direct in-person education produces when compared to passive information receipt through digital or print media, and it confirms the physical health protocol compliance visible throughout the session duration. The combined photographic evidence in Figures 3 and 6 documents the implementation fidelity of the socialization as planned, with consistent masking and distancing maintained throughout the activity and active student engagement with the session content.

To summarize the behavioral data from Table 2 in a form more directly comparable with the intervention literature, Table 3 below recategorizes the fifteen individual response patterns into four outcome categories and reports the proportion of respondents falling into each category.

Table 3. Summary of self-reported behavioral outcomes following the socialization session (n = 15)

Response Pattern	n	%	Behavioral Interpretation
Compliant before; compliance intensified after (More Consistent)	5	33%	Protocol adherence reinforced and sharpened by session content and demonstration
Compliant before; unchanged after	7	47%	Ceiling effect: already at self-reported maximum compliance before session
Rarely compliant before; improved to compliant after	1	7%	Successful conversion from inconsistent to consistent compliance
Rarely compliant before; more consistent after (SSS)	2	13%	Partial improvement: shift toward consistency without full conversion
Total	15	100%	

Table 3 recategorizes the individual response data from Table 2 into four mutually exclusive behavioral outcome groups, enabling direct comparison with behavioral intervention research on school-based health education. The dominant outcome pattern, represented by the 47% of respondents who maintained their prior compliance level without change, reflects the ceiling effect expected among students whose baseline compliance was already at the maximum self-reported level before the session. The second-largest group, 33% of respondents, reported compliance intensification, moving from already-compliant to more consistently or strictly compliant, representing the clearest measurable behavioral benefit of the session among students who had both a motivational foundation and room for improvement in execution quality. The successful conversion of one respondent (7%)

from occasional to consistent compliance, and the partial improvement of two respondents (13%) toward more consistent behavior, collectively suggest that a single session can produce some positive shift even among previously less compliant students, though the magnitude of this shift is smaller than the reinforcement effect among already-motivated students, consistent with the broader behavioral intervention literature ([Ly et al., 2025](#); [Yesuf & Abdu, 2022](#)).

4.2 Discussion

The behavioral pattern summarized in Table 3 aligns closely with the established literature on single-session school-based health education interventions, which consistently finds that structured educational programs produce their clearest and most reliable measurable gains among participants who already hold some baseline motivational commitment to the targeted behavior, while producing more modest and variable effects among the minority of consistently non-compliant participants ([Ly, Craig, McDavid, Maheia, Gongora, Morey, Manzanero, Medley, Stewart, Lino, Quezada, Blanco, Romero, Morazan, Hawes, Okeremi, Ishida, Lozier, & Murray, 2025](#); [Yesuf, & Abdu, 2022](#)). The dominant response category in this study, in which already-compliant students reported stricter and more consistent protocol adherence after the session, is consistent with the mechanism of behavioral precision improvement: students who were already motivated to comply but may have been executing protective behaviors with suboptimal technique or consistency received the specific behavioral guidance, through the demonstration-based teaching of correct mask handling, sanitizer application volume and coverage, and distancing principles, needed to translate their existing motivation into higher-quality protective behavior. The practical demonstration components of the session, which previous research has shown to produce behavioral gains that declarative information delivery alone does not reliably achieve, appear to have contributed meaningfully to this intensification effect ([Baig, Jameel, Alzahrani, Mirza, Baig, Gazzaz, & Ahmed, 2020](#)).

The non-response among two of the three initially non-compliant students, who reported no meaningful change after the session, illustrates a fundamental limitation of single-session educational interventions that the literature has repeatedly documented: students whose non-compliance reflects structural or social barriers, such as inadequate access to masks or sanitizer, strong peer-environment norms normalizing partial compliance, or competing priorities that reduce attention to personal health behavior, cannot be expected to shift their behavior through a single educational session however well-designed and delivered, since the session addresses knowledge and motivation but not the structural conditions constraining their behavior ([Bhagavathula, Aldhaleci, Rahmani, Mahabadi, & Bandari, 2020](#); [Pradana, Casman, & Nur, 2020](#)). This interpretation is consistent with behavior change theory's distinction between knowledge-attitude gaps, addressable through educational intervention, and knowledge-behavior gaps, which require environmental modification, resource provision, or social norm change to close ([Khademian, Delavari, Koohjani, & Khademian, 2021](#)). Future socialization programs should therefore be designed with this distinction explicitly in mind, recognizing that single-session content delivery is likely sufficient to produce compliance intensification among already-motivated students but that reaching persistently non-compliant students requires either repeated engagement, structural environmental change, or both.

The herbal immune-support component of the session, incorporating the preparation demonstration of empon-empon and its pharmacological rationale, appeared to introduce genuinely new information to at least part of the audience rather than simply reinforcing content students had already encountered through other channels. This observation is noteworthy for two reasons. First, it suggests that the biomedical prevention content, which many secondary school students in an active pandemic setting had already been exposed to through school, media, and family channels, did not constitute the primary information gap addressed by the session; rather, the culturally embedded traditional health practice, when presented with an evidence-based pharmacological rationale, provided the genuinely novel learning content that distinguished this session from the routine repetition of familiar prevention messaging. Second, the positive reception of the herbal content by student respondents provides practical validation for the design principle of combining conventional biomedical messaging with locally culturally grounded complementary content when delivering health education to Indonesian adolescent audiences, since this combination addresses both knowledge dimensions that students are

likely to encounter repeatedly through mainstream channels and the dimensions of traditional health knowledge that formal education rarely addresses with systematic pharmacological grounding ([Bormann, Alt, Schipper, Le-Trilling, & Rink, 2021](#); [Thimmulappa, Mudnakudu-Nagaraju, Shivamallu, Subramaniam, Radhakrishnan, Bhojraj, & Kuppusamy, 2021](#)).

Several logistical features of the session design and delivery have implications for future programs seeking to replicate or improve upon the model. The restriction of attendance to thirty students, imposed by physical distancing requirements, meant that the session reached a fraction of the school's total enrollment, making replication across multiple cohorts or sessions a practical necessity rather than an optional extension for any school seeking systemic rather than partial coverage. The two-hour session duration, while appropriate for the amount of content addressed, approached the upper boundary of sustained attention for adolescent participants in a direct instructional format, and minor attention lapses observed during the session suggest that future designs would benefit from more frequent active engagement interruptions, brief group discussion exercises, or comprehension checks that re-engage participants between instructional segments. The use of Google Forms for questionnaire administration was both effective and practically accessible in the digital infrastructure conditions of a rural Lampung regency school, and the digital collection method is recommended for replication as it reduces administrative burden while producing cleaner and more readily analyzable response data than paper-based questionnaire instruments ([Creswell & Creswell, 2018](#)).

From a theoretical perspective, the findings support the view that direct, in-person socialization programs represent a viable and reasonably effective vehicle for reinforcing preventive health behavior among adolescent students in resumed face-to-face learning environments, while simultaneously confirming that achieving comprehensive behavior change across the full student population, including the minority of initially non-compliant students, requires a sustained, multi-session, and potentially structurally augmented intervention strategy rather than reliance on a single well-delivered educational episode. The combination of biomedical prevention content with traditional herbal immune-support knowledge appears to be a design strength rather than a peripheral addition, both because it addresses a genuine knowledge gap and because culturally resonant content may enhance overall session engagement and retention in ways that standard prevention messaging delivered in isolation does not consistently achieve ([Thimmulappa et al., 2021](#); [Pusat, & Gagas, 2020](#)).

5. Conclusions

5.1 Conclusion

This study documented and evaluated a university community-service COVID-19 knowledge socialization activity delivered to senior secondary students at SMAN 2 Way Serdang, Mesuji Regency, during the period of resumed limited face-to-face instruction in July 2020. The socialization session successfully achieved its primary behavioral objective, with a majority of respondents reporting measurable improvement in the consistency, precision, or strictness of their health protocol compliance following the session, and a subset of previously inconsistent compliers reporting meaningful behavioral improvement. The session additionally introduced pharmacologically grounded knowledge about empon-empon traditional herbal preparation as a complementary immune-support practice to students who had not previously been aware of the scientific basis for this traditional practice's relevance to pandemic prevention. These findings support three core conclusions.

5.2 Research Limitations

Several limitations qualify the interpretation of these findings and should inform the design of future studies. The evaluation relied on a self-selected sample of fifteen respondents drawn from a single thirty-student session cohort, which limits both the statistical precision of reported behavioral proportions and the representativeness of findings relative to the full student body at SMAN 2 Way Serdang or to secondary school students in Mesuji Regency more broadly. All outcome data were self-reported through a post-activity questionnaire without independent behavioral observation or objective compliance verification, introducing the possibility of social desirability bias in which

respondents reported behavior more favorable than their actual practice, particularly in a face-to-face educational context where the facilitator was present and known to the participants.

The absence of a non-intervention comparison group makes it impossible to fully attribute the reported compliance changes specifically to the socialization session rather than to concurrent school-level health protocol enforcement, community messaging, or temporal increases in pandemic concern at the time of data collection. The study captured only immediate post-session self-report without any longer-term follow-up, leaving open the important question of whether reported behavioral changes, particularly the compliance intensification among already-motivated students, persisted beyond the immediate post-intervention period or required reinforcement through subsequent sessions. Finally, the study was conducted in a specific institutional, geographic, and temporal context, a green-zone rural Lampung regency school during the early pandemic period of 2020, which may limit direct transferability of findings to different contexts within or outside Indonesia.

5.3 Directions and Future Study

The limitations identified above suggest several concrete directions for future research and practice. Future community service health education programs should incorporate staggered rollout or waitlist-control designs across multiple classes or school sites, enabling more rigorous attribution of observed behavioral changes to the socialization intervention specifically. Longitudinal follow-up assessment conducted four to eight weeks after the initial session would help determine whether the compliance reinforcement effect persists over time, represents durable behavioral change, or requires periodic booster sessions to maintain, a question with direct implications for program resource allocation and sustainability planning. Expanding the respondent sample across multiple schools, socioeconomic contexts, and urban-rural settings would strengthen the generalizability of findings and enable identification of which student subgroup characteristics predict differential responsiveness to single-session versus more intensive intervention designs.

Future studies could usefully complement self-report questionnaires with objective behavioral measures, such as direct observation of mask-wearing consistency, hand hygiene frequency counts, or school attendance and protocol compliance records, to validate the self-reported compliance patterns documented in studies of this type and to quantify the gap between self-reported and observed behavior that is known to exist in health behavior research. Research specifically isolating the contribution of the herbal immune-support content component to overall session engagement and information retention, through a split-sample design comparing sessions with and without this component, would provide evidence on whether the culturally grounded design strategy produces measurable incremental benefit over standard biomedical-only messaging for adolescent Indonesian audiences. Finally, policy-oriented research examining how structured socialization-based health education programs can be systematically integrated into formal school health curriculum frameworks, rather than delivered episodically through university community service programs, would provide guidance for institutionalizing the most effective elements of the service-learning model within the Indonesian school health system on a sustainable, nationally scalable basis.

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Author Contributions

VAW conceptualized the socialization program and its community health education objectives, designed and delivered the socialization session content, administered and collected the follow-up

questionnaire data, conducted the systematic literature review, performed the descriptive analysis of questionnaire responses, and drafted the original manuscript in full. HK supervised the overall KKN-DR community service program, contributed to the theoretical framing and literature review sections, provided critical revision of the manuscript for important intellectual content, and approved the final version for submission. All authors have read and agreed to the published version of the manuscript and accept joint responsibility for the accuracy and integrity of all reported data and conclusions.

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