Impact of Lockdown during COVID-19 on Annual Effective Dose Equivalent values of Natural Gamma Radiation

Manoj Kumar Jindal (manojjindal1989@gmail.com)
Bhilai Institute of Technology https://orcid.org/0000-0002-3420-1412
Santosh Kumar Sar
Bhilai Institute of Technology https://orcid.org/0000-0002-2545-1479

Short Report

Keywords: Annual Effective Dose Equivalent, Lockdown, COVID-19, Gamma Dose Rate, Chhattisgarh region

Posted Date: September 15th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-57140/v2

Version of Record: A version of this preprint was published on October 12th, 2020. See the published version at https://doi.org/10.1007/s10967-020-07432-x.

Abstract

The study aimed to find the impact of COVID-19 on values of Annual Effective Dose Equivalent of the natural Gamma dose rate from Balod, Durg and Bemetara districts of Chhattisgarh (India). COVID-19 is a severe problem for many countries and to control and prevent the spread of this problem implemented the lockdown approach in many countries, including India. In this lockdown situation, almost all people are staying at home for 24 hours. Due to the present status of COVID-19, the Indian government also fixed the 67 days lockdown and one day was already successfully done as Janta Curfew, which worked the same as a lockdown. The value of indoor gamma dose rates was reported higher in most places as compared to the outdoor gamma dose rate, but in this pandemic situation, occupancy factor values are not applicable as recommended by UNSCEAR for calculation of Annual Effective Dose Equivalent (AEDE). Therefore, the present study introduces the new equations, which can measure the extra AEDE value during the lockdown for adults, children and infants.

Introduction

COVID-19 due to Coronavirus is distressing many countries and their territories around the world [1, 2]. This pandemic emerged during December 2019 from Wuhan city of China to other parts of the world [3]. In this problematic situation, every country is working on applying many strategies to prevent and control the spread of coronavirus among their people. Many countries already applied tremendous strategies, which include one of the dominant strategies is lockdown of state or country. The Indian government has also adopted this strategy and before applying lockdown, the prime minister of India has requested to Indian public to follow self-lockdown as called Janta Curfew for one day (22 March 2020) and which was efficacious. The Indian government has declared a total of 21 days (from 24 March 2020 to 14 April 2020) as a lockdown, which extended three times from 15 April 2020 to 3 May 2020; 4 May 2020 to 17 May 2020 and 18 May 2020 to 31 May 2020 [4]. The Annual effective dose of gamma radiation is the most important value to estimate the effect of gamma radiation on mankind, UNSCEAR was given the formula for calculation of these values and this formula is utilized around the world for estimation of AEDE values [5]. The annual effective dose is calculated by using indoor and outdoor gamma dose and based on many studies, indoor gamma dose rate values are usually higher than compared to the outdoor gamma dose rate, except in a few countries or territories of the world [5, 6]. Lockdown situations where movement restricted will affect the AEDE values because, in this period, the public stays inside of the house instead of outside. Hence, values of the annual gamma dose rate will change in the lockdown period. The intention of this study was to estimate the extra AEDE value of the natural background gamma dose rate during this lockdown period for adults, children and infants from areas (Balod, Durg and Bemetara) of the Chhattisgarh region.

Material And Methodology

All researchers usually used the formulas for calculation of AEDE value, which were reported by UNSCEAR by applying the indoor and outdoor gamma dose rate, which was as [5, 7]:

$$AEDE(indoor/outdoor) = D(indoor/outdoor) \times T \times conversion\ coefficient \times occupancy\ factor \quad (1)$$

where:

$D_{(indoor)}$ = Indoor absorbed gamma dose rate (nGy/h)

$D_{(outdoor)}$ = Outdoor absorbed gamma dose rate (nGy/h)

T = Time conversion factor (hour into a year) (1year = 8760 hours)

The dose conversion coefficient value for an adult was 0.7 (UNSCEAR), and the values of the occupancy factor for outdoor and indoor were 0.2 and 0.8, respectively [5]. The conversion coefficient values for the children and infants were approximately 10 and 30 % higher than those for adults [5]. The value of total AEDE value was calculated by the accumulation of the AEDE values of indoor and outdoor gamma dose rates.

In India (including all state), 68 days set for lockdown means people of the country will be spending 1632 hours inside of houses. It indicated that out of 8670 hours in a year, people utilize 1632 hours inside of houses. Moreover, the remaining hours of the year 7128 hours can be utilized as the normal distribution of occupancy factor 0.8 and 0.2 for indoor and outdoor. As of now (18 July 2020), the COVID-19 condition is still continuing [1, 4]. The lockdown of the few places of Chhattisgarh State might be increased by the central government or state government of India. The Indian government has declared June and July month as unlock-1 and unlock-2 means all work will start slowly but still education or few other organizations such as schools, colleges closed.

Results And Discussion

The Annual effective dose values were already published by many researchers and in our previous studies [6-9]. Table 1 show the calculation of extra annual effective dose values by using Balod, Durg and Bemetara districts indoor and outdoor gamma dose rate values [6-9]. In columns, D and E present the AEDE values of indoor and outdoor, respectively, by using the 7128 hours after subtracting the 1632 hours of lockdown (period of lockdown) [4]. F column indicates the AEDE value during lockdown and the addition of D, E and F is the total AEDE value with 68 days lockdown. Annual effective dose values were also

calculated by using equation 1 with occupancy factor of 0.8 and 0.2 for indoor and outdoor respectively, and these values were subtracted from lockdown values to obtain the total extra dose, which can be received by people during the lockdown period, which was precisely the same as calculated. The same value can be calculated directly by using the following formula.

$$Extra\ AEDE\ value\ during\ lockdown = D(indoor - outdoor) \times Time\ of\ lockdown \times conversion\ coefficient \times difference\ in\ occupancy\ factor \quad (2)$$

$$Extra\ AEDE\ value\ during\ lockdown\ for\ adult = [(X \times 228) + \{(-2.42) \times e^{-11}\}] \quad (3)$$

$$Extra\ AEDE\ value\ during\ lockdown\ for\ children = [(X \times 261) + \{(-3.78) \times e^{-11}\}] \quad (4)$$

$$Extra\ AEDE\ value\ during\ lockdown\ for\ infants = [(X \times 294) + \{(-3.02) \times e^{-11}\}] \quad (5)$$

where X= difference between indoor and outdoor gamma dose rate

The range of difference between indoor and outdoor gamma dose rate was found from -20 to124 nSv/h. These difference values were used to calculate the extra annual dose rate during the lockdown period for adults, children and infants. The resultant values showed a strong correlation between indoor and outdoor gamma dose rate. The relation between both can be calculated by using equations 3, 4 and 5 for adults, children and infants, respectively. The relationship between extra gamma dose rate values during lockdown and differences in indoor-outdoor gamma dose rate are shown in Figs. 1, 2 and 3 for adults, children and infants, respectively. The extra dose rate ranged from -4.57 to 28.33 μSv/y; -5.22 to 32.38 μSv/y and -5.88 to 36.43 μSv/y for adults, children and infants respectively.

Table 1 Calculation of extra AEDE values during the lockdown period for adults, children and infants from Balod, Durg, Bemetara districts [6-9].

).	Indoor Gamma Dose rate (nSv/h) (A)	Outdoor Gamma Dose rate (nSv/h) (B)	Indoor-Outdoor (C)	For Adult								For Children
				D=Ax7128x0.7x0.8	E=Bx7128x0.7x0.2	F=Ax1632x0.7x1	Total AEDE with lockdown =D+E+F	G=Ax8760x0.7x0.8	H=Bx8760x0.7x0.2	Total AEDE without lockdown = G+H	Total AEDE with lockdown- Total AEDE without lockdown (Extra Dose = Cx1632x0.7x0.2 nSv/y)	Cx1632x0.8x((nSv/y)
	194	133	61	774386	132723	221626	1128735	951686	163111	1114798	13937	15928
	198	142	56	790353	141705	226195	1158252	971309	174149	1145458	12795	14623
	211	154	57	842244	153680	241046	1236971	1035082	188866	1223947	13023	14884
	184	163	21	734469	162661	210202	1107332	902630	199903	1102534	4798	5484
	165	126	39	658627	125738	188496	972861	809424	154526	963950	8911	10184
	178	146	32	710519	145696	203347	1059563	873197	179054	1052251	7311	8356
	201	160	41	802328	159667	229622	1191617	986026	196224	1182250	9368	10706
	181	140	41	722494	139709	206774	1068977	887914	171696	1059610	9368	10706
	157	170	-13	626694	169646	179357	975697	770179	208488	978667	-2970	-3395
	185	147	38	738461	146694	211344	1096499	907536	180281	1087817	8682	9923
	198	145	53	790353	144698	226195	1161246	971309	177828	1149137	12109	13839
	232	159	73	926070	158669	265037	1349776	1138099	194998	1333097	16679	19062
	174	107	67	694552	106777	198778	1000107	853574	131225	984799	15308	17495
	175	126	49	698544	125738	199920	1024202	858480	154526	1013006	11196	12795
	132	103	29	526902	102786	150797	**780484**	647539	126319	**773858**	6626	7572
	180	127	53	718502	126736	205632	1050870	883008	155753	1038761	12109	13839
	182	133	49	726486	132723	207917	1067126	892819	163111	1055930	11196	12795
	185	120	65	738461	119750	211344	1069555	907536	147168	1054704	14851	16973
	221	115	106	882161	114761	252470	1249392	1084138	141036	1225174	24219	27679
	200	119	81	798336	118752	228480	1145568	981120	145942	1127062	18507	21151
	174	147	27	694552	146694	198778	1040024	853574	180281	1033855	6169	7050
	198	135	63	790353	134719	226195	1151267	971309	165564	1136873	14394	16451
	192	139	53	766403	138711	219341	1124454	941875	170470	1112345	12109	13839
	232	130	102	926070	129730	265037	1320836	1138099	159432	1297531	23305	26634
	189	179	10	754428	178628	215914	1148969	927158	219526	1146684	2285	2611
	196	125	71	782369	124740	223910	1131020	961498	153300	1114798	16222	18540
	213	127	86	850228	126736	243331	1220295	1044893	155753	1200646	19649	22456
	221	126	95	882161	125738	252470	1260370	1084138	154526	1238664	21706	24806
	260	165	95	1037837	164657	297024	1499518	1275456	202356	1477812	21706	24806
	179	135	44	714511	134719	204490	1053720	878102	165564	1043666	10053	11489
	209	153	56	834261	152682	238762	1225704	1025270	187639	1212910	12795	14623
	177	158	19	706527	157671	202205	1066404	868291	193771	1062062	4341	4961
	193	154	39	770394	153680	220483	1144557	946781	188866	1135646	8911	10184
	181	201	-20	722494	200582	206774	1129850	887914	246506	1134420	**-4570**	**-5222**
	176	165	11	702536	164657	201062	1068255	863386	202356	1065742	2513	2872
	198	157	41	790353	156673	226195	1173221	971309	192545	1163854	9368	10706
	188	129	59	750436	128732	214771	1093939	922253	158206	1080458	13480	15406
	199	147	52	794344	146694	227338	1168376	976214	180281	1156495	11881	13578
	176	120	56	702536	119750	201062	1023348	863386	147168	1010554	12795	14623
	245	188	57	977962	187609	279888	1445459	1201872	230563	1432435	13023	14884
	150	123	27	598752	122744	171360	892856	735840	150847	886687	6169	7050
	167	129	38	666611	128732	190781	986123	819235	158206	977441	8682	9923
	165	112	53	658627	111767	188496	958890	809424	137357	946781	12109	13839
	249	169	80	993928	168648	284458	1447034	1221494	207262	1428756	18278	20890
	186	168	18	742452	167651	212486	1122589	912442	206035	1118477	4113	4700
	183	123	60	730477	122744	209059	1062281	897725	150847	1048572	13709	15667
	201	157	44	802328	156673	229622	1188624	986026	192545	1178570	10053	11489
	255	194	61	1017878	193596	291312	**1502787**	1250928	237922	**1488850**	13937	15928
	256	165	91	1021870	164657	292454	1478981	1255834	202356	1458190	20792	23762
	187	154	33	746444	153680	213629	1113753	917347	188866	1106213	7540	8617
	196	135	61	782369	134719	223910	1140999	961498	165564	1127062	13937	15928
	198	124	74	790353	123742	226195	1140290	971309	152074	1123382	16908	19323
	204	123	81	814303	122744	233050	1170096	1000742	150847	1151590	18507	21151
	177	133	44	706527	132723	202205	1041456	868291	163111	1031402	10053	11489
	189	140	49	754428	139709	215914	1110050	927158	171696	1098854	11196	12795
	188	153	35	750436	152682	214771	1117889	922253	187639	1109892	7997	9139
	160	120	40	638669	119750	182784	941203	784896	147168	932064	9139	10445
	162	151	11	646652	150686	185069	982407	794707	185186	979894	2513	2872
	157	157	0	626694	156673	179357	962724	770179	192545	962724	0	0
	148	126	22	590769	125738	169075	885582	726029	154526	880555	5027	5745
	185	165	20	738461	164657	211344	1114462	907536	202356	1109892	4570	5222
	167	113	54	666611	112765	190781	970156	819235	138583	957818	12338	14100
	172	104	68	686569	103784	196493	986845	843763	127546	971309	15537	17756

	180	102	78	718502	101788	205632	1025922	883008	125093	1008101	17821	20367
	169	118	51	674594	117755	193066	985414	829046	144715	973762	11652	13317
	155	115	40	618710	114761	177072	910543	760368	141036	901404	9139	10445
	180	169	11	718502	168648	205632	1092783	883008	207262	1090270	2513	2872
	178	146	32	710519	145696	203347	1059563	873197	179054	1052251	7311	8356
	145	126	19	578794	125738	165648	870180	711312	154526	865838	4341	4961
	145	102	43	578794	101788	165648	846229	711312	125093	836405	9825	11228
	165	105	60	658627	104782	188496	951905	809424	128772	938196	13709	15667
	171	124	47	682577	123742	195350	1001670	838858	152074	990931	10739	12273
	237	223	14	946028	222536	270749	1439313	1162627	273487	1436114	3199	3656
	210	143	67	838253	142703	239904	1220859	1030176	175375	1205551	15308	17495
	205	189	16	818294	188607	234192	1241093	1005648	231790	1237438	3656	4178
	184	149	35	734469	148690	210202	1093361	902630	182734	1085364	7997	9139
	170	101	69	678586	100790	194208	973584	833952	123866	957818	15765	18017
	186	121	65	742452	120748	212486	1075687	912442	148394	1060836	14851	16973
	212	133	79	846236	132723	242189	1221148	1039987	163111	1203098	18050	20628
	141	124	17	562827	123742	161078	847647	691690	152074	843763	3884	4439
	173	127	46	690561	126736	197635	1014932	848669	155753	1004422	10510	12012
	174	134	40	694552	133721	198778	1027051	853574	164338	1017912	9139	10445
	178	166	12	710519	165655	203347	1079521	873197	203582	1076779	2742	3133
	159	145	14	634677	144698	181642	961017	779990	177828	957818	3199	3656
	136	144	-8	542868	143700	155366	841935	667162	176602	843763	-1828	-2089
	166	138	28	662619	137713	189638	989970	814330	169243	983573	6397	7311
	154	129	25	614719	128732	175930	919380	755462	158206	913668	5712	6528
	172	103	69	686569	102786	196493	985848	843763	126319	970082	15765	18017
	201	165	36	802328	164657	229622	1196607	986026	202356	1188382	8225	9400
	197	136	61	786361	135717	225053	1147131	966403	166790	1133194	13937	15928
	150	117	33	598752	116757	171360	886869	735840	143489	879329	7540	8617
	172	141	31	686569	140707	196493	1023768	843763	172922	1016686	7083	8095
	181	124	57	722494	123742	206774	1053011	887914	152074	1039987	13023	14884
	231	107	124	922078	106777	263894	1292750	1133194	131225	1264418	**28332**	**32379**
	171	107	64	682577	106777	195350	984705	838858	131225	970082	14623	16712
	174	184	-10	694552	183617	198778	1076947	853574	225658	1079232	-2285	-2611
	182	147	35	726486	146694	207917	1081097	892819	180281	1073100	7997	9139
	202	144	58	806319	143700	230765	1180785	990931	176602	1167533	13252	15145
	154	147	7	614719	146694	175930	937343	755462	180281	935743	1599	1828
0	158	106	52	630685	105780	180499	916964	775085	129998	905083	11881	13578
1	177	112	65	706527	111767	202205	1020499	868291	137357	1005648	14851	16973
2	195	113	82	778378	112765	222768	1113911	956592	138583	1095175	18735	21412
3	208	155	53	830269	154678	237619	1222566	1020365	190092	1210457	12109	13839
4	192	153	39	766403	152682	219341	1138425	941875	187639	1129514	8911	10184
5	196	137	59	782369	136715	223910	1142995	961498	168017	1129514	13480	15406
6	153	144	9	610727	143700	174787	929215	750557	176602	927158	2056	2350
7	204	142	62	814303	141705	233050	1189057	1000742	174149	1174891	14166	16189
8	151	170	-19	602744	169646	172502	944892	740746	208488	949234	-4341	-4961
9	202	158	44	806319	157671	230765	1194756	990931	193771	1184702	10053	11489
0	237	143	94	946028	142703	270749	1359480	1162627	175375	1338002	21477	24545
1	205	156	49	818294	155676	234192	1208162	1005648	191318	1196966	11196	12795
2	253	160	93	1009895	159667	289027	1458589	1241117	196224	1437341	21249	24284
3	177	152	25	706527	151684	202205	1060416	868291	186413	1054704	5712	6528
4	211	147	64	842244	146694	241046	1229985	1035082	180281	1215362	14623	16712
5	202	151	51	806319	150686	230765	1187770	990931	185186	1176118	11652	13317
6	198	154	44	790353	153680	226195	1170228	971309	188866	1160174	10053	11489
7	198	154	44	790353	153680	226195	1170228	971309	188866	1160174	10053	11489
8	202	151	51	806319	150686	230765	1187770	990931	185186	1176118	11652	13317
9	205	134	71	818294	133721	234192	1186208	1005648	164338	1169986	16222	18540
0	240	145	95	958003	144698	274176	1376878	1177344	177828	1355172	21706	24806
1	226	145	81	902120	144698	258182	1305000	1108666	177828	1286494	18507	21151
2	192	181	11	766403	180624	219341	1166367	941875	221978	1163854	2513	2872
3	249	162	87	993928	161663	284458	1440049	1221494	198677	1420171	19878	22717
4	183	117	66	730477	116757	209059	1056293	897725	143489	1041214	15080	17234
5	207	144	63	826278	143700	236477	1206455	1015459	176602	1192061	14394	16451
6	186	175	11	742452	174636	212486	1129575	912442	214620	1127062	2513	2872
7	186	171	15	742452	170644	212486	1125583	912442	209714	1122156	3427	3917
8	188	166	22	750436	165655	214771	1130862	922253	203582	1125835	5027	5745
9	198	185	13	790353	184615	226195	1201163	971309	226884	1198193	2970	3395
0	177	138	39	706527	137713	202205	1046445	868291	169243	1037534	8911	10184
1	200	170	30	798336	169646	228480	1196462	981120	208488	1189608	6854	7834
2	175	148	27	698544	147692	199920	1046156	858480	181507	1039987	6169	7050
3	223	159	64	890145	158669	254755	1303569	1093949	194998	1288946	14623	16712
4	184	129	55	734469	128732	210202	1073402	902630	158206	1060836	12566	14362
5	236	153	83	942036	152682	269606	1364325	1157722	187639	1345361	18964	21673

6	198	152	46	790353	151684	226195	1168232	971309	186413	1157722	10510	12012
7	210	153	57	838253	152682	239904	1230839	1030176	187639	1217815	13023	14884
8	145	141	4	578794	140707	165648	885148	711312	172922	884234	914	1044
9	187	165	22	746444	164657	213629	1124730	917347	202356	1119703	5027	5745
0	224	154	70	894136	153680	255898	1303714	1098854	188866	1287720	15994	18278
1	205	171	34	818294	170644	234192	1223131	1005648	209714	1215362	7768	8878
2	170	154	16	678586	153680	194208	1026473	833952	188866	1022818	3656	4178
3	251	176	75	1001912	175634	286742	1464288	1231306	215846	1447152	17136	19584
4	165	145	20	658627	144698	188496	991822	809424	177828	987252	4570	5222
5	201	135	66	802328	134719	229622	1166669	986026	165564	1151590	15080	17234
6	207	124	83	826278	123742	236477	1186497	1015459	152074	1167533	18964	21673
7	196	165	31	782369	164657	223910	1170936	961498	202356	1163854	7083	8095
8	195	162	33	778378	161663	222768	1162809	956592	198677	1155269	7540	8617
9	191	164	27	762411	163659	218198	1144268	936970	201130	1138099	6169	7050
0	197	132	65	786361	131725	225053	1143139	966403	161885	1128288	14851	16973
1	202	181	21	806319	180624	230765	1217708	990931	221978	1212910	4798	5484
2	224	115	109	894136	114761	255898	1264795	1098854	141036	1239890	24904	28462
3	191	189	2	762411	188607	218198	1169216	936970	231790	1168759	457	522
4	221	156	65	882161	155676	252470	1290307	1084138	191318	1275456	14851	16973
erage value											10657 nSv/y	12179 nSv/y

Conclusion

- It has been observed that the calculation of extra AEDE values through equation 2 is the same as calculated by using AEDE separately; hence, it is suitable for estimation of additional natural gamma dose rate values during lockdown situations.
- This study will be helpful in calculating the extra annual effective dose value, and the mean values of extra AEDE for Balod, Durg and Beemetara districts of India were 10.66 μSv/y, 12.18 μSv/y and 13.70 μSv/y for adult, children and infants respectively.
- This study will be applicable in lockdown situations only, and formula (Equations 3, 4 and 5) can be used for the estimation of extra AEDE values of natural gamma dose in many countries during 2020 due to COVID-19.
- The value of AEDE due to lockdown have been obtained highest and lowest 28332 nSv/y and -4570 nSv/y respectively at area Bortara (Bemetara district) and Piparchhedi (Balod district).
- During the COVID-19 most of the people are inside the shelter so the scenario of radiation upon outside and inside are drastically varied. Due to population, it varies somewhere low and high; however, geology and civil structural may be one cause of this variation.
- The range of relative difference in lockdown vs. non-lockdown AEDEs varies from -0.46 to 2.24% (-4570 to 28332 nSv/y, absolute difference). The impact of lockdown is appears inconsequential because the variability across the locations studied have a 48% relative difference in non-lockdown AEDE values (773858 - 1488850 nSv/y) and lockdown AEDE values (780484 - 1502787 nSv/y). In other words, while the lockdown produces a small difference in AEDE, the total effect is small compared to the variability in AEDE.
- This study will be beneficial for mankind to predict the annual gamma dose rate during the pandemic situation.

Declarations

Conflict of Interest: The authors declare that they have no conflict of interest.

References

1. Coronavirus disease (COVID-2019) situation reports, available at https://www.who.int/emergencies/diseases/novel-coronavirus-2019 (accessed on 10 July 2020)
2. Worldometer, available at https://www.worldometers.info/coronavirus (accessed 18 July 2020)
3. Mackenzie JS and Smith DW (2020) COVID-19: a novel zoonotic disease caused by a coronavirus from China: what we know and what we don't. Microbiology Australia. MA20013. Advance online publication. DOI 10.1071/MA20013
4. National Portal of India, available at https://www.india.gov.in and https://www.mygov.in/covid-19 (accessed on 10 July 2020)
5. UNSCEAR (United Nation Scientific Committee on the effect of Atomic Radiations) (2000) Ionizing radiation. Sources and biological effects report to the general assembly with scientific annexes. New York, United Nations.
6. Jindal MK and Sar SK (2020) Blueprint of indoor gamma dose rate through statistical modelling for Kabirdham district. J Radioanal Nucl Chem. 325:121–131 DOI 10.1007/s10967-020-07205-6
7. Jindal MK, Sar SK, Singh S and Arora A (2018) Risk assessment from gamma dose rate in Balod District of Chhattisgarh, India. J Radioanal Nucl Chem. 317(1):387-395. DOI 10.1007/s10967-018-5846-9
8. Jindal MK, Sar SK, Arun A, Singh S, Sahu M and Diwan V (2018) Annual Effective Dose Equivalent of population staying in industrial area Bhilai, Chhattisgarh India estimated using Gamma dose rate measurements. Research Journal of Chemistry and Environment. 22(12):22-27.
9. Jindal MK and Sar SK (2020) Statistical Comparative Study of the Gamma Dose Rate and Associated Risk Assessment in Rural and Urban Areas of Durg District, Chhattisgarh, India. Radiochemistry. 62(2):275-287. DOI 10.1134/S1066362220020186

Figures

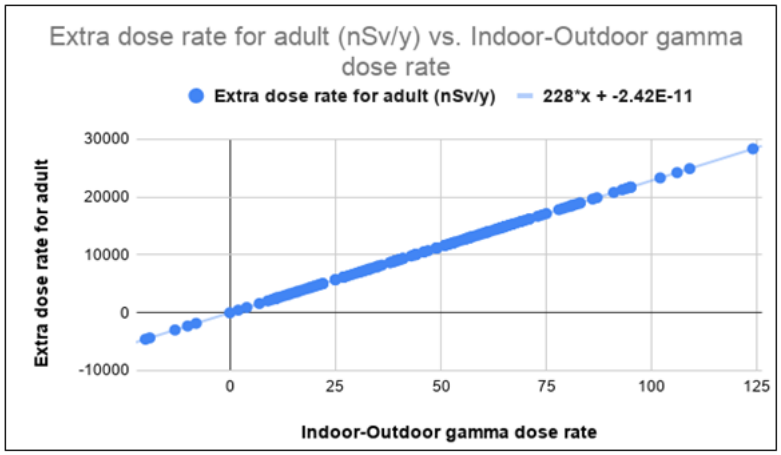

Figure 1

Relationship between extra gamma dose rate values during lockdown and difference values of indoor-outdoor gamma dose rate for adults.

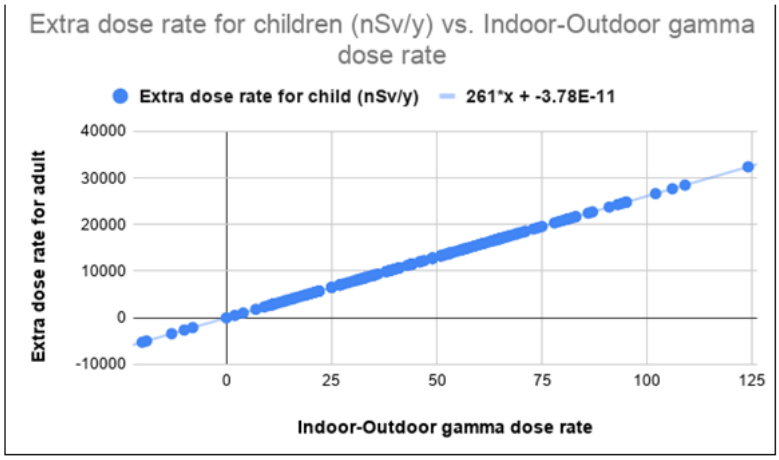

Figure 2

Relationship between extra gamma dose rate values during lockdown and difference values of indoor-outdoor gamma dose rate for children.

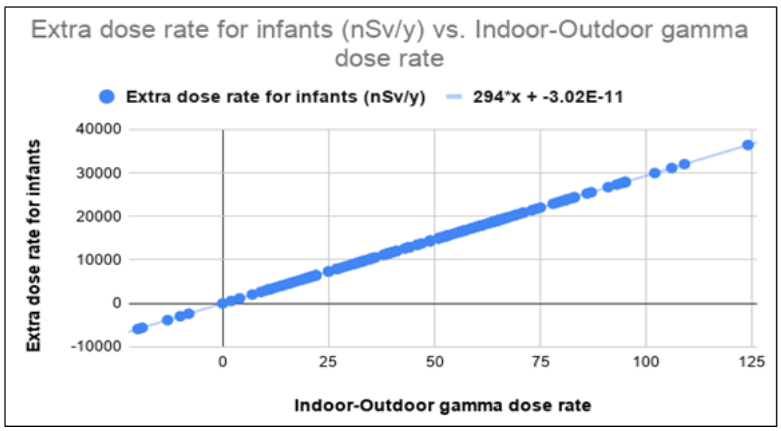

Figure 3

Relationship between extra gamma dose rate values during lockdown and difference values of indoor-outdoor gamma dose rate for infants.