Measurement the average gamma rate radiation for some regions in Baghdad city

Ra'afat k. Ahmed

Department of Physics, College of sciences

Kufa University

Abstract:

The assessment of radiation dose from natural sources is important because natural ionizing radiation is the largest contributor to the collective effective dose received by the world's population. Measured gamma dose rate in indoor and outdoor environments estimated corresponding annual effective dose for some regions in Baghdad city. Indoor and outdoor environmental gamma dose rates were measured using Inspector Exp instrument, in 6 selected regions [A, B, C, D, E and F]. the average dose rates in air resulting from gamma background radiation indoor and outdoor were 121 ± 22 nSv.hr^{-1} and 111 ± 24 nSv.hr^{-1} with range 95 – 147 nSv.hr^{-1} and 80 – 150 nSv.hr^{-1} respectively. Then the annual average effective dose of residents regions was 0.729 mSv.

قياس معدل الجرعة الإشعاعية لأشعة كاما في بعض مناطق بغداد

رأفت خالد احمد

جامعة الكوفة – كلية العلوم – قسم الفيزياء

الخلاصة :

أن تقييم جرعة الإشعاع المستلمة من المصادر الطبيعية مهم لان الإشعاع الطبيعي المؤين يعتبر المساهم الأكبر في الجرعة الفعالة التراكمية المستلمة من قبل سكان العالم . تم قياس معدل جرعة أشعة كاما في البيئات الداخلية (المنازل) والخارجية وحسبت الجرعة الفعالة السنوية لبعض مناطق مدينة بغداد . استعمل جهاز Inspector Exp لقياس الجرعة الداخلية والخارجية في ست مناطق من مدينة بغداد حيث كانت نتائج معدل الجرعة لأشعة كاما في الهواء داخل وخارج المنازل 121 ± 22 nSv.hr^{-1} و 111 ± 24 nSv.hr^{-1} ضمن مدى 95 – 147 nSv.hr^{-1} و80 – 150 nSv.hr^{-1} على التوالي , وان معدل الجرعة الفعالة السنوية لسكان المناطق المختارة كانت 0.729 mSv

Introduction:

The great interest expressed worldwide for the study of naturally occurring radiation and environmental radioactivity has led to the performance of extensive surveys in many countries. Such investigations can be useful for both assessment of public dose rates and the performance of epidemiological studies, as well as keeping reference .data records to ascertain possible changes in the environmental radioactivity due to nuclear, industrial, and other human activities [1].

The natural background ionization radiation is due to ambient radioactivity and cosmic rays. Terrestrial background radiation primarily arise from gamma emitting primordial radionuclide such as uranium and thorium (and their decay products) and potassium 40, which are naturally occurring in geologic material and associated soils. Primary cosmic radiation (mostly protons) impinging on the upper Atmosphere from outer space interacts with atmospheric nuclei to produce secondary radiation reaching the earth's surface in the form of mesons, electrons, and other particles.

Dose rate from this secondary cosmic radiation at the earth's surface increases with both elevation and latitude[2].The variability of natural background in time and space, both cosmic and terrestrial gamma has been reviewed in some detail of[3,4] and NCRP report 94[5]. The major variation of cosmic-ray intensity was with altitude, which approximately doubles for every 2000-meter increase in elevation [5]. The studies were performed both indoor and outdoor areas .The global dose rate value of outdoor was 59 $nSv.h^{-1}$ with the range of 18-93 $nSv.hr^{-1}$. The same value for inside dwellings was 84 $nSv.hr^{-1}$ with the range of 20-200 $nSv.hr^{-1}$ [6].In the present paper measurement of gamma radiation was performed in different regions of Baghdad city the results showed that an average dose rate in the form of map of ambient gamma background radiation was obtained using Inspector Exp, Instrument , These instrument were used to estimate the annual effective dose in residents regions .

How the Inspector Detects Radiation:

The Inspector uses a Geiger-Mueller tube to detect radiation. The Geiger tube generates a pulse of electrical current each time radiation passes through the tube and causes ionization. Each pulse is electronically detected and registers as a count. The Inspector displays the counts in the mode you choose. The number of counts detected by the Inspector varies from minute to minute due to the random nature of radioactivity. A reading is expressed more accurately as an average over time, and the average is more accurate over a longer time period.

Materials and methods:

The measurements were accomplished by the Inspector Exp instrument that offers excellent sensitivity of low levels of alpha, beta, gamma and x-ray. Measurements were made during

daylight from October to November 2011 , the gamma background radiation measurement were performed both indoor and outdoor in five areas north , south , west , east and center in six regions of Baghdad city (Appendix 1) . All building , were built with cement and bricks, the outdoor radiation measurements were performed by placing the detector at least 5 meters away from each building or wall, and one meter higher than the ground in order to reduce their effects on the radiation field . The indoor radiation measurements were also performed by placing the detector one meter higher than the ground at the side buildings. The values of the outdoor and indoor absorbed dose were calculated by using occupancy factors of 20% and 80%, respectively [6]. The values of annual effective dose were determined based on the equivalent dose.

Equivalent Dose (Sv) = Absorbed Dose (Gy) x Radiation Weighting Factor (w_R)

$$H = D \cdot w_R \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where:

H = the equivalent dose in sievert.

D = the absorbed dose in gray.

W_R = the radiation weighting factor.

Effective Dose (Sv) = Equivalent Dose (Sv) x w_T

$$E = H \times w_T \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Where:

E = the effective dose

H = the equivalent dose

W_T = the tissue weighting factor.

Absorbed indoors dose (mSv)

$$= D_{in.}.. T. Of = 0.847 \quad \ldots\ldots\ldots\ldots (3)$$

Absorbed outdoors dose (mSv)

$$= D_{out.} T. Of = 0.195 \quad \ldots\ldots\ldots\ldots (4)$$

Where:

D_{in} = the mean absorbed dose rates in air indoor.

D_{out}= the mean absorbed dose rates in air outdoor.

T = the time converter from hour to year.

Of = the occupancy factor (0.2 indoor, 0.8 outdoor).

Since radionuclide decay and cosmic radiation fluency varies slightly with time, the total exposure time of one hour was considered in each measurement.

The annual effective dose which was determined by the following equation [6]:

The annual effective dose (indoor)

$$= D_{in.}. T. Of. \text{ The conversion coefficient} \quad \ldots\ldots\ldots (5)$$

The annual effective dose (outdoor)

$$= D_{out} . T. Of . \text{ The conversion coefficient} \quad \ldots\ldots\ldots (6)$$

The conversion coefficient = 0.7 Sv Gy^{-1}

Results:

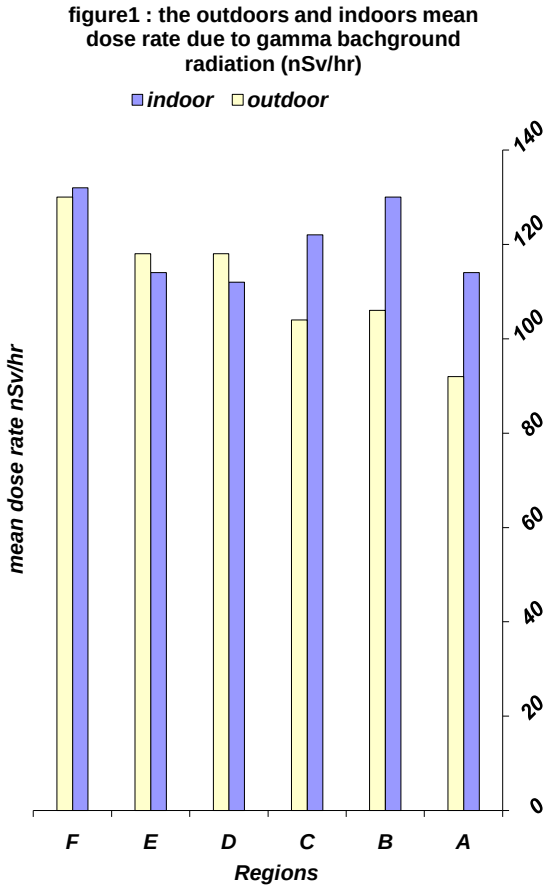
The absorbed dose rate measurements due to the outdoor and indoor gamma background radiation in 6 regions of Baghdad city. As show in table (1) and (2) which show that the maximum and minimum outdoor dose rate were 130 ± 55 and 92 ± 17 $nSv.hr^{-1}$ in regions (F) and (A) respectively and the average of outdoor dose rates were 111± 24 $nSv.hr^{-1}$. Also the maximum and minimum values of indoor were 132 ± 8 and 112 ± 23 $nSv.hr^{-1}$ in regions (F) and (D), respectively and the average of indoor dose rates were 121 ± 22 $nSv.hr^{-1.}$ The average ratio indoors to outdoors dose rate was 1.09 in Baghdad city.

region	Indoor mean dose rate ± SD $nSv.hr^{-1}$	Range $nSv.hr^{-1}$
A	114 ±10	100-130
B	130±25	100-170
C	122±42	90-150
D	112±23	70-140
E	114±21	90-150
F	132±8	120-140
Average	121 ±22	95-147

Table 1: The indoors values of dose rates due to gamma background radiation in the region of Baghdad city:

region	outdoor mean dose rate ± SD $nSv.hr^{-1}$	Range $nSv.hr^{-1}$
A	92 ±17	70-120
B	106±14	90-130
C	104±20	70-130
D	118±25	80-150
E	118±15	100-140
F	130±55	70-230
Average	111 ±24	80-150

Table 2: The outdoors values of dose rates due to gamma background radiation in the region of Baghdad city:



The annual effective doses of each of the regions are calculated from equation (5) and (6) as show in tables (3) and (4). Gamma radiation is less absorbed in children and infants resulting a higher dose conversion coefficient (adults: 0.7, children: 0.8 and infants: 0.9). [7]

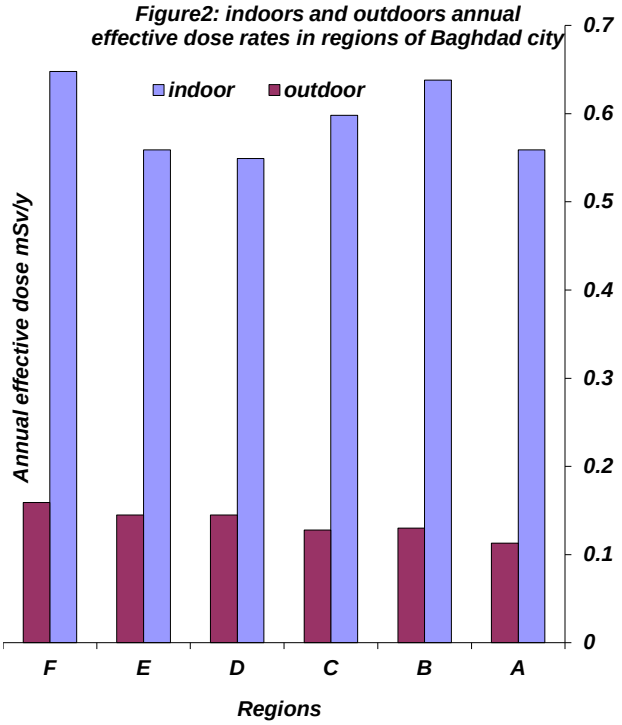
Then the annual average effective dose for adults would be:
(0.847 + 0.195) x 0.7 = 0.729 mSv

Table 3: The indoors annual effective dose in six selected regions of Baghdad city:

region	annual effective dose $mSv.Gy^{-1}$
A	0.559
B	0.638
C	0.597
D	0.549
E	0.559
F	0.649
Average	0.592

Table 4: The outdoors annual effective dose in six selected regions of Baghdad city:

region	annual effective dose $mSv.Gy^{-1}$
A	0.113
B	0.130
C	0.128
D	0.145
E	0.145
F	0.159
Average	0.136



Discussion:

Studies of background radiation measurements are of great importance in most countries [8, 9, and 10]. The results obtained by the Inspector Exp detector, showed that the average outdoor dose rate in Baghdad city was about 111 ± 24 $nSv.hr^{-1}$, from range 80 – 150 $nSv.hr^{-1}$. This value was due to terrestrial radioactive sources and the cosmic rays .The achieved has been higher result in comparison with the values reported by UNSCEAR 2000 from different countries with mean of 59 $nGyhr^{-1}$ in the range of 18 – 93 $nGyhr^{-1}$ [6] but it was nearest or lower than the values which are reported in Mashhad 91 $nSv.h^{-1}$, Tabriz 114$nSv.h^{-1}$, Yazd 101 $nSv.h^{-1}$ / Iran [11, 12] and Jordan the measured absorbed dose rates in air ranged from 20 to 130 $nSv.h^{-1}$ [13].

The mean value due to indoor radiation was measured as 121 ± 22 $nSv.h^{-1}$ from range 95 – 147 $nSv.h^{-1}$. The result was higher than the mean absorbed dose rate that has been reported by UNSCEAR 2000 with mean of 84 $nGyhr^{-1}$ in the range of 20 – 200 $nGyhr^{-1}$ [6].

Conclusion:

The average annual effective dose for gamma background radiation in Baghdad city was 0.729 mSv, with the range of 0.136 – 0.592 mSv which is more than the global value 0.48 mSv.

Appendix (1):

Symbol	Region
A	Quarter Al-salaam
B	Allawe Al- hilla
C	Al-Sader city section 79
D	Al-kamalia
E	Al-durra
F	Al-sha'ab

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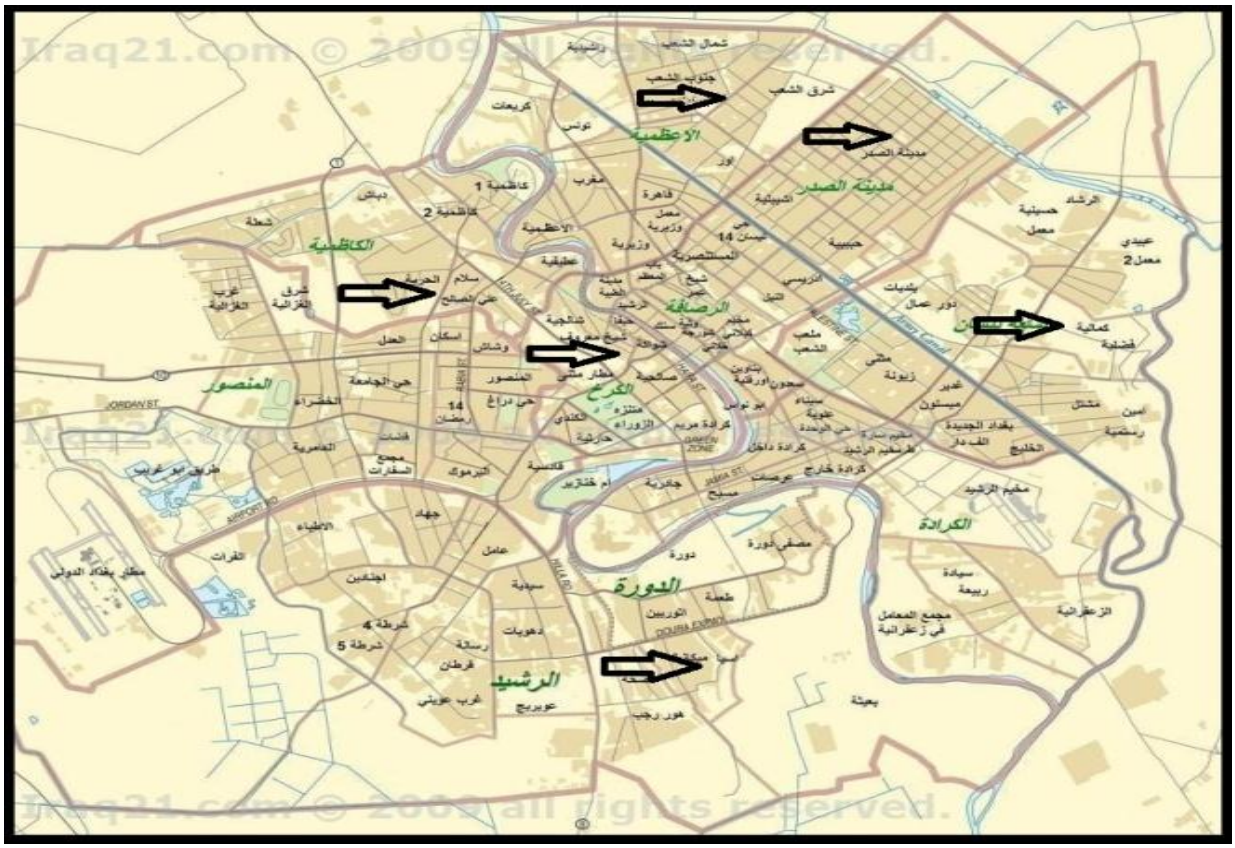

Figure3: The map of Baghdad city and the selected regions