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Relationship Between Anthropometric Measurements with Radiation Dose During Screening Mammography

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Abstract

*The incidence of breast issues, such as breast cancer, has been increasing in Iraq in recent years. Nonetheless, early detection and screening initiatives utilizing mammography and complementary ultrasoand have substantially lowered mortailty rates from this emerging disease. This study examines the relationship between breast density classification in the right and left breast, average glandular dose (AGD) for cranio-caudal (CC) and medio-lateral oblique (MLO) views, age, body mass index (BMI) across three groups of patients and compresses breast thickness. The study of population comprises of 100 paired MLO and CC mammography obtained on one mammography unit in Alawiya Educational hospital. Twenty one out of 100 females have a lesion (21%) of the total group and seventy nine out 100 females do not have a lesion ,representing 79% of total patients .Mean patient age was 46.8 years and mean body mass index (BMI) was 31.25 .Mean compreessed breast thickness was 50.35 mm for cc and 61.12 mm for MLO. Univariate analysis displayed no association between AGD in CC and MLO views with lesion in breast and BMI of patient ,negative association with age(P<0.05) ,BMI(P=0.694 for CC ,P=0.510 for MLO),lesion (P=0.209 for CC ,P=0.571 for MLO) and the relationships between average glandular dose (of both CC and MLO) and compression breast thickness (of MLO and CC) are not statistically significant (r=0.001, p= 0.996for cc and r=0.079, P=0.267 for MLO).However, there is a statisitically significant moderate positive relationship between the compression breast thickness of MLO and CC (r=-0.001, P=0.985 for cc and r=0.253** ,P=0.0001 for MLO).The AGD and dose in our routine mammography, the equivalent is within recommended limits, and the amount of radiation absorbed by glandular tissue is manageable.of breast. The study suggests a potential trend between both the average glandular dose during mammography, the breast lesions, age of patient ,compressed breast thickness and BMI, there were statistically significant between AGD , compressed breast thickness (CBT) and age . While, there were no significant differences between AGD , BMI of body patient and lesion of breast.*

Keywords: *Mammography, Average glandular dose(AGD), compressed breast thickness(CBT).*

Introduction

X-ray mammography poses a slight yet notable potential of radiation-induced harm. It is the most precise and dependable method for identifying tiny undetectable breast cancer. [1] The carcniogenic risk linked to mammography. The breast's absorption of radiation has generated concern. Breast cancer usually begins in the glandular breast tissue. The mean absorbed radiation dose is a measure of the radiation risk linked with mammography. Carcinogens Calculating the mean glandular dose is an essential aspect of quality controle for mammographic imaging systems. There was a 10% increase in the incidence of breast cancer per year. The occurrence of the condition has risen among people under the age of forty due to frequent routine check-ups and early identification. Increasing the degree of radiation exposure during mammography is a significant concern due to its association with breast cancer. [2][12][21].

The breast has the potential to view as a homoegeneous mixture of fibro glandular and adipose tissues in radiological examinations. The fibro glandular tissues are the tissues most susceptible to cancer development. The radiation dose to this tissue is crucial in. Assessing the radiation hazards of mammography examinations, ICRU44 presents the basic structures of fibro glandular and adipose breast tissues. [3][11]

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The average glandular dosage (MGD) is calculated, not physically measured. Assuming precise values based on empirically established entrance expasure surface dose (ESD) using conversion factors. The criteria were determined depending on thickneѳss. KVP and HVL, according to WUS,[1]. MGD was calculoted by multiplying the ESDpa-to-absorbed dosage conversion factor (g) by AGD, as shown below: MGD = g x ESDpa.

The average glandular dose (AGD) and dosage values were converted to milligrammes using the GY=100rad technique. Researchers Geis and Palchevsky [5][10], on the other hand, The study indicated that the glandularity distribution widens between compressed thicknesses of 3cm and 7cm but narrows outside of this range. Helvie and colleagues. According to AL-sarraf SA and Lee,I.J ,et al . [6][9], the average compressed breast thickness among 250 patients is roughly 44cm. Additional AL-saiegh reaserch [4]. This study evaluated the volumetric breast density with average glandular dose (AGD) in craniocaudal (CC) and mediolateral oblique (MLO) in Iraqi women. It also evaluated radiological recommendations for these women. The researchers found no correlation between volumetric breast density and daily dose after conducting examinations in multiple hospitals when AGD no association with volume lesion density [6][13].

A study revealed that approximateley 59.8% of the pateints (N=88) had heterogeneously dense breasts (BIRADS C) and 9.5% (N=14) had entirely fatty breasts (BIRADS A). Patients categorized under BIRADS D had the lowest mean age of 47.4 years. Furthermore, a larger proportion of Chinese patients were classified as BIRADS C and D, whereas more Indian patients fell into BIRADS A and B. The study revealed a statistically significant variation in average glandular dose (AGD) across different breast densities ($p<0.001$) for right craniocaudal (RCC) and left craniocaudal (LCC) mammograms. Post-hoc analysis indicated significant AGD differences between BIRADS A and C in RCC, and between BIRADS A and C, as well as BIRADS B and C in LCC. However, no significant AGD differences were found across breast densities in right mediolateral oblique (RMLO) and left mediolateral oblique (LMLO) mammograms [7, 14].

Materials and Methods

A descriptive statistical analysis was carried out among female participants selected through successive sampling from Alawiya Educational Hospital in Baghdad. 100 mammograms were examined, consisting of 50 paired mediolateral oblique (MLO) and craniocadul (cc) views,.**100** pairs of mammograms were taken using an Italian Giotto HI_techi mammographic equipment with an easy-to-use control panel. The LCD screen provides precise information on average glandular dose (AGD),CBT in automatic exposure control mode. The device can quickly select the optimal. The rhodium filter reduces the x-ray dose for very thick breasts by adjusting the milliamperes (mAs) and tube voltage in automated exposure control (AEC) mode .[8][15].Patient demographic ,including age, height, and weight was collected from self-reported entries in questionnaire filled out at the time of screening mammography. Body mass index (BMI) was calculted using self-reperted weight and height.

Study Design

This study was an observaitional study examining the association between AGD for both craniocaudal (CC) and mediolateral oblique (MLO) views, as well as lesion breast and other variables including age, body mass index (BMI), and CBT, were considered. Statistical Analysis: A one-way analysis of variance (ANOVA) was used to compare differences in AGD (CC and MLO), age, and BMI among the three patient groups. A p-value of less than 0.05 was considered statistically significant. Ethical Considerations: The study was conducted in accordance with ethical guidelines and received approval from the relevant institutional review board. All patients provided informed consent before participiation.

Results

The age distribution of the participants was as follows: 20% were aged 30-39 years, 41% were aged 40-49 years, and 39% were aged 50-59 years, with a mean age of 46.8 years and a standord deviation of 7.7 years.

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The average weight of the participants was 79.72 kg with a standard deviation of 12.45 kg, and the average height was 159.80 cm with a standard deviation of 5.85 cm. The patient's weight and height were noted in order to calculate the body mass index (BMI) [16].

$$\mathbf{BMI} = \frac{\mathbf{(Weight\ (kg)}}{\boldsymbol{Height\ (m^2)}}$$

In terms of BMI categories, 7% of participants were within the normal range (18.5-24.9), 32% were overweight (25-29.9), 46% were obese (30-34.9), and 15% were in the obese II category (BMI of 35 or more). The average BMI was 31.25 with a standard deviation of 4.83 (kg/(m^2).These shows at table (1).

Table 1. Mean of participants according to Anthropometric measurements of patient's.

		No	**%**
Age (years)	30---39	20	20.0
	40---49	41	41.0
	50---59years	39	39.0
	Age ,Mean±SD (Range)	46.8±7.7	(35-59)
BMI (Kg/m2)	Normal (18.5-24.9)	7	7.0
	Overweight (25-29.9)	32	32.0
	Obese (30-34.9)	46	46.0
	Obese II (=>35)	15	15.0
	BMI, Mean±SD (Range)	31.25±4.83	(20.08-44.14)
	Weight (Kg), Mean±SD (Range)	79.72±12.45	(54-120)
	Height (cm), Mean±SD (Range)	**159.80±5.85**	**(150-175)**

The lesions were present in 21 participants and absent in 79 participants. Show at figure (1)

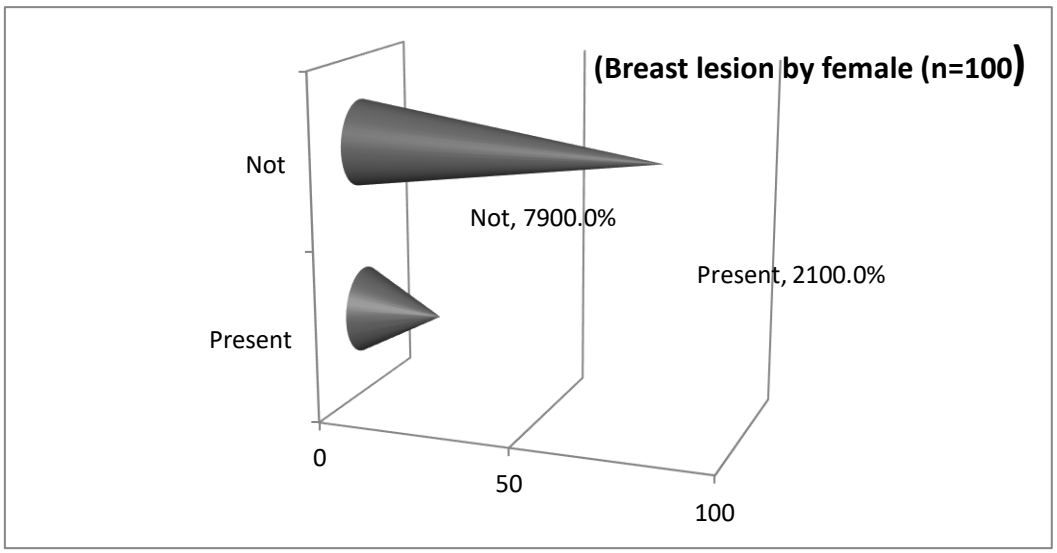

Figure 1. Breast tissue lesions

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Mean and standard deviation of compressed breast thickness (CBT) was (50.62±9.62) mm (range 30.0-77.0) for cc and (61.12 ±12.57) mm(range 33.0-89.0) for MLO views of mammography. Display at figure(2,3)

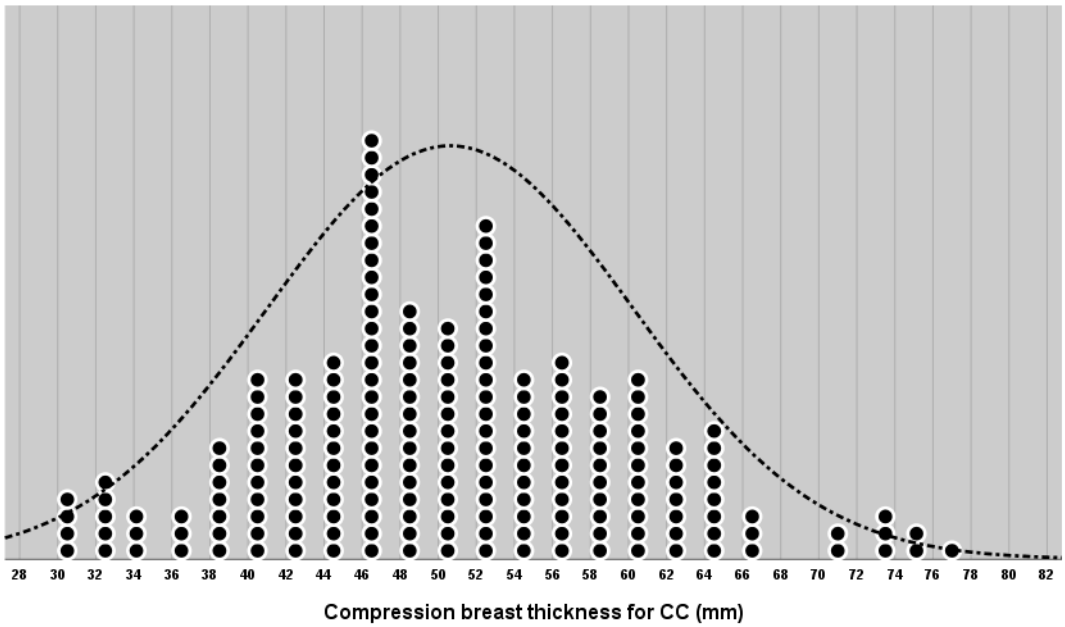

Figure 2. Mean of compreessed breast thickness (CBT) for CC view of mammography.

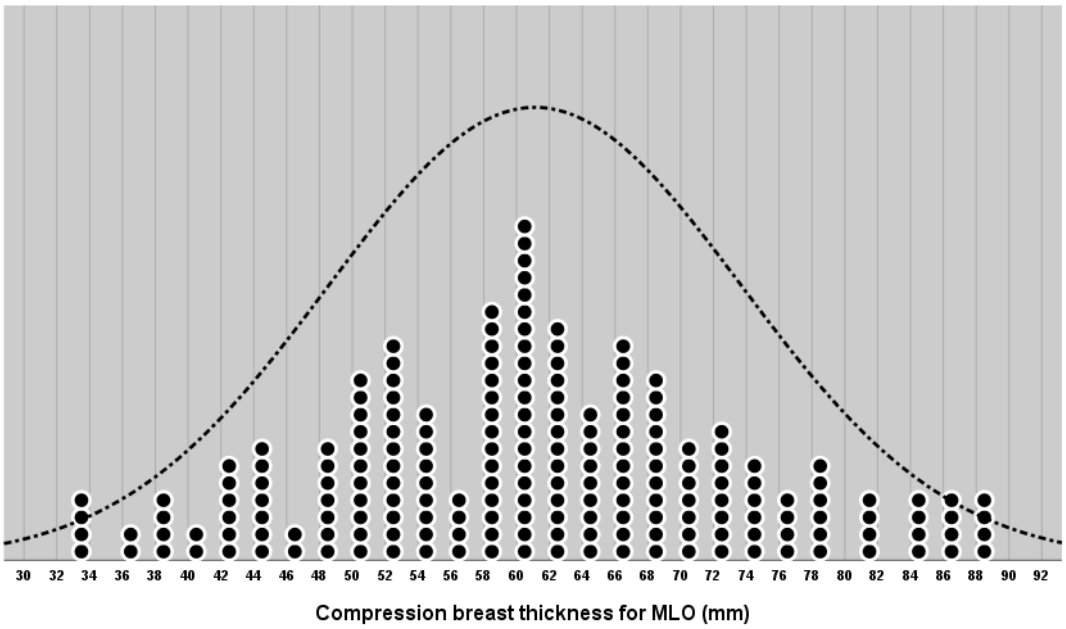

Figure 3. Mean of compreessed breast thickness (CBT) for MLO view of mammography.

Mean and standard deviation of average glandular dose was (2.93±0.50) mGy (range1.57-4.16) for cc and (3.08±0.55) mGy (range 1.52-4.76) for MLO views of mammography. Display at figure(4,5)

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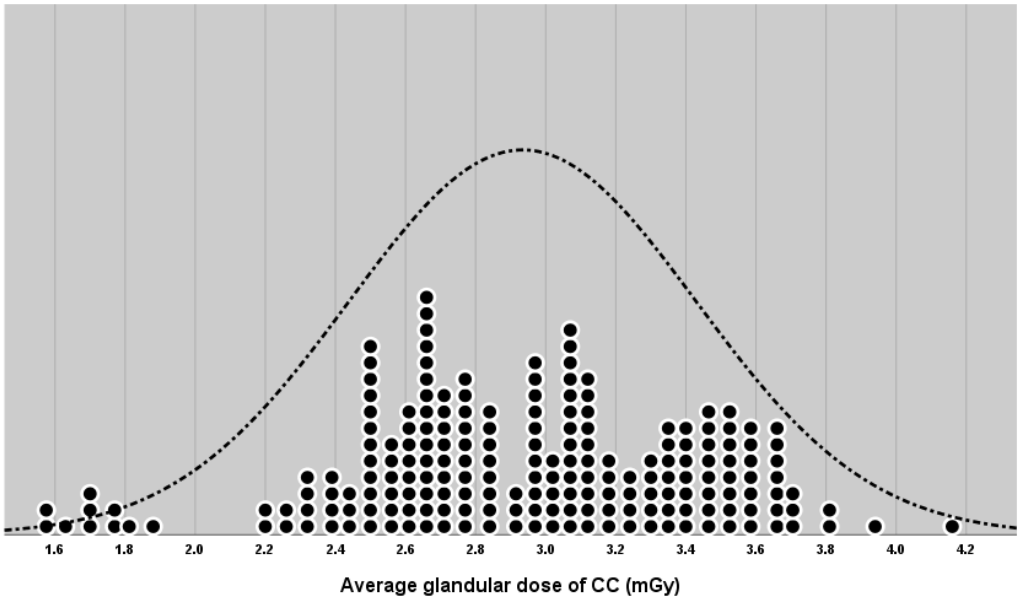

Figure 4. Average glandular dose for CC view of mammography.

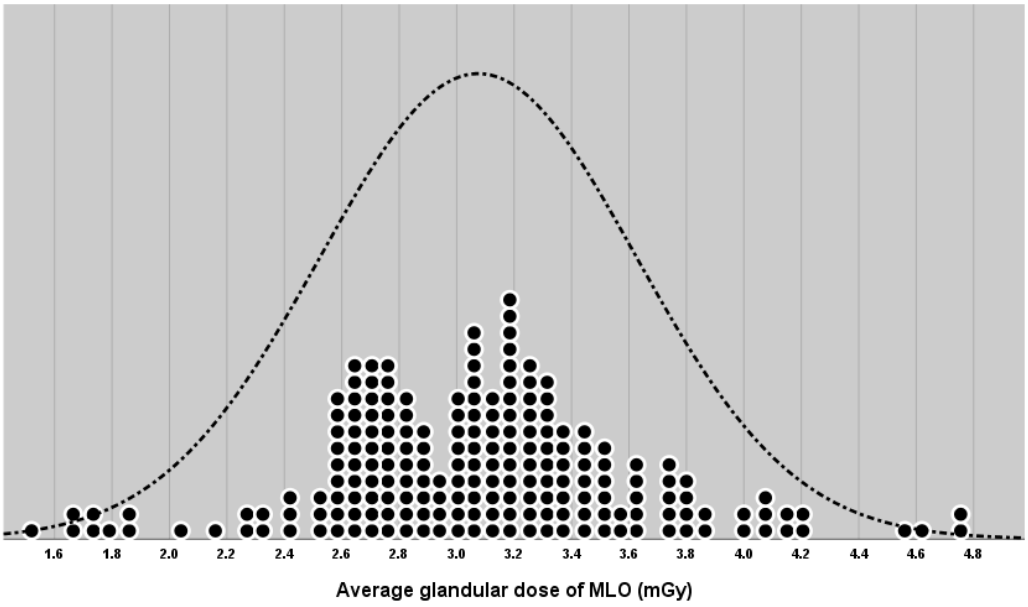

Figure 5. Average glandular dose for MLO view of mammography.

Univariate relationships between average glandular dose (mGy) with age ,BMI, lesion of breast and CBT ,that AGD negative relation with age of patients (P=0.0001^ for cc,P=0.003^) (Table2) and no correlation AGD with BMI(P= 0.694 for cc,P= 0.510 for MLO) ,table (3) and lesion of breast (P=0.209 for cc,P=0.571 for MLO). The relationships between average glandular dose (of both CC and MLO) and compression breast thickness (of MLO and CC) are not statisticailly significant (r=0.001, p= 0.996for cc and r=0.079, P=0.267 for MLO).However, there is a statistically significant moderate positive relationship betwaen the compression breast thickness of MLO and CC (r=-0.001, P=0.985 for cc and r=0.253** ,P=0.0001 for MLO) table (4).

Table 2. Relation between Average glandular dose with age of patients.

	Anthropometric measurements of body patients	

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	Age (years)						P-value
	30---39		40---49		50---59years		
	Mean±SD	Range	Mean±SD	range	Mean±SD	Range	
Average glandular dose of CC (mGy)	3.07±0.43	(2.19-3.94)	3.06±0.45	(1.79-4.16)	2.74±0.51	(1.57-3.68)	0.0001^
Average glandular dose of MLO (mGy)	3.18±0.50	(2.55-4.76)	3.18±0.53	(2.04-4.75)	2.91±0.56	(1.52-4.21)	0.003^
^Significant difference among more than two independent means using ANOVA-test at 0.05 level.							

Table 3. Relation between Average glandular dose with BMI of patients.

	BMI (Kg/m2)								P value
	Normal (18.5-24.9)		Overweight (25-29.9)		Obese (30-34.9)		Obese II (=>35)		
Average glandular dose of CC (mGy)	2.90±0.41	2.31-3.53	2.99±0.44	1.63-3.72	2.92±0.53	1.57-3.94	2.87±0.55	1.79-4.16	0.694
Average glandular dose of MLO (mGy)	3.24±0.41	2.42-4.01	3.04±0.48	1.65-4.21	3.10±0.64	1.52-4.76	3.00±0.46	2.04-4.16	0.510
Significant difference among more than two independent means using ANOVA-test at 0.05 level.									

Table 4. Relation between Average glandular dose with presence lesion.

	Lesion				P value
	Present (n=21)		Not (n=179)		
Average glandular dose of CC (mGy)	3.03±0.53	(1.79-3.83)	2.91±0.49	(1.57-4.16)	0.209
Average glandular dose of MLO (mGy)	3.02±0.40	(2.04-3.76)	3.08±0.58	(1.52-4.76)	0.571
Significant difference among more than two independent means using ANOVA-test at 0.05 level.					

Table 4. Relation between Average glandular dose with CBT of mammography.

		Compression breast thickness CC (mm)	Compression breast thickness MLO (mm)
Average glandular dose of CC (mGy)	R	0.001	0.079
	P	0.996	0.267
Average glandular dose of MLO (mGy)	R	-0.001	0.253**
	P	0.985	0.0001
*Correlation is significant at the 0.05 level. **Correlation is highly significant at the 0.01 level.			

CBT: compression breast thickness

Discussion

The study shows that breast lesions were present in 21 women and in 79% no lesion was present in

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females.17]] The sample is evenly distributed across age groups, with a mean age of 46.8 years. The majority of individuals are either overweight (32%) or obese (61%), highlighting a high prevalence of excess body weight. Weight.[18] The mean weight is 79.72 kg, with a broad range from 54 kg to 120 kg. The mean dose is highest in the 30-39 age group (3.07 ± 0.43 mGy) and 40-49 age group (3.06 ± 0.45 mGy), with the lowest dose in the 50-59 age group (2.74 ± 0.51 mGy) [19].

The ANOVA test shows a significant difference ($p = 0.0001$) among the three age groups, indicating that the average glandular dose of CC varies with age. Similarly, the mean dose is highest in the 30-39 (3.18 ± 0.50 mGy) and 40-49 age groups (3.18 ± 0.53 mGy), with the lowest dose in the 50-59 age group (2.91 ± 0.56 mGy) [20][22].

Again, a significant difference ($p = 0.003$) was found among the three age groups using ANOVA, showing variation in the average glandular dose of MLO based on age. there are minimal differences in the average glandular doses for CC and MLO views across different BMI categories. The variations observed are not statistically significant (P=0.694 for cc ,P=0.510 for MLO), implying that BMI may not play a significant role in influencing the average glandular dose in mammography. Individuals with lesions have a slightly higher average dose (3.03 ± 0.53 mGy) compared to those without lesions (2.91 ± 0.49 mGy).The p-value of 0.209 suggests that the difference in doses between the two groups is not statistically significant ,alsolesions have a slightly lower average dose (3.02 ± 0.40 mGy) compared to those without lesions (3.08 ± 0.58 mGy).The p-value of 0.571 indicates that the difference in doses between the two groups is not statistically significant for MLO view of mammography. The correlation (r) between compression breast thickness and average glandular dose of CC is very weak ($r = 0.001$), and the p-value (0.996) is not statistically significant. This suggests that there is no meaningful relationship between compression breast thickness and average glandular dose of CC. There is a moderate positive correlation ($r = 0.253$) between compression breast thickness and average glandular dose of MLO, which is statistically significant ($p = 0.0001$).This indicates that as compression breast thickness increases, the average glandular dose of MLO also tends to increase.

In this study, Age Distribution: An imbalanced age distribution among participants may affect the representativeness of the results. Measurement Methods: Variations in methods used to measure volumetric breast density, AGD, and BMI across different participants may impact data consistency. Self-reported Data: Some data, such as age and body weight, may rely on self-reporting by participants, which can introduce bias. Environmental and Genetic Factors: Unaccounted-for environmental and genetic factors may influence the observed correlations.

Conclusion

The study shows that age and breast thickness are key factors influencing average glandular doses during mammography, with younger patients and those with thicker breasts receiving higher doses. In contrast, variations in BMI and the presence of breast lesions have minimal impact on dose levels.These results highlight the importance of personalized mammography protocols based on age and breast thickness to optimize radiation exposure and ensure patient safety.

Conflict of Interest

The authors declare that they have no conflicts of interest.

Funding

The study was self-funded.

Ethical Clearance

Informed consent was obtained for all the patients involved in this study.

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