

A Comprehensive Survey-based Study on Pre and Post COVID-19 Impact Using Statistical Design on School Students in Urban Areas of Chennai

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Abstract

Aim: The aim of our study was to assay pre and post covid-19 impact on school students in Chennai and their psychological impact of online learning on them. **Material and methods:** 500 school students were surveyed for their Post COVID and Pre COVID experience in their academic life. We calculated samples by using statistical packages for social science (SPSS). **Result:** The study highlights students performed and enjoyed organized learning experience in the pre COVID-19 time to post COVID lockdown. **Conclusion:** Although the most data were statistically insignificant ($P>0.05$), based on the number of responses for given conditions in the survey, we were able to infer that post COVID-19 was more stressful and had a greater impact on school students (Chi square, Correlation).

Key-words: Novel Survey Study, Psychological Stress, Pre and Post COVID-19 Experience, School Students, Medical Informatics.

1. Introduction

The year 2020 was declared as a global pandemic after nearly 100 years. It has impacted students and educational organizations throughout the world. The COVID-19 pandemic impacted schools, colleges and universities to lock down their campuses in order to follow distance learning (Kuhfeld et al., 2020); (Malboeuf-Hurtubise et al., 2021); (Adnan & Boz, 2015); (Kampe et al., 2020); (Malboeuf-Hurtubise et al., 2021). The lockdown has been impacted on psychological stress

for school during the covid-19 pandemic. (Radwan et al., 2020; Radwan & Radwan, 2020) b; (Reimer et al., 2021) .The survey is based on school students in urban areas of Chennai and also has better awareness on the effect of online learning for school students (Chennai).

Igor and team in 2021 have reported that 16% of the high school students in Ecuador felt depressed during the learning process in the lockdown (Igor Asanov, Francisco Flores, David McKenzie, Mona Mensmann, Mathis Schulte, 2021) (Zhang et al., 2021) (Igor Asanov, Francisco Flores, David McKenzie, Mona Mensmann, Mathis Schulte, 2021)). Pursuing distance education and virtual education did not arise overnight (Chaturvedi et al., 2021); (Radwan et al., 2020); (Zhang et al., 2021). Digital learning technology has become an important learning part in this pandemic (Grubic et al., 2020); (Camacho-Zuñiga et al., 2021); (Jiao et al., 2020); (Yang et al., 2020). The heightened effect of social media simultaneously also led to increase in mental disturbances in primary school students by 81% in netherlands (Radwan et al., 2020; Radwan & Radwan, 2020) b). This was the best literature we were exposed to frame our study.

Previously our team has a rich experience in working on various research projects across multiple disciplines (Gheena & Ezhilarasan, 2019; Jose et al., 2020; Ke et al., 2019; Krishnaswamy et al., 2020; Malli Sureshbabu et al., 2019; Mehta et al., 2019; Muthukrishnan et al., 2020; M. S. Samuel et al., 2019; S. R. Samuel et al., 2020; Sathish & Karthick, 2020; Sharma et al., 2019; Varghese et al., 2019; Venu, Raju, et al., 2019; Venu, Subramani, et al., 2019; Vignesh et al., 2019; Vijayakumar Jain et al., 2019). Now the growing trend in this area motivated us to pursue this project.

We found that no Chennai area based study was done for school student's experiences in the lockdown. The survey data addresses gaps or falls in online learning. The main aim of our study is based on surveys impacted on psychological stress on school students during COVID-19 pandemics. The comparison was done between survey output using statistical tools (Pearson chi square test and correlation) and IBM version 22 from SPSS was used for analysis.

2. Materials and Methods

An online questionnaire was designed and was shared with different groups in various social media platforms. School students were asked to answer the questionnaire for our project. Sample size was calculated to be 500 students each for posts and 500 per COVID-19 responses. Sample size was calculated using Clinical.com using the Radu and teams published article (Radu et al., 2020). The Power value was G-power 80%, Alpha- 0.05.

In group1- Online survey questionnaire on pre COVID-19 experiences were used to collect responses from 500 school students. The number of responses were collected using excel scores. Similarly for group2- Online survey questionnaires on post COVID-19 experiences of school students were collected in the same way. The comparison was done between survey output using statistical tools (Pearson chi square test and correlation) and IBM version 22 from SPSS was used for analysis. We conducted a cross- sectional survey with a sample of 1000 random school students from different schools located in different zones of chennai. Data were analyzed in two major group categories as mentioned above.

Statistical Analysis

Analysis done by SPSS using chi square and correlation platforms. We didn't have any independent variables in our studies and dependent variables were responses given by the school students (chi square and correlation).

3. Results

Table 1 represents the age of school students and those who participate in our current study. Maximum number of students participating were in the age group of 17-18 for Pre COVID responses (32.8%) and 13-14 for post COVID responses (31%). The least number of responses were given by students between the ages of 11-12 (14.4%) in pre COVID survey and 10% in post COVID survey.

Table 1- Represents the Age of School Students who Participate in the Pre and Post COVID-19 Data Survey

AGE	Pre COVID responses	Pre COVID (%)	Post COVID Responses	Post COVID (%)
11-12	72	14.4%	50	10%
13-14	115	23%	155	31%
15-16	149	29.8%	153	30.6%
17-18	169	32.8%	142	28.4%
	Total=500 (for each group)			

Table 2- Represents the Gender of School Students who Participated in Pre and Post COVID-19 Data Survey

Gender	Responses	Percentage
MALE	225	45%
FEMALE	275	55%
	TOTAL=500	

Table 2 represents the male and female of school students, those who participate in COVID-19 data collection relate to our study. In this female responses dominated more when compared to male (55%). This pattern of gender responses was seen in both the surveys. Table 3 depicts the four zones of Chennai that harboured schools that were used to collect responses for this survey. The maximum number of students responded from east Chennai 155 (31%). The least number of responses were from schools that were located in south Chennai (16.8%). Table 4 represents the sample size of our study. 500 school students were surveyed for their Post COVID and Pre COVID experience in their academic life. Hence, the total size was found to be around 1000 responses. This was analysed in SPSS.

Table 3- Represents the School Student's Location who Participated in Pre and Post COVID-19 Data Survey

School location	Responses	Percentage
West Chennai	114	22.8%
East Chennai	155	31%
North Chennai	147	29.4%
South Chennai	84	16.8%
	Total=500	

Table 4- Represents the overall Sample Size of the Responses Collected in Pre and Post COVID-19 Data Survey

	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
pre_post_school_students* Group	1000	100.0%	0	0.0%	1000	100.0%

Fig. 1- Represents the Pre and Post COVID Abroad Study Plans among School Students in Chennai. X Axis: Pre COVID and Post COVID Study Abroad Plans. Y Axis: Mean Value of Pre COVID and Post COVID Study Abroad Plans +/- 1 SD

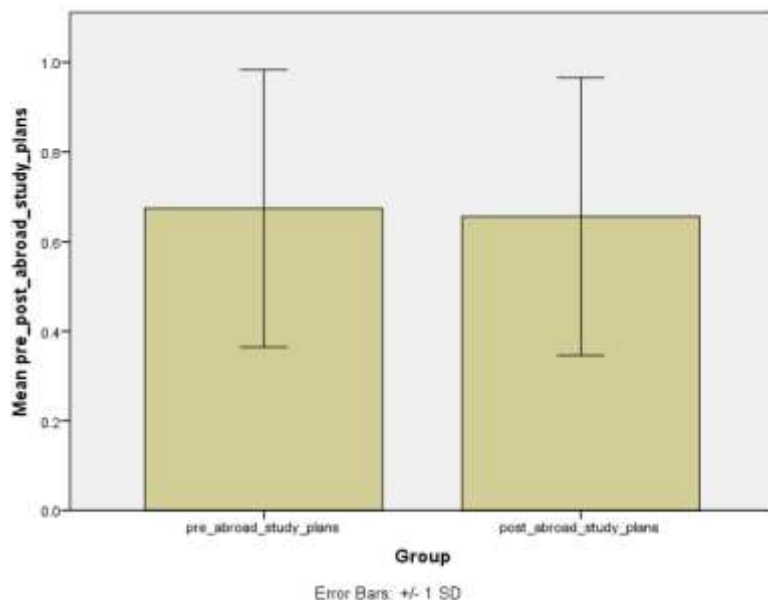


Table 5a represents the comparison of changes in abroad study plans in school students during the Pre and Post COVID times. Many students opted for postponing their abroad plans (508 responses). There was a statistical insignificance between the data ($P > 0.05$ Chi square analysis with Correlation). A negative correlation was seen between the responses which is depicted in Table 5b and 5c. The bar chart shown in Fig. 1 represents the comparison between the changes in abroad study plans in school students during the Pre and Post COVID times. There was a statistical insignificance between the data. ($P > 0.05$ Chi square analysis with Correlation). The deviation was seen to be more for post COVID-19 study abroad plans when compared to pre COVID times among school students.

Table 5a- Represents the Comparison of Responses Regarding Changes in Abroad Study Plans in School Students during the Pre and Post COVID Times. (1 Represents Continuing their Studies, 0.5 Represents Postponing their Studies, 0 Represents Cancelling their Studies)

		Group		Total
		pre_abroad_study_plans	post_abroad_study_plans	
pre_and post_abroad_study_plans	.0	39	42	81
	.5	248	260	508
	1.0	213	198	411
Total		500	500	1000

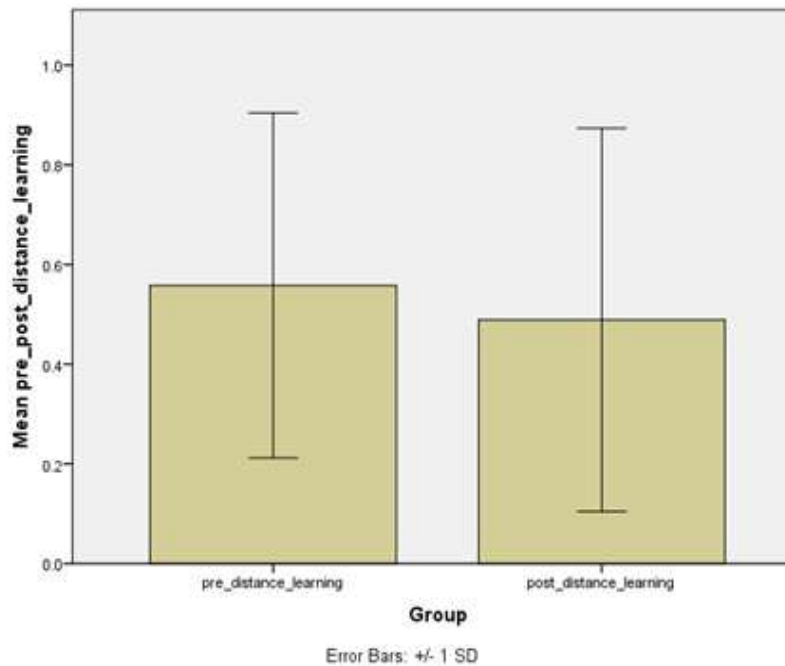
Table 5b- Represents the Comparison of Responses Regarding Changes in Abroad Study Plans in School Students during the Pre and Post COVID Times using Chi-Square Tests and Correlation Analysis

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.942 ^a	2	.624
Likelihood Ratio	.942	2	.624
Linear-by-Linear Association	.845	1	.358
N of Valid Cases	1000		

Table 5c- Correlation Regarding Changes in Abroad Study Plans in School Students during the Pre and Post COVID Times using Chi-Square Tests and Correlation Analysis

		Value	Asymp. Std. Error ^a	Approx. T ^b	Approx. Sig.
Interval by Interval	Pearson's R	-.029	.032	-.919	.358 ^c
Ordinal by Ordinal	Spearman Correlation	-.030	.032	-.952	.341 ^c
N of Valid Cases		1000			

Fig. 2- Represents the Pre and Post COVID-19 for Distance Learning among School Students in Chennai. X Axis: Pre COVID and Post COVID Distance Learning Plans. Y Axis: Mean value of Pre COVID and Post COVID Distance Learning Plans +/- 1 SD



The comparison of changes in distance study convenience in school students during the Pre and Post COVID times is tabulated in table 6a. There was a statistical significance between the data ($P < 0.05$ Chi square analysis with Correlation). There was a negative correlation between the data which is shown in Fig. 6b and 6c. Here, 1 represents study through laptops and desktop, 0.5 represents study through smart phone, 0 represents study through tablets. Most of the students studied on smartphones (459 responses). Bar chart shown in Fig. 2 represents the comparison between the changes in distance learning in school students during the Pre and Post COVID times. There was a statistical significance between the data ($P < 0.05$ Chi square analysis with Correlation). School students felt that distance education was much better and efficient during Pre COVID times as the deviation and inconsistency was very much predominant in post COVID lockdown.

Table 6a- Comparison of Responses for Changes in Distance Study Convenience in School Students during the Pre and Post COVID Times. (1 Represents Study through Laptops and Desktop, 0.5 Represents Study through Smart Phone, 0 Represents Study through Tablets)

		Group		Total
		pre_distance_learning	post_distance_learning	
pre_post_distance_learning	.0	94	153	247
	.5	254	205	459
	1.0	152	142	294
Total		500	500	1000

Table 6b- Comparison of Responses for Changes in Distance Study convenience in School Students during the Pre and Post COVID Times using Chi-Square Tests and Correlation Analysis

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	19.664 ^a	2	.000
Likelihood Ratio	19.811	2	.000
Linear-by-Linear Association	8.828	1	.003
N of Valid Cases	1000		

Table 6c- Correlation for Changes in Distance Study Convenience in School Students during the Pre and Post COVID Times

	Value	Asymp. Std. Error ^a	Approx. T ^b	Approx. Sig.
Interval by Interval Pearson's R	-.094	.031	-2.983	.003 ^c
Ordinal by Ordinal Spearman Correlation	-.092	.032	-2.910	.004 ^c
N of Valid Cases	1000			

Comparative responses for one and one discussion in school students with their teachers during the Pre and Post COVID times is represented in Fig. 7a. There was a statistical insignificance between the data ($P > 0.05$ Chi square analysis with Correlation). There was a negative correlation between the data which is shown in Fig. 7b and 7c. Here, 1 represents discussion with teachers 20 and more, 0.5 represents discussion with teachers 10-20 minutes, 0 represents discussion with teachers 15 minutes. Most of the students have one and one discussion within 10-20 Minutes (271 responses). Figure 3 represents a bar chart comparing the changes in one and one discussion in school students and their teachers during the Pre and Post COVID times. There was a statistical insignificance between the data ($P < 0.05$ Chi square analysis with Correlation). One and one discussion with the teacher increase in post COVID-19 times with higher standard deviation.

Table 7a- Comparison of Responses for One and One Discussion in School Students with their Teachers during the Pre and Post COVID Times. (1 Represents Discussion with Teachers 20 and more, 0.5 represents Discussion with Teachers 10-20 Minutes, 0 Represents Discussion with Teachers 15 Minutes)

		Group		Total
		pre_one_one_discussion	post_one_one_discussion	
pre_post_one_one_discussion	.0	298	279	577
	.5	131	140	271
	1.0	71	81	152
Total		500	500	1000

Table 7b- Comparison of Responses for One and One Discussion in School Students with their Teachers during the Pre and Post COVID Times Using Chi-Square Tests and Correlation Analysis

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1.582 ^a	2	.453
Likelihood Ratio	1.583	2	.453
Linear-by-Linear Association	1.532	1	.216
N of Valid Cases	1000		

Table 7c- Correlation for One and One Discussion in School Students with their Teachers during the Pre and Post COVID Times

		Value	Asymp. Std. Error ^a	Approx. T ^b	Approx. Sig.
Interval by Interval	Pearson's R	.039	.032	1.238	.216 ^c
Ordinal by Ordinal	Spearman Correlation	.040	.032	1.258	.209 ^c
N of Valid Cases		1000			

Fig. 3- Represents the Pre and Post COVID-19 for One and One Discussion among School Students in Chennai. X Axis: Pre COVID and Post COVID Distance Learning Plans. Y Axis: Mean value of Pre COVID and Post COVID Distance Learning Plans +/- 1 SD

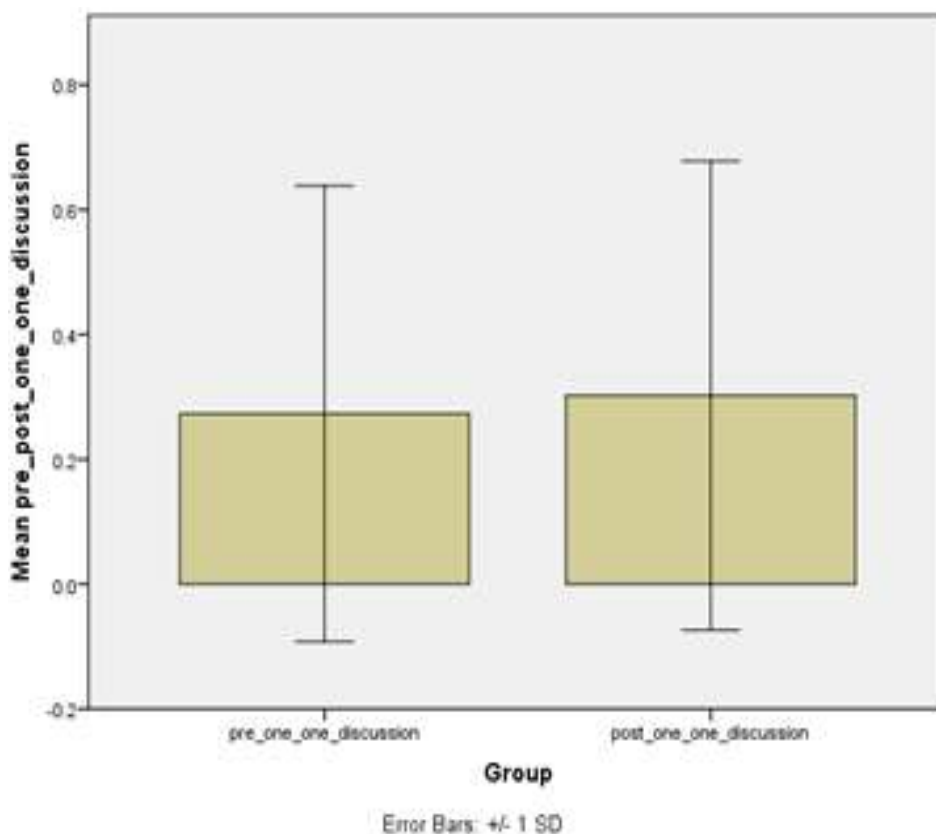


Table 8a represents the comparison of changes in the schedule of school students during the Pre and Post COVID times. There was a statistical insignificance between the data ($P > 0.05$ Chi square analysis with Correlation). There was a negative correlation seen between the data as shown in Fig. 8b and 8c. In this study, 1 represents schedule time strongly agrees, 0.5 represents schedule time is neutral, 0 represents schedule time and strongly disagrees. Bar chart shown in Fig. 4 represents the comparison between changes that occurred in the schedule of school students during Pre and Post COVID times. There was a statistical insignificance between the data ($P > 0.05$ Chi square analysis with Correlation). They felt the schedule was much more organized during pre-COVID-19 time.

Table 8a- Comparison of Response Regarding Schedule for School Students during the Pre and Post COVID times. (1 Represents Schedule Time is Strongly Agree, 0.5 Represents Schedule Time is Neutral, 0 Represents Schedule Time is Strongly Disagree)

		group		Total
		pre_School_Schedule	post_School_Schedule	
pre_post_School_Schedule	.00	144	168	312
	.50	164	192	356
	1.00	191	139	330
Total		499	499	998

Table 8b- Comparison of Response Regarding Schedule for School Students during the Pre and Post COVID Times Using Chi-Square Tests and Correlation Analysis

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.242 ^a	2	.002
Likelihood Ratio	12.281	2	.002
Linear-by-Linear Association	8.992	1	.003
N of Valid Cases	998		

Table 8c- Correlation for Schedule in School Students with their Teachers during the Pre and Post COVID Times

	Value	Asymp. Std. Error ^a	Approx. T ^b	Approx. Sig. ^c
Interval by Interval Pearson's R	-.095	.031	-3.011	.003 ^c
Ordinal by Ordinal Spearman Correlation	-.095	.031	-3.025	.003 ^c
N of Valid Cases	998			

Table 9 represents the mental health condition of school students during lockdown. Most of the students felt lockdown-based work was very stressful (31.2%). 141 students found the online learning manageable (28.2%). The student feedback on workload during lockdown is tabulated in table 10. Most of the student's felt lockdown based work was comparative more when compared to pre COVID times (182 responses).

Table 9- Represents the Mental Health Condition for School Students

Response for mental health in lockdown	Responses	Percentage
Very stressful	156	31.2%
stressful	111	22.4%
Manageable	141	28.2%
No difference	92	18.4%
	Total =500	

Table 10- Represents the Workload during Lockdown for School Students in Chennai Region

Amount of work changes in pandemics	Responses	Percentage
Increase in work	182	36.4%
Decrease in work	114	22.3%
Neither increase or decrease	155	31%
None of these	49 Total =500	9.8%

4. Discussion

Our survey suggested that post COVID-19 online studies were less effective, non- interactive, depressing and disorganized among school students in Chennai. The response analysis was found to be statistically insignificant ($P>0.005$). Majority of the respondents were females (55%) hailing from East Chennai. In the lockdown students had to postpone their study abroad plan (260 respondents) which might be due to sealing of the borders. Majority of the students used smartphones (205 respondents) while studying with a maximum of 20 minutes of one on one discussion (140 respondents) with the teacher in the pandemic. There seemed to be a drastic increase in workload among the students. The negative correlation between each data set signifies the inverse relation between the post and pre COVID learning experiences in Chennai.

Previous literature states that the lockdown has higher psychological impact on school students up to 100% (depression) which is contractually to our stress percentage (31%) (Igor Asanov, Francisco Flores, David McKenzie, Mona Mensmann, Mathis Schulte, 2021)). School students all around the world felt a large deviation from their study abroad plans, less organised learning schedule and more work load in the lockdown (Kuhfeld et al., 2020); (Grubic et al., 2020)2020). Hence we would like to infer that Chennai based school students might not be well aware of their own mental health state. This decreased stress level might be independent to the demographic country, family structure, education system and their curriculum (Chennai) (Camacho-Zuñiga et al., 2021); (Jiao et al., 2020). A survey of this kind exclusive for the school students of Chennai is the novelty in this paper.

Our institution is passionate about high quality evidence based research and has excelled in various fields ((Ezhilarasan et al., 2019; Mathew et al., 2020; Pc et al., 2018; Ramadurai et al., 2019; Ramesh et al., 2018; Sridharan et al., 2019; Vijayashree Priyadharsini, 2019). We hope this study adds to this rich legacy.

The prospective limitation in or study would be that the data given in online mode by school students might not be given very seriously. Data in person would be much more authentic.

To frame a better online learning platform curriculum for school students in the Chennai region. To have an understanding of the mental health and study preference specific for school students in the Chennai region.

5. Conclusion

Our study inferred that school students in Chennai performed and enjoyed organized learning experience in the pre COVID-19 times when compared to post COVID lockdown. Although most of the data were statistically insignificant, based on the number of responses for a given condition in the survey, we were able to infer that post COVID-19 lockdown was more stressful and had a greater impact on school students (Chi square, Correlation).

Declarations

Conflict of interests

No conflict of interest in this manuscript.

Authors Contributions

Author NV was involved in data collection, data analysis and manuscript writing. Author ND was involved in conceptualization, data validation and critical review of the manuscript.

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References

- Adnan, M., & Boz, B. (2015). Faculty Members' Perspectives on Teaching Mathematics Online: Does Prior Online Learning Experience Count? In *Turkish Online Journal of Qualitative Inquiry*, 6(1). <https://doi.org/10.17569/tojqi.60223>
- Camacho-Zuñiga, C., Pego, L., Escamilla, J., & Hosseini, S. (2021). The impact of the COVID-19 Pandemic on Students' Feelings at High school, Undergraduate, and Postgraduate levels. In *Heliyon*, e06465. <https://doi.org/10.1016/j.heliyon.2021.e06465>
- Chaturvedi, K., Vishwakarma, D.K., & Singh, N. (2021). COVID-19 and its impact on education, social life and mental health of students: A survey. In *Children and Youth Services Review*, 121, 105866. <https://doi.org/10.1016/j.childyouth.2020.105866>
- Ezhilarasan, D., Apoorva, V.S., & Ashok Vardhan, N. (2019). Syzygium cumini extract induced reactive oxygen species-mediated apoptosis in human oral squamous carcinoma cells. *Journal of Oral Pathology & Medicine: Official Publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology*, 48(2), 115–121.
- Gheena, S., & Ezhilarasan, D. (2019). Syringic acid triggers reactive oxygen species-mediated cytotoxicity in HepG2 cells. *Human & Experimental Toxicology*, 38(6), 694–702.
- Grubic, N., Badovinac, S., & Johri, A.M. (2020). Student mental health in the midst of the COVID-19 pandemic: A call for further research and immediate solutions. In *International Journal of Social Psychiatry*, 66(5), 517–518. <https://doi.org/10.1177/0020764020925108>
- Igor Asanov, Francisco Flores, David McKenzie, Mona Mensmann, Mathis Schulte. (2021). Remote-learning, time-use, and mental health of Ecuadorian high-school students during the COVID-19 quarantine. *World Development*, 138, 105225.
- Jiao, W.Y., Wang, L.N., Liu, J., Fang, S.F., Jiao, F.Y., Pettoello-Mantovani, M., & Somekh, E. (2020). Behavioral and Emotional Disorders in Children during the COVID-19 Epidemic. *The Journal of Pediatrics*, 221, 264–266.e1.
- Jose, J., Ajitha, & Subbaiyan, H. (2020). Different treatment modalities followed by dental practitioners for Ellis class 2 fracture – A questionnaire-based survey. *The Open Dentistry Journal*, 14(1), 59–65.
- Kampe, E.O. im, Lehfeld, A.S., Buda, S., Buchholz, U., & Haas, W. (2020). Surveillance of COVID-19 school outbreaks, Germany, March to August 2020. In *Eurosurveillance*, 25(38). <https://doi.org/10.2807/1560-7917.es.2020.25.38.2001645>
- Ke, Y., Al Aboody, M.S., Alturaiki, W., Alsagaby, S.A., Alfaiz, F.A., Veeraraghavan, V.P., & Mickymaray, S. (2019). Photosynthesized gold nanoparticles from *Catharanthus roseus* induces caspase-mediated apoptosis in cervical cancer cells (HeLa). *Artificial Cells, Nanomedicine, and Biotechnolog*, 47(1), 1938–1946.
- Krishnaswamy, H., Muthukrishnan, S., Thanikodi, S., Arockiaraj, G., Antony, & Venkatraman, V. (2020). Investigation of air conditioning temperature variation by modifying the structure of passenger car using computational fluid dynamics. *Thermal Science*, 24(1 Part B), 495–498.

- Kuhfeld, M., Soland, J., Tarasawa, B., Johnson, A., Ruzek, E., & Liu, J. (2020). Projecting the Potential Impact of COVID-19 School Closures on Academic Achievement. *In Educational Researcher*, 49(8), 549–565. <https://doi.org/10.3102/0013189x20965918>
- Malboeuf-Hurtubise, C., Léger-Goodes, T., Mageau, G.A., Joussemet, M., Herba, C., Chadi, N., Lefrançois, D., Camden, C., Bussi eres,  .L., Taylor, G.,  thier, M.A., & Gagnon, M. (2021). Philosophy for children and mindfulness during COVID-19: Results from a randomized cluster trial and impact on mental health in elementary school students. *Progress in Neuro-Psychopharmacology & Biological Psychiatry*, 107, 110260.
- Malli Sureshbabu, N., Selvarasu, K., Nandakumar, M., & Selvam, D. (2019). Concentrated growth factors as an ingenious biomaterial in regeneration of bony defects after periapical surgery: A report of two cases. *Case reports in dentistry*.
- Mathew, M.G., Samuel, S.R., Soni, A.J., & Roopa, K.B. (2020). Evaluation of adhesion of Streptococcus mutans, plaque accumulation on zirconia and stainless steel crowns, and surrounding gingival inflammation in primary molars: Randomized controlled trial. *Clinical oral investigations*, 24(9), 3275-3280. <https://link.springer.com/article/10.1007/s00784-020-03204-9>
- Mehta, M., Deeksha, Tewari, D., Gupta, G., Awasthi, R., Singh, H., Pandey, P., Chellappan, D.K., Wadhwa, R., Collet, T., Hansbro, P.M., Kumar, S.R., Thangavelu, L., Negi, P., Dua, K., & Satija, S. (2019). Oligonucleotide therapy: An emerging focus area for drug delivery in chronic inflammatory respiratory diseases. *Chemico-Biological Interactions*, 308, 206–215.
- Muthukrishnan, S., Krishnaswamy, H., Thanikodi, S., Sundaresan, D., & Venkatraman, V. (2020). Support vector machine for modelling and simulation of heat exchangers. *Thermal Science*, 24 (1 Part B), 499–503.
- Pc, J., Marimuthu, T., & Devadoss, P. (2018). Prevalence and measurement of anterior loop of the mandibular canal using CBCT: A cross sectional study. *Clinical Implant Dentistry and Related Research*. <https://europepmc.org/article/med/29624863>
- Radu, M.C., Schnakovszky, C., Herghelegiu, E., Ciubotariu, V.A., & Cristea, I. (2020). The Impact of the COVID-19 Pandemic on the Quality of Educational Process: A Student Survey. *International Journal of Environmental Research and Public Health*, 17(21).
<https://doi.org/10.3390/ijerph17217770>
- Radwan, E., & Radwan, A. (2020). Social and Economic Impact of School Closure during the Outbreak of the COVID-19 Pandemic: A Quick Online Survey in the Gaza Strip. *In Pedagogical Research*, 5(4), em0068. <https://doi.org/10.29333/pr/8254>
- Radwan, E., Radwan, A., & Radwan, W. (2020). The role of social media in spreading panic among primary and secondary school students during the COVID-19 pandemic: An online questionnaire study from the Gaza Strip, Palestine. *In Heliyon*, 6(12), e05807.
<https://doi.org/10.1016/j.heliyon.2020.e05807>
- Ramadurai, N., Gurunathan, D., Samuel, A.V., Subramanian, E., & Rodrigues, S.J.L. (2019). Effectiveness of 2% Articaine as an anesthetic agent in children: randomized controlled trial. *Clinical Oral Investigations*, 23(9), 3543–3550.
- Ramesh, A., Varghese, S., Jayakumar, N.D., & Malaiappan, S. (2018). Comparative estimation of sulfiredoxin levels between chronic periodontitis and healthy patients - A case-control study. *Journal of Periodontology*, 89(10), 1241–1248.
- Reimer, D., Smith, E., Andersen, I.G., & Sortk er, B. (2021). What happens when schools shut down? Investigating inequality in students’ reading behavior during Covid-19 in Denmark. *Research in Social Stratification and Mobility*, 71(100568), 100568.

- Samuel, M.S., Bhattacharya, J., Raj, S., Santhanam, N., Singh, H., & Pradeep Singh, N.D. (2019). Efficient removal of Chromium (VI) from aqueous solution using chitosan grafted graphene oxide (CS-GO) nanocomposite. *International Journal of Biological Macromolecules*, 121, 285–292.
- Samuel, S.R., Acharya, S., & Rao, J.C. (2020). School Interventions-based Prevention of Early-Childhood Caries among 3-5-year-old children from very low socioeconomic status: Two-year randomized trial. *Journal of Public Health Dentistry*, 80(1), 51–60.
- Sathish, T., & Karthick, S. (2020). Wear behaviour analysis on aluminium alloy 7050 with reinforced SiC through taguchi approach. *Journal of Japan Research Institute for Advanced Copper-Base Materials and Technologies*, 9(3), 3481–3487.
- Sharma, P., Mehta, M., Dhanjal, D.S., Kaur, S., Gupta, G., Singh, H., Thangavelu, L., Rajeshkumar, S., Tambuwala, M., Bakshi, H.A., Chellappan, D.K., Dua, K., & Satija, S. (2019). Emerging trends in the novel drug delivery approaches for the treatment of lung cancer. *Chemico-Biological Interactions*, 309, 108720.
- Sridharan, G., Ramani, P., Patankar, S., & Vijayaraghavan, R. (2019). Evaluation of salivary metabolomics in oral leukoplakia and oral squamous cell carcinoma. *Journal of Oral Pathology & Medicine: Official Publication of the International Association of Oral Pathologists and the American Academy of Oral Pathology*, 48(4), 299–306.
- Varghese, S.S., Ramesh, A., & Veeraiyan, D.N. (2019). Blended Module-Based Teaching in Biostatistics and Research Methodology: A Retrospective Study with Postgraduate Dental Students. *Journal of Dental Education*, 83(4), 445–450.
- Venu, H., Raju, V.D., & Subramani, L. (2019). Combined effect of influence of nano additives, combustion chamber geometry and injection timing in a DI diesel engine fuelled with ternary (diesel-biodiesel-ethanol) blends. *Energy*, 174, 386–406.
- Venu, H., Subramani, L., & Raju, V.D. (2019). Emission reduction in a DI diesel engine using exhaust gas recirculation (EGR) of palm biodiesel blended with TiO₂ nano additives. *Renewable Energy*, 140, 245–263.
- Vignesh, R., Sharmin, D., Rekha, C.V., Annamalai, S., & Baghkomeh, P.N. (2019). Management of Complicated Crown-Root Fracture by Extra-Oral Fragment Reattachment and Intentional Reimplantation with 2 Years Review. *Contemporary Clinical Dentistry*, 10(2), 397–401.
- Vijayakumar Jain, S., Muthusekhar, M.R., Baig, M.F., Senthilnathan, P., Loganathan, S., Abdul Wahab, P.U., Madhulakshmi, M., & Vohra, Y. (2019). Evaluation of Three-Dimensional Changes in Pharyngeal Airway Following Isolated Lefort One Osteotomy for the Correction of Vertical Maxillary Excess: A Prospective Study. *Journal of Maxillofacial and Oral Surgery*, 18(1), 139–146.
- Vijayashree Priyadharsini, J. (2019). In silico validation of the non-antibiotic drugs acetaminophen and ibuprofen as antibacterial agents against red complex pathogens. *Journal of Periodontology*, 90(12), 1441–1448.
- Yang, D., Swekwi, U., Tu, C.C., & Dai, X. (2020). Psychological effects of the COVID-19 pandemic on Wuhan's high school students. *Children and Youth Services Review*, 119, 105634.
- Zhang, X., Huang, P.F., Li, B.Q., Xu, W.J., Li, W., & Zhou, B. (2021). The influence of interpersonal relationships on school adaptation among Chinese university students during COVID-19 control period: Multiple mediating roles of social support and resilience. *Journal of Affective Disorders*, 285, 97–104.