



Post-COVID green supply chain management of used products: a study towards awareness for vaccination

Tripti Singh¹ · Sarvesh Tripathi¹ · Ashish Dwivedi² · Ángel Acevedo-Duque³

Received: 4 August 2021 / Accepted: 2 June 2022 / Published online: 10 June 2022
© The Author(s), under exclusive licence to Springer-Verlag GmbH Germany, part of Springer Nature 2022

Abstract

In the era of digital media, there is rapid spread of information. During coronavirus (COVID-19) pandemic situation, the government and other administrative bodies were highly dependent on media outlets, as direct contact was not feasible. Visual communication tools are used to spread awareness and encourage people towards vaccination. The circulation of wrong information may lead to confusion, which may cause denying the vaccine. There was a need to know the extent for contribution of visual communication tools for spreading correct information and motivating the society towards vaccination in post COVID times. In the present study, survey questionnaires were framed specific to which media (print or digital) was more effective to deliver the correct information to the targeted audience. The present study objectives to answer the questions through a survey of 312 people of different age groups, and the data was collected about their families. The obtained data was tested through hypothesis, and fact-checked was performed adopting analysis of variance (ANOVA). The results from the study highlighted that different age groups prefer different mediums of communication. The reach and adoption of digital media have tremendously increased, and it helped to achieve the sustainable development goals (SDGs) by efficient green supply chain management (GSCM) of daily plastic and paper wastage during post-pandemic.

Keywords COVID-19 · Vaccination · Green supply chain management · Sustainable development goals

Introduction

Corona virus and vaccination process

A pneumonia outbreak associated with a novel coronavirus was first documented in Wuhan, China, in December 2019 (Zaid et al. 2020). At that time, the infection spread was across China that later spread to numerous countries around the world. According to a study by Nishiura et al. (2020), the total number of cases on January 24, 2020, the cumulative incidence in China, was 830 cases. Furthermore, the study estimated the cumulative incidences in China as 5502. In the same line of work, a report posted by a research group at Imperial College London (ICL) on January 22, 2020, estimated the number of incidence around 4000 cases (Nishiura et al. 2020). The World Health Organization (WHO), on January 30, 2020, declared a public health emergency of international concern. WHO identified the disease on February 12, 2020, as Coronavirus Disease 2019 (COVID-19) caused by SARS-COV2. This novel COVID-19 created menace throughout the world. The prevention of society from this infection was a challenging task for the Indian Government

Communicated by Philippe Garrigues

✉ Ashish Dwivedi
ashish0852@gmail.com

Tripti Singh
dr.triptis14@gmail.com

Sarvesh Tripathi
sarvesht9@gmail.com

Ángel Acevedo-Duque
angel.acevedo@uautonoma.cl

¹ Department of Mechanical Engineering, Design Discipline, Prasad Mishra Indian Institute of Information Technology, Design and Manufacturing, Jabalpur, Madhya Pradesh, India

² Jindal Global Business School, O.P. Jindal Global University, Sonapat, India

³ Observatory of Public Policy, Universidad Autónoma de Chile, Santiago, Chile

due to population size, education level, and a large section living in slums. In India, the world's biggest lockdown was being observed to stop the spread of the virus. The lockdown was an effective measure towards environmental sustainability, but it was not suitable for the daily wages workers and some professionals who lost their jobs. The strategies developed for precautionary measures revolve around escalating awareness through campaigns that employed digital and printed material by the Ministry of Health and Family Welfare, Government of India. The government and public organizations used various channels from traditional to digital media to raise these awareness campaigns. These initiatives objective to expand awareness messages towards communities and encourage them to fight against the pandemic.

On January 3, 2021, the Drug Controller General of India (DCGI), the Central Drugs Standard Control Organization (CDSCO), with the recommendations of the Subject Expert Committee (SEC), approved the COVID-19 vaccines of both Serum Institute of India (SII) and Bharat Biotech for restricted use in the country. The SII started manufacturing Covishield, the Indian variant of the AZD1222 vaccine developed by Oxford University. Bharat Biotech started manufacturing homegrown government-backed vaccine named as Covaxin. The first line of vaccination was given to the forefront workers; they are healthcare workers who helped India's battle against the novel coronavirus.

Equally, the awareness for using the body protection kits and masks is an area of concern, as the used material is required to be cordoned off sustainably to create a more negligible effect on the environment. The support and encouragement for appropriate check for the vaccination are to alleviate any possible disappointment expressed by unfulfilled demand for the vaccine. Along with this to address vaccine "hesitancy" which could arise because of understanding around efficacy, vaccine safety, myths, and misinterpretation. Some pivotal aspects gave potential inside probability and alleviate unintended crises. Therefore, action is planned to strengthen the trust among society towards COVID-19 vaccine by managing misinformation and transparency in communication, disinformation, and rumors (Kent et al. 2003). These disinformation and rumors were to alleviate apprehensions about the vaccine, counter these attacks, and ensure its acceptance and encourage uptake. Therefore, there was a requirement, for a visual communication strategy.

The present study adds value to understand perception of people regarding digital communication material. At the same time, vaccine hesitancy among the people was also studied. The question was raised about efficacy of vaccine. The contribution of this study is in the form of information strategy of the Government of India (GoI) to educate people about pandemic as it was observed that fake news related to pandemic was being circulated continuously. The GoI ran a campaign to deliver the correct information regarding

COVID-19. Many strategies and reports were published, which were the theoretical basis for this study. There was hesitancy regarding the COVID-19 vaccine. Hence, communication medium preference and the trust of the medium became the focus of research. This study contributes to identify the communication medium most trusted by the people during the pandemic times. Furthermore, the environmental awareness of people regarding adoption of digital media is discussed in this study. GSCM is considered the way forward. At every stage of production, this digital or conventional mode of communication should be sustainable in nature.

Vaccine encouragement with sustainable usage of different visual communication tools

The issues specific to environment were first brought by Carson 1962 release of "Silent Spring." This report sensitized and had driven the government to frame environment-friendly policies. This resulted in creating a better understanding of the ecological factors and effects. The UN Environment Commission Report, also known as the Brunt Land Report, was presented in the year 1987. This report suggested the importance of sustainability efforts to follow. In the report, sustainable development referred as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Sustainable development includes four dimensions: society, environment, culture, and economics, all of which are interwoven rather than distinct.

The availability of resources and balance regarding the environment, social, and economic front is critical to develop a modern society waste dealing structure that can cope with the media-related pollutant and wastage. This enhances the concern regarding usage of various resources in print material and digital media products to create awareness. These concerns escalate with the increasing demand and need to reach each individual for vaccination in a highly populated country. Regulation has been applied to training material, advertisements, and direction indications, as well as other vaccination booth requirements as a response to resource limitation at the national level, which may limit minimal usage of such content in an effective fashion.

After introduction of vaccine, it was observed that people have different opinion about efficacy of vaccine. The source of information was not trustworthy still people believe on rumors, and information without fact checked. Interestingly, trust on source of information varies with age group. This fact motivates to find the answer for following research questions (RQs):

RQ1: What is the opinion of people regarding vaccination? Are they ready for vaccination? Is there some kind

of hesitancy? If yes, then how it varies with different age groups?

RQ2: What is most trusted medium of communication which can be used for vaccine awareness among people?

RQ3: Is there any significant difference on trust on communication medium and age group?

RQ4: How people of different age accept the digital medium than conventional medium of communication?

RQ5: What will be the effect on SDGs at time of pandemic by adopting digital communication medium?

RQ6: Do people use any communication medium for fact check of information?

RQ7: How to perform the GSCM of plastic and paper wastage efficiently during post-COVID times?

The remaining paper is presented as follows. In the “[Literature review](#)” section, literature review is reflected highlighting past studies related to visual communication tools and green supply chain management of waste. Research methodology and the data analysis are reflected in the “[Data collection and methodology](#)” section. In the “[Results](#)” section, results and hypothesis testing are explained. Discussion and managerial insight are provided in the “[Discussion and managerial insights](#)” section. Final conclusion of the study is reflected in the “[Conclusion, limitations, and future research directions](#)” section.

Literature review

In the present study, the literature analysis was performed in two phases. In the first phase, studies specific to visual communication tools for spreading awareness were presented. The second phase highlighted the previous studies related to green supply chain management of waste. The need for study is recognized based on the performed literature analysis.

Studies specific to visual communication tools for awareness

COVID-19 pandemic has created unprecedented demand for rapid and effective scientific communication capable of engaging the public in behavioral change on a mass scale. Kearns and Kearns (2020) described comics as a communication medium at the time of the pandemic. It was reported that comics could engage people’s graphic narratives, visuals, text, and storytelling in a unique and engaging format. Comics are very familiar and accessible to audiences and can reach beyond language barriers, age, culture, and knowledge. Simplification and schematic representation can make the abstract concepts tangible. The stories driven by emotion are powerful than data-driven arguments. During COVID-19 pandemic, induced global pandemonium and misinformation, delivering the correct facts to the right people is the priority, and comics

can be a part of communication strategy to deliver the correct information effectively (Kearns and Kearns, 2020).

Amidon et al. (2021) highlighted three tensions (global–local, epideictic–deliberative, conceptual metaphors–data representations) to suggest the practical solution for adopting visual risk literacy in their study. The study highlighted that in technical and professional communication, communicators should develop multiple visual metaphors and actively confront the misuse and misrepresentation of visuals by policymakers and the public. Martikainen and Sakki (2021) described the importance of mass media for social representation in the society. Furthermore, the study added that media grows particular understanding by representing it in a certain way and by meta-representations. Camilleri (2021) described the importance of digital communication; an organization can use digital and social media in their crises’ communications and risk management plans. The study revealed that digital communication enables organizations to be better positioned to engage in credible and transparent dialogic communications with different stakeholders. It was further reported that organizations should be credible in their dialogical communications to reinforce their legitimacy in society.

Li et al. (2020) performed a study on the effectiveness of YouTube as a communication medium. The study discovered that most of the viewed content on COVID-19 was misleading, not having credible source of information, reaching large audience. As the present COVID-19 pandemic worsens, public health agencies must make better use YouTube to deliver timely and accurate information and minimize misinformation spread. Furthermore, Katsoni and Dionysopoulou (2018) described the importance of visual communication and Information and Communications Technology (ICT) in tourism industries. It may assist all stakeholders for the promotion of destination and economic development. The authors emphasize to redefine the mode of communication, value addition and creation between tourism principals, as per the requirement of the tourism industries. Haseeb et al. (2019) reported that ICT usage assists in improving the environmental quality. The empirical results demonstrate that rise in both internet usage and mobile cellular subscription likely mitigates CO₂ emissions. In a similar study, Anser et al. (2021) concluded that for sustainable consumption and production, a green ICT infrastructure is required. Green ICT infrastructure positively affects the production techniques and environmental regulations policies towards sustained growth. Smith and Joffe (2013) presented visualizations study of global warming. Similarly, in context of COVID-19, various depictions are circulating but it is the visual material that has the most significant impact on public engagement. Thelwall et al. (2012) evaluated the impact of reports on multimedia production, anonymous content, length, subject matter, format, shared networks, and referral systems. Multimedia content studies are recent. The researchers spend much time figuring out

how these elements are tweaked and modified. The visual products used for understanding are more or less valuable (Welbourne and Grant 2016). It is important to consider prices when considering popularity to formulate the scope in a written letter. Video popularity is linked to or based on two different elements of content: content and elements (Borghol et al. 2012; Figueiredo et al. 2014). Content elements seem to be the most informative and are commonly used to understand what affects more or less optical communication products (Welbourne and Grant 2016).

The need for this research is on critical issues highlighting reports, documentaries, and animations as the most current and popular formats. Taxonomy and content analysis are some of the first published teaching methods to be maintained over the years (Thelwall et al. 2012; Morcillo et al. 2015; Plank et al. 2017). While most experts agree that online science multimedia are short, attractive, and easy to watch (García-Avilés and Lara 2018), it is essential to know what visual communication is created and what components can be improved. Multimedia blogs, Television (TV) features, TV news, or documentaries are the most widely used multimedia formats in scientific communication (García-Avilés and Lara 2018). It was reported that Qatar government used multilingual printed pamphlets and multilingual audio-visual communication through radio and social media, as well as interviews conducted with key figures who were part of the awareness campaign. The report reflected the significant role of community, religious leaders, and social media influencers in disseminating the awareness information to the diverse migrant language communities (Ahmad and Hillman 2021). These awareness materials were visual communication-based material, including stickers, printed posters for display in public places like hospitals, bus stands, and malls.

Studies specific to green supply chain management of waste

Abylkhani et al. (2021) conducted a field study in Kazakhstan. The study reflected that in the municipal waste, organic waste was major (46.3%), followed by plastics (15.2%) and paper (12.8%). Similarly, Adeniran et al. (2017) discussed the component of waste material. The components found in waste material were 24% polythene materials, 15% paper related material, 15% organic matters, 9% plastic matters, 8% inert materials, 7% sanitary, 7% textile materials, 4% leather, 3% metals, 2% glass, and 6% other. Recycling, optimize reuse and reduce waste generation were waste management options discussed in this study. Speier et al. (2018) correlate the population density with the organic fraction of municipal solid waste (OFMSW) shares in urban household waste. It was reported that highest amount of waste generated from medium dense populated area and least amount of waste generated in low dense populated area. Total street

waste and urban Litter Spot (LS) had comparatively lower OFMSW shares. In sub-urban area, LS contribute the lowest in OFMSW shares. It was reported in the study that urban household and LS waste have the same source of generation. Hazardous element like lead and copper exceeds the permissible limit in OFMSW waste. This implies the highest pollution level in suburban area. Naldi et al. (2021) conducted a study in Desa Paulan city of Indonesia. The study discussed three good governance principles to solve the waste management problems. Furthermore, the study highlighted participation, the rule of law, effectiveness, and efficiency are the strongest three of eight sound governance principles that affect the sustainability of solid waste management in Desa Paulan city in Indonesia. Abid et al. (2021) discussed the importance of good governance to achieve environmental sustainable goals. Ikram et al. (2020) discussed the importance of corporate sustainability in creating a prosperous future for organizations.

Anshassi et al. (2019) showed in their study that to apply sustainable material management (SMM) more accurately, regions will need to better track and report their materials generated and disposed of. For recovery from waste materials, the material should be targeted, such as paper or metals. Furthermore, there is a requirement for promotion and a track record of waste reduction. Jum'a et al. (2021) reported that environmental sustainability was directly influenced by supply chain practices and have significant effect on financial performance of the company. Fabian and Lou (2019) pointed out three fundamental problems associated with waste management. In the study, lack foresight and planning of authority, lack of auxiliary waste management technology, and limited capacity to recycle are highlighted as the three fundamental problems. Furthermore, Mousavi et al. (2020) discussed the importance of vermicomposting as an appropriate technology for bio-conversion of newspaper waste, grass clipping, and cow dung to valuable material. The study provides scientific information on the vermicomposting of grass, newspaper, and cow dung, either alone or in combination. The vermicomposting from waste materials (60% newspaper waste, 30% of cow dung, and 10% of grass waste) reported the highest reproduction of worms after 3 months. The authors added that results reflected due to different physicochemical properties of substrates, the single substrate and mixed substrates had a different effect on the process. Finally, it is concluded from the study that vermicomposting can be used for lawn wastes, educational wastes, and cow dung management. Oginni (2021) suggested that pyrolysis can be used to transform used face masks into bio products. COVID-19 virus cannot survive at operational temperature of pyrolysis. Hence, there will be no question of further transmission virus. Also, Obuah and Okon (2017) discovered that clear messages and communication

channels helped residents have knowledge and awareness regarding waste management and disposal procedure in the river. Sahoo (2021) reported that there is significant correlation between air pollutants and COVID-19 infected cases. This fact can explain the link between national lockdown and prevention from the spread of disease.

COVID-19 causes environmental waste problem due to disposal of medical waste in environment (Hasan Eroğlu, 2021). It was reported that the quantity of household waste increased across country due to the social distancing measure of staying at home (Sarkodie and Owusu 2021). There is an urgent global call for waste management from households, medical facilities and toxic waste to be treated as essential public service (Sarkodie and Owusu 2021). Das et al. (2021) suggested that proper scientific methods are required for treatment of MSW. Proper communication tool should be used to spread awareness regarding handling household medical wastes. Innovatively maximizing usage of digital gadgets to spread awareness becomes more environmentally sound and can be achieved by developing technologies. The creation of vaccination centers for using more environmentally sound materials in both the governmental and non-governmental. Information transmission for awareness about product and service chain related to COVID-19 awareness can be achieved by encouraging digital media. It has delivered more usability of resources than any other medium, which causes less immersion, resulting in less environmental burdens.

In India, the population and waste will be an issue, once the vaccination drive is over and people are vaccinated in a short time. Schmitt et al. (2021) reported that there is a need to educate families to reinforce their intentions and behaviors to food waste, as well as make them aware of the social, economic, and environmental effect. Also, Ikram et al. (2020) included COVID-19 pandemic as a new aspect of social sustainability in his study.

A significant section of the population is un-informed regarding the dangers of careless trash disposal and needs to be taught. There are numerous approaches to cater this situation, including re-cycling through modifying the production, manufacturing, distribution, and packaging processes. The Allwood defined material efficiency (E) as an equation:

$$E = \frac{P}{M} \quad (1)$$

“In this Allwood’s material efficiency (E) equation, P stands for product and service produced and M for material used in the process”

It is desirable to have higher efficiency of material used for sustainable development. Thus, material efficiency will be affected by both the factor, one in material used to produce specific products or services, second is the amount of product or service produced,

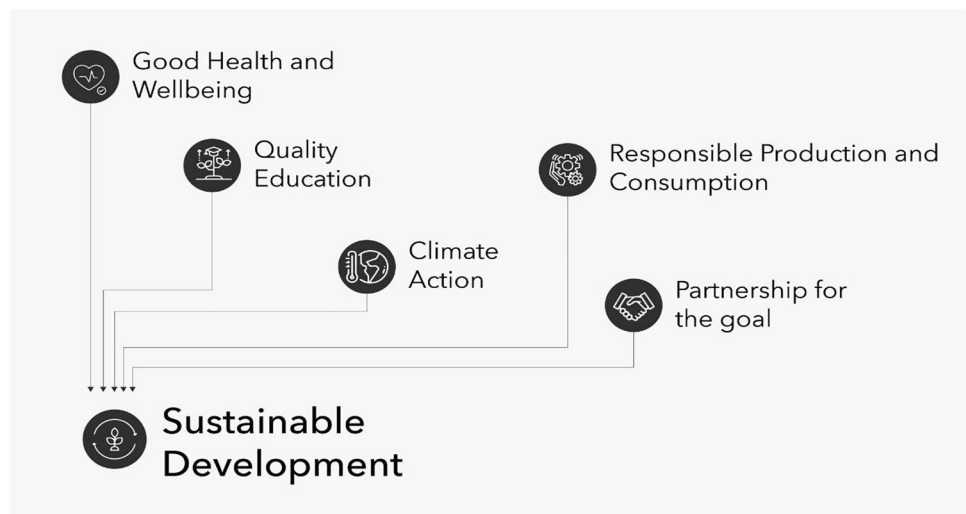
so material efficiency can be maximized by minimizing the amount of effective material use, both in design change and materializing substitution for more environment-friendly or digital material. In economic terms, efficiency is told about the economic value associated with a unit of material consumed, while eco-efficiency metrics scale or discount these economic value with the associated environmental costs of each material (Lifset and Eckelman 2013). The efforts to improve efficiency/eco-efficiency focused on quantitative changes as opposed to qualitative changes (Lifset and Eckelman 2013). However, where the quality of the products is improved, the provision of services and products can be improved qualitatively and efficiently. The product’s societal benefits and drawbacks must be evaluated. Product redesign should improve the benefits while eliminating the drawbacks.

The present study reflects that 59% of respondents prefer to have the digital mode of communication, especially at the time of pandemic (Table 1). By doing so, nearly five SDGs can be achieved as mentioned below (Fig. 1):

- *Climate action*: Digital mode of communication will reduce daily wastage like paper and plastic. By controlling wastage, environmental pollution can be reduced drastically. This would positively affect the country’s climate.
- *Quality education*: During pandemic, most of the educational institutions are closed. Digital communication quickly reaches every doorstep without any infection. Most of the classes are running online. Information is widely circulated through digital mode. Hence, it will help to achieve quality education.
- *Responsible consumption and production*: Digital communication help consumer and producer to block their deal without meeting each other.
- *Good health and well-being*: At the time of pandemic, circulation of paper and other convention modes were stopped; the correct information at the right time can assist to save people’s lives. Government effort and policy are widely circulated through digital medium that helps to achieve sustainable goal.
- *Partnership goal*: By spreading positive and correct information, digital communication can indirectly achieve other SDGs. For example, no poverty and hunger, recently government introduced one nation one card scheme to overcome poverty and hunger problem. Digital communication, at the time of the pandemic, spread information regarding this scheme, and people became more aware towards this opportunity. Digital communication can be part of achieving another SDGs.

Table 1 Number of people who prefer particular communication medium to access the pandemic related information

Communication medium	Above 60+	44–60 year	Below 44	Total	% Total people who used a particular communication medium
Newspaper	49	70	153	272	20%
Television	51	69	168	288	21%
Social media	38	64	138	240	18%
Local health center	33	37	74	144	11%
Ring tones and other messages	16	23	64	103	8%
Health bulletin	37	41	86	164	12%
Community mobilizer	23	47	73	143	11%
Total	247	351	756	1354	100%

Fig. 1 Targeted sustainable development goals

Need for study

During pandemic, the communication medium played an essential part in the social construction and deconstruction. The adoption of efficient communication tools can unite the general masses to overcome losses from pandemic such as COVID-19. In recent times, the social visual communication tools reflect more reach than conventional media. These tools are more interactive and dialogic and form a perception faster (Kent et al. 2003; Schultz and Wehmeier 2010; White and Raman 1999) than the classic one. However, the effects of different media on recipients in pandemic are still understudied (Schultz et al. 2011). Considering the current COVID-19 situation, the present study examines the trust of people of different age groups in different communication mediums for information regarding the post COVID-19 vaccine. Misleading and wrong information produces suspicion among society towards the vaccination. This paper has made attempt to find the answer for the research questions highlighted above in (Sect. 1.3).

Data collection and methodology

An online survey was conducted to collect data about the most trusted communication medium to access the information related to COVID-19 vaccination by the society in India. The GoI decided on vaccination at three different age-group levels. Therefore, the responses are divide into three age-group levels. This online survey hardly took 5 min, so no incentive was given to participants. The survey used a questionnaire divided into four sections. In the first section, social variables were included such as name, gender, place, email. The second section enquired the family member's point of view who are 60+ years of age to access the information regarding COVID-19 vaccine, which communication medium they generally used. Similarly, the third section enquired the family member's point of view who are 44 to 60 years of age, and the fourth section asked about family members who are less than 44 years of age. To simplify the scenario, 60+ age group people were coded as group 1, age group 44 to 60 year were coded as group 2 and below 45 year

age people were coded as group 3 respectively. Seven communication medium were identified from literature survey which are generally used to access the information in India. They are newspapers, television, social media, ringtones and message, local health center, health bulletin, and community mobilizer giving information regarding COVID-19 (Table 2). Social media included various platforms such as WhatsApp, Facebook, and Instagram. Local health centers used posters, templates, word of mouth, etc., to provide vaccines. Also, community mobilizer played a significant role in providing information, especially in rural places. This included anganwadi workers, self-help groups, and people.

Data collection

The previous studies highlight that online panel data can deliver high-quality data outcomes. Porter et al. (2019) recommend using online panel data, particularly for qualitative studies. They required access to specific populations. Between March 1 and March 24, 2021, the online survey was distributed via mail and social media networks to sample the Indian population randomly. The participants received an email with a link to the online experiment. A short instruction that helped them to understand the essential terms used in this survey was provided in the mail.

Sample space

The survey for this study was performed during COVID-19 time. The survey and data collection process was designed very carefully. A single person in a particular family was approached and questions were floated towards all the family members (Table 6, Appendix section). The questionnaire was designed with very specific questions for collecting data from the participant and its family members (Table 7, Appendix section). In total, 105 families were contacted for the survey process. A number of 312 participants responded to the survey. The respondents belonged to different part of country. Hence, enough responses were obtained to

understand region wise effect of communication medium on daily life during pandemic. During the survey, statistical sampling guidelines were followed as recommended (Thomas et al. 2015), and their responses were considered for further analysis. The mean age of the participant was 23.33 years. On the last page, participants were thanked and debriefed.

Methodology description and data analysis

The Statistical Package for the Social Sciences (SPSS, version 21, Chicago, IL, USA) software was used for statistical analysis. The data from each of the questionnaires were coded and entered in the software. Descriptive statistics, including percentages and frequency distribution, were calculated for each of the questions. This study focused on the comparison of independent variables, which is categorical, so chi-square test was used to find a significant difference among the trust of different age people on communication medium at a 5% significance level. A chi-square test is a descriptive test to test correlation not prediction. In literature, many authors used chi-square test rather than more complicated method; it was seen most of the cases end result is same. Furthermore, it was reported by Franke et al. (2012) that chi-square test is computationally simple. It is used to examine independence across two categorical variables or to assess how well a sample fits the distribution of a known population (goodness of fit) (Franke et al. 2012).

In the same line, reliability and ANOVA test were performed. Reliability test of a questionnaire: Reliability is an extent to which a questionnaire produces the same results on repeated trials. In simple terms, research reliability refers to the degree to which research method produces stable and consistent results (Larsen and Marx 2005). Analysis of variance (ANOVA) refers to collection of statistical models and their associated estimation procedures (such as the “variation” among and between groups) to analyze the differences among mean (Prentice and Lindgren 1977). ANOVA, in its most basic form, is a statistical test that determines if two or more population means are equal, and so

Table 2 Communication medium used by different age group people

Communication medium	Above 60+ (in %) Group 1	44–60 years (in %) Group 2	Below 44 (in %) Group 3	References of medium
Newspaper	19.84	19.94	20.24	Mercer (2020)
Television	20.65	19.66	22.22	Roscoe (2004)
Social media	15.38	18.23	18.25	Chou et al. (2009)
Local health center	13.36	10.54	9.79	Xu et al. (2016)
Ring tones and other messages	6.48	6.55	8.47	GOI report on COVID-19
Health bulletin	14.98	11.68	11.38	Krause et al. (2020)
Community mobilizer	9.31	13.39	9.66	Adebisi et al. (2021)
Total	100	100	100	

extends the *t*-test beyond two means (Prentice and Lindgren 1977; Larsen and Marx 2005).

In addition, to check the reliability of data, Cronbach’s alpha was calculated and compared from the standard limit. ANOVA test was carried out to find significant differences among communication groups as the study has more than two groups of variables to compare. Tables 2 and 3 present exact values, and Fig. 2 provides an overall assessment of the data (Schriger et al. 2006, Lang and Secic 2006).

- *Independent variable:* In this data set, age group is considered an independent variable. At the present stage, GoI announced vaccination in three age groups. There was a consideration that trust of people on communication medium was divided into three age group.
- *Dependent variable:* In the questionnaire, participants were asked to choose their trusted mode of communication at the time of COVID-19. These seven visual

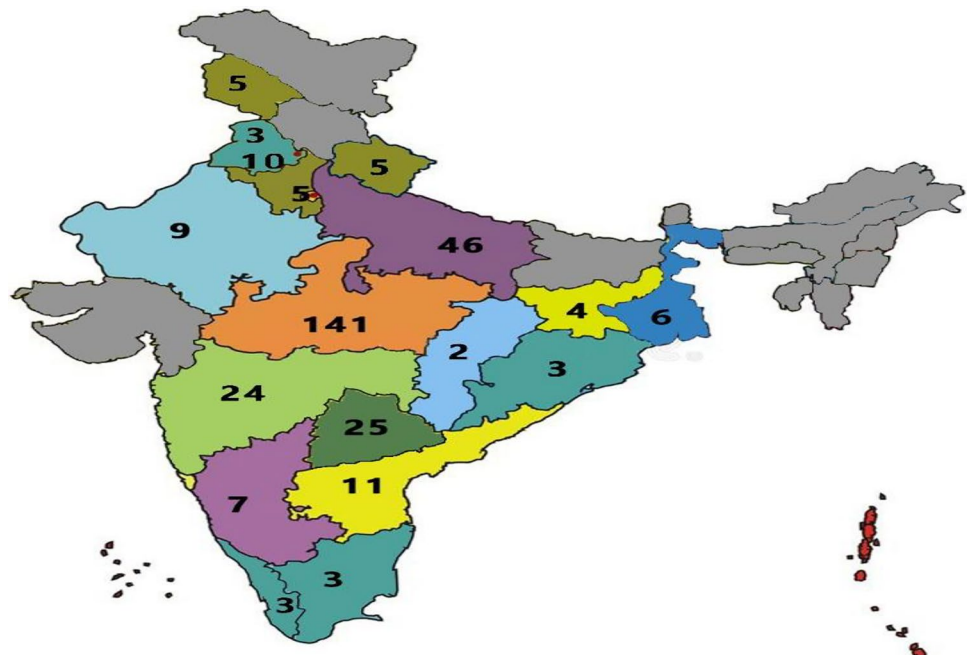
Table 3 Mean and standard deviation and ANOVA scores

Item statistics		Mean	Standard deviation	<i>N</i>		
Newspaper		.76	1.160	312		
Television		.77	1.148	312		
Social media		.74	1.161	312		
Ringtones and messages		.34	.863	312		
Local health center		.44	.957	312		
Health bulletin		.44	.950	312		
Community mobilizer		.45	.968	312		
ANOVA		Sum of squares	Degree of freedom (df)	Mean square	<i>F</i>	Sig
Between people		850.227	311	2.734		
Within people	Between items	65.421	6	10.904	13.692	.000
	Residual	1486.007	1866	.796		
	Total	1551.429	1872	.829		
Total		2401.655	2183	1.100		

* *F* value, *F*-test static value

* *Sig.*, *p*-value

Fig. 2 Comparative representation of communication medium used by different age group people



communication media tools were considered dependent variables. How people of different age groups believe on above communication medium to trust at the time of COVID-19 situations.

After collection of data, it was discovered that around 312 participants completed the survey. An attempt was made to collect data from all over country. Nearly 45.2% participants were from Madhya Pradesh and 14.74% belonged to Uttar Pradesh. Figure 3 reflects the exact number of participants from each state. Around 56% of participant's families have 60+ years of age. Nearly, 22% of people were vaccinated, 36% of them were registered and waiting for vaccination, 22% were interested in vaccination in future, and 19% of them were not interested in vaccination. Around 87% of participants' families have 45 to 60 years of age. Twelve percent of them were vaccinated, which can be justified because vaccination just started for that age group, 59% of them were registered, and 29% were not interested in vaccination.

Results

The present study examined seven modes of communication. It is discovered that conventional and comparatively old newspapers consist of 20% of share, local health centers that used paper and physical material consist around 11% share, and community mobilizer used 11% share of physical materials like pamphlet and sticker (Table 1). The total share of conventional source is 41%, and digital mode has 59% of share, which practically does not generate waste daily. For calculating material efficiency, if we assume generating product or outcome from

communication is constant, compared to conventional and digital communication tools based on daily material. The paper in conventional mode is waste after their use; recycle efficiency is maximum 45% in China (Lifset and Eckelman 2013). Still, 55% of biological material is waste. On the other hand, digital media do not have any waste material on daily basis. One hundred percent material is reused daily as people do not change TV, mobile phone daily. Hence, material efficiency is much higher in the case of digital mode. Eco-efficiency is where economic benefits are associated with an environmental cost. In this case also, eco-efficiency of digital mode of communication is much higher than conventional mode because digital mode impacts the environment for daily communication.

Derivation of hypothesis

Hypothesis 1a

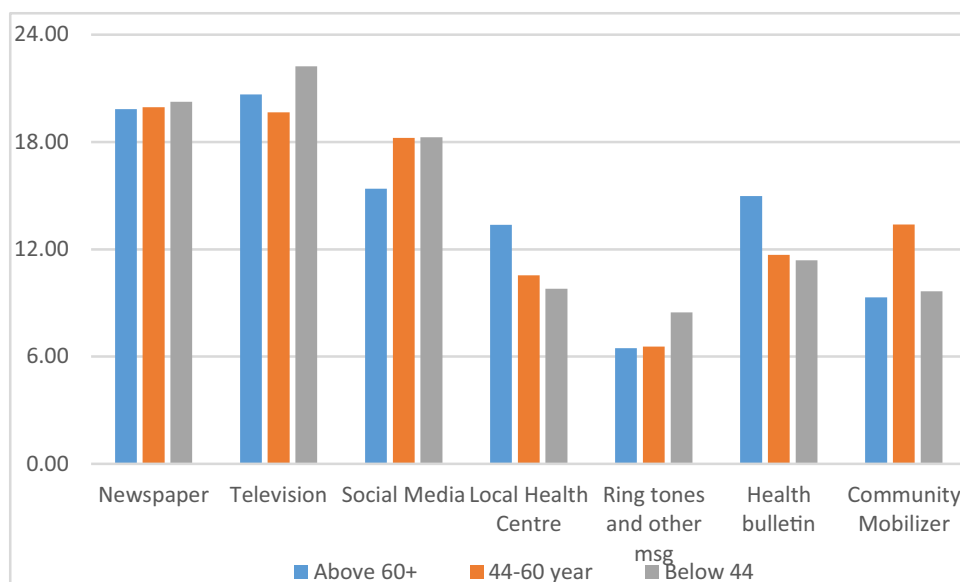
At the time of pandemic, different age groups trust different communication mediums to access information regarding the pandemic.

Hypothesis 1b

Effective medium of communication to encourage COVID-19 vaccination depends on age group.

For awareness, the national media, including traditional and digital media, disseminate correct and factual information by proactively addressing misinformation or incorrect messaging. There is a constant circulation of misinformation regarding vaccination, so they tried to stop people from taking vaccination doze till such misinformation was

Fig. 3 State wise distribution of number of participants in survey



verified. The age and education level play a significant role in encountering such misinformation.

Hypothesis 2

Communication medium used to check vaccine efficacy depends on age group.

People from academia, alternative medicine practitioners, traditional healers, naturopaths, homeopaths, etc., came forward to create awareness among different sectors. The professional bodies, including hesitant groups, medical fraternity, social influencers, and youth platforms and networks, have been utilized along with civil society organizations. There is an essential role for the elected representatives like member of parliaments (MPs) and member of legislative assemblies (MLAs), including panchayat representatives for the noble cause. The visual communication information-based graphics were needed to be circulated based on vaccine effectiveness as it went through various trials. It is safe to use the government's criteria for the eligibility of getting doses and vaccination process. It was required to educate people regarding vaccination centers and how and when to enroll. The process of registration and pre-conditions for vaccination is needed to educate people. Moreover, it is most important to make them understand the post-vaccination care and support.

Hypothesis testing

In hypotheses 1a and 1b, it is expected that people of different age groups to trust different communication sources for pandemic information and encourage vaccination. The significance value of the chi-square test was 0.00. In comparison, two communication mediums, the chi-square test significance value was 0.00 in each case which is less than the significance level (0.05) (Sharpe 2015). In hypothesis 2, it is expected from people to verify presented facts that which medium they use according to their age. Statistically, chi-square test value was 0.00, which was less than 0.05. Hence, hypothesis 2 is accepted that means people use different medium for fact check.

Discussion and managerial insights

After analyzing the results, majority of people (81% in group 1 and 71% in group 2) were interested in vaccination. Some of them were already vaccinated or registered

for vaccination and waiting for their turn. Hence, majority of people are eager to take vaccine dose. Vaccine eagerness among the people can be a driving force towards the success of this enormous vaccination drive (Sharma and Pardeshi 2021). Around 19% of people from group 1 and 29% people from group 2 were not interested in vaccination. The reason behind the same may be due to lack of trust in the vaccine; these people were hesitant. Misinformation and rumors that spreads through various communication mediums can be a reason for mistrust over vaccine efficacy. Middle-aged from 45–60 age group and elder from 60 onwards do not demonstrate much willingness to learn new media tools and are not media literate. Hence, they are more prone to get misinformation through these tools. Therefore, they quickly become prey from the rumors spreaders during pandemics (Sun et al. 2020). Thus, there is a requirement for a strategic framework to manage the misinformation. The correct information communicates better and can help build trust in a shorter time frame. To answer the question, it observed that only 20% of people prefer newspapers, and 59% prefer another digital mode to get information. Peiser (2000) reported in Newspaper Research Journal in the year 2000 that the increasing numbers of younger people who read less frequently versus decreasing numbers of older people who read more regularly newspaper readership in both Germany and the USA.

The implication is that this process will bring about further decline in the future. Hence, this trend is also visible in India. Table 4 shows the number of people who trust particular medium. Twenty-one percent people trust television and 20% trusts newspaper. To answer this question, hypothesis 1a and 1b are accepted (Sect. 4.3). It means that the trust on particular communication medium varies with age group. If we add total percent of people who prefer different digital platform for information, then 59% people prefer digital medium than conventional medium (Table 1). It was observed that the digital methods engaged communication to have at least five SDGs to achieve. Kreps and Neuhauser (2010) discussed the importance of E-health directly associated with the digital communication medium. E-health platform covered mobile health communication programs, online health information websites, health decision-support programs, interactive electronic health records, advanced telehealth applications, tailored health education programs, health care system portals, etc. Digital

Table 4 Fact check frequency on the communication medium

Communication medium frequencies		Responses		Percent of cases
		N	Percent	
Effective for the vaccination fact check	Newspaper	31	22.3%	50.0%
	Television	28	20.1%	45.2%
	Social media	20	14.4%	32.3%
	Ringtone and other messages	8	5.8%	12.9%
	Local health center	15	10.8%	24.2%
	Health bulletin	21	15.1%	33.9%
	Community mobilizer	16	11.5%	25.8%
Total		139	100.0%	224.2%

communication tools have the potential to serve the general mass in many ways in a sustainable way. Constant monitoring is needed to prevent misuse of medium. There is a complete plan for the COVID-19 vaccination for such type of situations.

However, it has been observed that effects on the environment are not included in any government plans. The question concerning the disposal of the used medical garbage, and used material such as flex printing, was not mentioned in any policy. Hence, by adopting digital medium, waste generation will be reduced and at least five SDGs can be achieved easily. As one of the respondents, specialized in the domain of ergonomics, highlighted that “If we do not sustainably do this, using low impact technologies, natural refrigerants rather than synthetic ones, we are going to have pieces of technology sitting here for the next 10, 15 years with big climate impact.”

Another respondent who was specialized in green supply chain management practices explained possible hazardous situations after completing the vaccination campaign. The expert added that “there is a need to estimate the risk of additional pollution caused by the deployment of COVID vaccine program as to make it negligible to non-existent.” Covaxin and Covisheild do not require that much refrigeration equipment, as they are conveniently hermetically sealed in an icebox that is reusable, and there is no risk of leaks. The expert continued saying that it is beneficial for less waste against medical waste. “We do not have indications that the increased use of single-use plastic as a protective material in the vaccination process has contributed to a significant overall increase in the amounts of a wasted generation.”

To answer the question that people use any communication medium for fact check of information, hypothesis 2 is accepted (Sect. 4.3) and (Table 4) shows the that 50% of respondents believe in newspapers, 45.2% television, 32.3% social media, and surprisingly 33.9% health bulletin. The results from the study conclude that during the pandemic time, most successful medium is digital one. The people of north India (nearly 75% of sample space belong to north India) (Fig. 3) are ready to accept this mode of communication. People are concerned regarding waste management and daily waste generation can be reduced adopting digital mode of communication.

The findings of this study are to be configured in the light of some limitations. The first is the sample size. The total number of participants for this study is 312. To draw a proper conclusion, this sample size may be small. There are many studies evident in literature that have used a sample size less than 312. Michaloski et al. (2019) used a final sample size of 64 people. In the same line, Aijse Willem et al. (2021) and Rahman et al. (2012) employed a sample size less than 105. Hence, by considering different constraints due to lockdown, a sample size of 312 was arranged for the present study.

There was another limitation related to the nature of participants. The data collection underwent during 1 March 2021 to 24 March 2021, this was the time of the second wave of COVID-19 in India and the partial lockdown was imposed. The COVID guidelines like social distancing and mask were required to be followed strictly. It was our limitation to go for online data collection i.e. whoever had smartphones or computers only expressed their views,

Table 5 Reliability test data

Reliability statistics		
Cronbach's alpha	Cronbach's alpha based on standardized items	Number of items
.709	.712	7

although nearly ten people were contacted personally for data collection which was around 10% of sample size.

Conclusion, limitations, and future research directions

The results from the study highlight that visual communication plays an enormous part in spreading awareness and encouraging people towards vaccination. Adequate measures are taken to effectively spread misinformation, which may lead to confusion and deny getting the vaccine. In this pandemic, visual communication is used to avoid direct contact. The print and digital media were both required, and the government and other administrative bodies had used both of them. If we combine television and social media like Facebook and WhatsApp and compare with newspapers, they had been effective infect required in this pandemic situation.

In the study, newspaper and television had the highest number of shares in all three age group categories. As expected, social media influence below 44 year age group more than other age group. No doubt, people in this age group spend more time on the internet than older people. Generally, local health centers used conventional modes to communicate message, such as posters, announcements, and hoarding. Around 13.36% of people from group 1 trust local health center, which were the highest among the three groups. Group 1 generally retire from work, so local health center communication effectively influences these age groups than other age groups. For all the data sets, Chronbach's alpha was 0.709, more significant than the accepted value (0.7) of alpha (Table 5). Therefore, the data set qualifies the reliability test, as the calculated significance value were less than the level of significance, hypotheses 1a, 1b, and 2 were accepted. Using the digital platform for spreading information is essential for green supply chain management because it will result in reduction of paper and plastic waste. Around 59% of people prefer information by digital mode, material efficiency and

eco-efficiency much higher than convention mode of material used for communication purposes. In addition, at the time of pandemic, digital mode showed their potential and reduced the risk of infection. Using the digital mode of communication, SDGs like quality education, good health and well-being, responsible consumption, decent work and economic growth, and production can be achieved easily in the communication medium. Different visual communication tools contribute to make people eager for vaccination by spreading correct and timely information. As there had been drive among the age groups and priority been given to health workers, it was observed that visual communication was effective and people used and followed those drives to reach the target audience.

As for sustainable usage of media-related wastage, the material does not have clear instructions and awareness. It may be predicted that environmental sustainability may be a different problem in future as the material used has no definite instructions to ensure reuse, controlling the wastage, and collection of waste material. There is a requirement to develop a toolkit that integrates framework with other sustainable assessments to support vaccination process, planning, and waste management. Whatever the outcome of the COVID-19 scenario, fundamental support for the masses must be ensured, which is difficult to do without solid strategic planning and multi-sectoral coordination for sustainability, which includes private sector and international help (Shammi et al. 2021). There is a requirement for a green supply chain framework for waste management after the usage of the awareness material.

Appendix

Table 6 Questionnaire for contact participants

1	ID no.:
2	Email id:
3	Place:
4	Does your family have 60 plus age of people? 1. Yes (please take the questionnaire 2) 2. No
5	Does your family have 45–59 year of age people? 1. Yes (Please take the questionnaire 3) 2. No
6	Does your family have below 44 year of age people? 1. Yes (continue) 2. No

Table 7 Questionnaire for member of family of participant

1	ID no
2	Age
3	Are you vaccinated? 1. Vaccinated 2. Registered and waiting for their turn 3. Not wanted to vaccinated
4	Which is most trusted medium of information regarding pandemic? 1. Newspaper 2. Television 3. Social Media 4. Health bulletin at state level 5. Community mobilizers and frontline workers 6. Ringtone and other messages from govt 7. Other
5	Which is the most effective medium to encourage corona vaccination drive? 1. Newspaper 2. Television 3. Social Media 4. Health bulletin at state level 5. Community mobilizers and frontline workers 6. Ringtone and other messages from govt 7. Other
6	Which medium used to check facts regarding vaccination? 1. Newspaper 2. Television 3. Social Media 4. Health bulletin at state level 5. Community mobilizers and frontline workers 6. Ringtone and other messages from govt 7. Others
7	Which medium is successful to social influence or endorsements regarding vaccination? Newspaper Television Social Media Health bulletin at state level Community mobilizers and frontline workers Ringtone and other messages from govt Other
8	The main source of information about efficacy of vaccine? 1. Newspaper 2. Television 3. Social Media 4. Health bulletin at state level 5. Community mobilizers and frontline workers 6. Ringtone and other messages from govt 7. Other

Note: Assumptions in data collection

Respondent of same age group in family answered the questionnaire independently (no influence from younger age people); if same age group member of one family had similar response, then consider them as one respondent

Abbreviations SDGs: Sustainable development goals; WHO: World Health Organization; GOI: Government of India; DCGI: Drug Controller General of India; CDSCO: Central Drugs Standard Control Organization; SEC: Subject Expert Committee; SII: Serum Institute of India; TV: Television; CAB: COVID appropriate behaviors; SOPs: Standard operation of procedures; NMRRC: National Media Rapid Response Cell; AEFI: Adverse events following immunization; ANM: Auxiliary

nursing midwifery; ASHA: Accredited Social Health Activist; AWW : Anganwadi worker; NRLM: National Rural Livelihood Mission; NSS: National Service Scheme; NYKS: Nehru Yuva Kendra Sangathan; LED: Light-emitting diode; FAQ: Frequently asked questions; MP: Member of parliaments; MLA: Member of legislative assemblies; OFMSW: Organic fraction of municipal solid waste; RQ: Research question

Author contribution Tripti Singh performed the conceptualization, validation, methodology, data collection, analysis, software, writing—methodology, theoretical implications and conclusions, writing—reviewing and editing, supervision. Sarvesh Tripathi performed the writing—abstract, introduction, and literature review, writing—reviewing and editing. Ashish Dwivedi performed the writing—results and discussions, future research directions, writing reviewing and editing. Ángel Acevedo-Duque performed writing—reviewing and editing.

Availability of data and materials The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval Not applicable (NA).

Consent to participate Not applicable (NA).

Consent for publication Not applicable (NA).

Competing interests The authors declare no competing interests.

References

- Abid N, Ikram M, Wu J, Ferasso M (2021) Sustainable production and consumption. <https://doi.org/10.1016/j.spc.2021.01.024>
- Abylkhani B, Guney M, Aiyembetov B, Yagofarova A, Sarbassov Y, Zorpas AA, Inglezakis V (2021) Detailed municipal solid waste composition analysis for Nur-Sultan City, Kazakhstan with implications for sustainable waste management in Central Asia. *Environ Sci Pollut Res* 28(19):24406–24418. <https://doi.org/10.1007/s11356-020-08431-x>
- Adebisi YA, Rabe A, Lucero-Prisno III, DE (2021) Risk communication and community engagement strategies for COVID-19 in 13 African countries. *Health Promot Perspect* 11(2):137–147. <https://doi.org/10.34172/hpp.2021.18>
- Adeniran AE, Nubi AT, Adelopo AO (2017) Solid waste generation and characterization in the University of Lagos for sustainable waste management. *Waste Manage* 67:3–10. <https://doi.org/10.1016/j.wasman.2017.05.002>
- Ahmad R, Hillman S (2021) Laboring to communicate: use of migrant languages in COVID-19 awareness campaign in Qatar. *Multilingua* 40(3):303–337. <https://doi.org/10.1515/multi-2020-0119>
- Amidon TR, Nielsen AC, Pflugfelder EH, Richards DP, Stephens SH (2021) Visual risk literacy in “flatten the curve” COVID-19 visualizations. *J Bus Tech Commun* 35(1):101–109. <https://doi.org/10.1177/1050651920963439>
- Anser MK, Ahmad M, Khan MA, Zaman K, Nassani AA, Askar SE, ... Kabbani A (2021) The role of information and communication technologies in mitigating carbon emissions: evidence from panel quantile regression. *Environ Sci Pollut Res* 28(17):21065–21084. <https://doi.org/10.1007/s11356-020-12114-y>
- Anshassi M, Laux SJ, Townsend TG (2019) Approaches to integrating sustainable materials management into waste management planning and policy. *Resour Conserv Recycl* 148:55–66. <https://doi.org/10.1016/j.resconrec.2019.04.011>
- Borghol Y, Ardon S, Carlsson N, Eager D, Mahanti A (2012) The untold story of the clones: Content-agnostic factors that impact YouTube video popularity. In Proceedings of the 18th ACM SIGKDD international conference on Knowledge discovery and data mining (pp. 1186–1194). <https://doi.org/10.1145/2339530.2339717>
- Camilleri MA (2021) Strategic dialogic communication through digital media during the COVID-19 crisis. In Strategic corporate communication in the digital age. Emerald Publishing Limited. <https://doi.org/10.1108/978-1-80071-264-520211001>
- Chou WYS, Hunt YM, Beckjord EB, Moser RP, Hesse BW (2009) Social media use in the United States: implications for health communication. *J Med Internet Res* 11(4):e48. <https://doi.org/10.2196/jmir.1249>
- Das AK, Islam MN, Billah MM, Sarker A (2021) COVID-19 and municipal solid waste (MSW) management: a review. *Environ Sci Pollut Res* 1–16. <https://doi.org/10.1007/s11356-021-13914-6>
- Eroğlu H (2021) Effects of Covid-19 outbreak on environment and renewable energy sector. *Environ Dev Sustain* 23(4):4782–4790. <https://doi.org/10.1007/s10668-020-00837-4>
- Fabian N, Lou LIT (2019) The struggle for sustainable waste management in Hong Kong: 1950s–2010s. *Worldw Waste: J Interdiscip Stud* 2(1). <https://doi.org/10.5334/wwwj.40>
- Figueiredo F, Almeida JM, Benevenuto F, Gummadi KP (2014) Does content determine information popularity in social media? A case study of YouTube videos' content and their popularity. In Proceedings of the SIGCHI conference on human factors in computing systems (pp. 979–982)
- Franke TM, Ho T, Christie CA (2012) The chi-square test: often used and more often misinterpreted. *Am J Eval* 33(3):448–458
- García-Avilés JA, de Lara A (2018) An overview of science online video: designing a classification of formats. *Communicating science and technology through online video*, 15–27
- Haseeb A, Xia E, Saud S, Ahmad A, Khurshid H (2019) Does information and communication technologies improve environmental quality in the era of globalization? An empirical analysis. *Environ Sci Pollut Res* 26(9):8594–8608. <https://doi.org/10.1007/s11356-019-04296-x>
- Ikram M, Zhang Q, Sroufe R, Ferasso M (2020) The social dimensions of corporate sustainability: an integrative framework including COVID-19 insights. *Sustainability* 12(20):8747. <https://doi.org/10.3390/su12208747>
- Jum'a L, Zimon D, Ikram M (2021) A relationship between supply chain practices, environmental sustainability and financial performance: evidence from manufacturing companies in Jordan. *Sustainability* 13(4):2152. <https://doi.org/10.3390/su13042152>
- Katsoni V, Dionysopoulou P (2018) Visual communication and ICTs for applying value co-creation strategies in hotels' websites in Athens, Greece. *Reg Sci Inq* 10(1):77–89
- Kearns C, Kearns N (2020) The role of comics in public health communication during the COVID-19 pandemic. *J Vis Commun Med* 43(3):139–149. <https://doi.org/10.1080/17453054.2020.1761248>
- Kent ML, Taylor M, White WJ (2003) The relationship between website design and organizational responsiveness to stakeholders. *Publ Relat Rev* 29:63–77
- Krause NM, Freiling I, Beets B, Brossard D (2020) Fact-checking as risk communication: the multi-layered risk of misinformation in times of COVID-19. *J Risk Res* 23(7–8):1052–1059
- Kreps GL, Neuhauser L (2010) New directions in eHealth communication: opportunities and challenges. *Patient Educ Couns* 78(3):329–336. <https://doi.org/10.1016/j.pec.2010.01.013>
- Lang T, Secic M (2006) How to report statistics in medicine: annotated guidelines for authors, editors, and reviewers, 2nd edition. American College of Physicians, Philadelphia
- Larsen RJ, Marx ML (2005) An introduction to mathematical statistics. Prentice Hall
- Li HOY, Bailey A, Huynh D, Chan J (2020) YouTube as a source of information on COVID-19: a pandemic of misinformation. *BMJ Glob Health* 5(5):e002604

- Lifset R, Eckelman M (2013) Material efficiency in a multi-material world. *Philos Trans R Soc A: Math Phys Eng Sci* 371(1986):20120002
- Martikainen J, Sakki I (2021) How newspaper images position different groups of people concerning the COVID-19 pandemic: a social representations approach. *J Commun Appl Soc Psychol*
- Mercer C (2020) Regular imaginings: the newspaper and the nation. In *Celebrating the nation* (pp. 26–46). Routledge
- Michaloski AO, Stradioto JP, de Paula Xavier AA (2019) Ergonomics study in the productive process in civil construction in the external plastering activity. In *International Conference on Applied Human Factors and Ergonomics* (pp. 245–255). Springer, Cham
- Morcillo JM, Czurda K, Trotha CY (2015) Typologies of the popular science web video. arXiv preprint [arXiv:1506.06149](https://arxiv.org/abs/1506.06149)
- Mousavi SA, Sader SR, Farhadi F, Faraji M, Falahi F (2020) Vermicomposting of grass and newspaper waste mixed with cow dung using *Eisenia fetida*: physicochemical changes. *Anal Methods* 13(40):10
- Naldi A, Herdiansyah H, Putri LS (2021) Good governance role for a sustainable solid waste management in rural communities. In: *IOP Conference Series: Earth and Environmental Science* (Vol. 819, No. 1, p. 012033). IOP Publishing
- Nishiura H, Jung SM, Linton NM, Kinoshita R, Yang Y, Hayashi K, ... Akhmetzhanov AR (2020) The extent of transmission of novel coronavirus in Wuhan, China, 2020. *J Clin Med* 9(2):330
- Obuah PF, Okon GB (2017) Environmental communication strategies of the Rivers State Waste Management Agency (RIWAMA): implications for sustainable waste management in Nigeria. *Int J Dev Sci* 6(11):1541–1558
- Oginni O (2021) COVID-19 disposable face masks: a precursor for synthesis of valuable bioproducts. *Environ Sci Pollut Res* 1–3
- Pais-Magalhães V, Moutinho V, Marques AC (2021) Scoring method of eco-efficiency using the DEA approach: evidence from European waste sectors. *Environ Dev Sustain* 23(7):9726–9748
- Peiser W (2000) Cohort replacement and the downward trend in newspaper readership. *Newsp Res J* 21(2):11–22
- Plank M, Molnár AD, Marín-Arriaza P (2017) Extending media literacy education: the popular science video workshop
- Porter COLH, Outlaw R, Gale JP, Cho HS (2019) The use of online panel data in management research: a review and recommendations. *J Manag* 45(1):319–344. <https://doi.org/10.1177/0149206318811569>
- Prentice MJ, Lindgren BW (1977) Statistical theory. *J R Stat Soc. Ser A (General)* 140(2):241. <https://doi.org/10.2307/2344888>
- Rahman MNA, Rani MRA, Rohani JM (2012) Investigation of work-related musculoskeletal disorders in wall plastering jobs within the construction industry. *Work* 43(4):507–514
- Roscoe J (2004) Multi-platform event television: reconceptualizing our relationship with television. *Commun Rev* 7(4):363–369
- Sahoo MM (2021) Significance between air pollutants, meteorological factors, and COVID-19 infections: probable evidences in India. *Environ Sci Pollut Res* 1–22. <https://doi.org/10.1007/s11356-021-12709-z>
- Sarkodie SA, Owusu PA (2021) Impact of COVID-19 pandemic on waste management. *Environ Dev Sustain* 23(5):7951–7960
- Schmitt VGH, Cequea MM, Neyra JMV, Ferasso M (2021) Consumption behavior and residential food waste during the COVID-19 pandemic outbreak in Brazil. *Sustainability* 13(7):3702
- Schriger DL, Arora S, Altman DG (2006) The content of medical journal instructions for authors. *Ann Emerg Med* 48:743–749. [749.e1-749.e4](https://doi.org/10.1016/j.annemergmed.2006.05.004)
- Schultz F, Wehmeier S (2010) Online Relations W Schweiger K Beck Eds *Handbuch Online-Kommunikation* Wiesbaden Germany. 409:433
- Schultz F, Utz S, Göritz A (2011) Is the medium the message? Perceptions of and Reactions to Crisis Communication via Twitter, Blogs and Traditional Media. *Publ Relat Rev* 37(2011):20–27. <https://doi.org/10.1016/j.pubrev.2010.12.001>
- Shammi M, Bodrud-Doza M, Islam ARMT, Rahman MM (2021) Strategic assessment of COVID-19 pandemic in Bangladesh: comparative lockdown scenario analysis, public perception, and management for sustainability. *Environ Dev Sustain* 23(4):6148–6191
- Sharma P, Pardeshi G (2021) Rollout of COVID-19 vaccination in India: a SWOT analysis. *Disaster Medicine and Public Health Preparedness*, 1–4
- Sharpe D (2015) Chi-square test is statistically significant: now what? *Pract Assess Res Eval* 20(1):8. <https://doi.org/10.7275/tbfa-x148>
- Smith N, Joffe H (2013) How the public engages with global warming: a social representations approach. *Public Underst Sci* 22(1):16–32
- Speier CJ, Mondal MM, Weichgrebe D (2018) Evaluation of compositional characteristics of organic waste shares in municipal solid waste in fast-growing metropolitan cities of India. *J Mater Cycles Waste Manage* 20(4):2150–2162
- Sun Z, Yang B, Zhang R, Cheng X (2020) Influencing factors of understanding COVID-19 risks and coping behaviors among the elderly population. *Int J Environ Res Public Health* 17(16):5889. <https://doi.org/10.3390/ijerph17165889>
- Thelwall M, Kousha K, Weller K, Puschmann C (2012) Assessing the impact of online academic videos. In *Social information research*. Emerald Group Publishing Limited. [https://doi.org/10.1108/S1876-0562\(2012\)0000005011](https://doi.org/10.1108/S1876-0562(2012)0000005011)
- Thomas A, Lang A, Douglas G (2015) Altman, Basic statistical reporting for articles published in Biomedical Journals: The “Statistical Analyses and Methods in the Published Literature” or the SAMPL Guidelines. *Int J Nurs Stud* 52(2015):5–9
- Welbourne DJ, Grant WJ (2016) Science communication on YouTube: factors that affect channel and video popularity. *Public Underst Sci* 25(6):706–718. <https://doi.org/10.1177/0963662515572068>
- White C, Raman N (1999) The World Wide Web as a public relations medium: The use of research and planning in website development. *Public Relations Review* 25:405–419
- de Vries AW, Krause F, de Looze MP (2021) The effectivity of a passive arm support exoskeleton in reducing muscle activation and perceived exertion during plastering activities. *Ergonomics*. <https://doi.org/10.1080/00140139.2020.1868581>
- Xu J, Pan R, Pong RW, Miao Y, Qian D (2016) Different models of hospital–community health centre collaboration in selected cities in China: a cross-sectional comparative study. *Int J Integr Care* 16(1). <https://doi.org/10.5334/ijic.2456>
- Zaid AA, Barakat M, Al-Qudah RA, Albetawi S, Hammad A (2020) Knowledge and awareness of community toward COVID-19 in Jordan: a cross-sectional study. *SRP* 11(7):135–142. <https://doi.org/10.31838/srp.2020.7.22>

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.