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# SONOELASTOGRAPHIC DIFFERENCES IN BREAST TISSUE ELASTICITY BETWEEN WOMEN USING AND NOT USING HORMONAL CONTRACEPTIVES

*A narrative review of available evidence, potential mechanisms, clinical assessment and research gaps*

**Urakova Maftuna Axmadovna**
Lecturer at Asia International University
Orcid ID 0009-0008-7921-4584
azimovakbarshox360@gmail.com

**Abstract.**

Breast tissue elasticity is a physiological property that may vary with age, hormonal status and the menstrual cycle. Sonoelastography offers a non-invasive way to assess tissue mechanical properties, but interpretation requires attention to acquisition technique and biological variation.

**Objective:** To critically review evidence on sonoelastographic breast tissue elasticity in women using and not using hormonal contraceptives and to identify methodological priorities for future comparative research.

**Methods:** A focused, non-systematic narrative review was prepared using targeted searches of biomedical literature and professional guidance available by 19 October 2026. Sources were selected for direct relevance to breast sonoelastography, menstrual-cycle variation and elastography methods. No meta-analysis or formal risk-of-bias assessment was performed.

Synthesis: A small longitudinal study of 22 healthy women reported cycle-related changes in breast parenchymal elasticity among women not using hormonal medication, whereas statistically significant cycle-dependent changes were not observed in the oral-contraceptive group. The study also reported differences between groups. These findings are relevant but cannot be generalized without caution because of the small sample and specific study conditions. International guidance emphasizes standardized acquisition and cautious interpretation.

Conclusion: Existing evidence suggests that hormonal status and menstrual-cycle timing may influence breast sonoelastographic measurements. Larger, well-designed studies using standardized protocols, clearly defined contraceptive exposures and appropriate control of physiological factors are needed before clinical thresholds or causal conclusions can be proposed.

**Keywords**: breast sonoelastography; hormonal contraception; breast elasticity; menstrual cycle; shear-wave elastography; strain elastography.

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## Introduction

Assessment of breast tissue is an important part of women's health care and contemporary diagnostic imaging. Conventional B-mode ultrasonography provides information about tissue architecture, lesion morphology and echogenicity. Sonoelastography adds a complementary dimension by estimating tissue deformation or stiffness under applied stress or by measuring shear-wave propagation. These measurements describe mechanical properties; they do not independently establish histological diagnosis or a specific hormonal effect.

Breast tissue is biologically dynamic. Age, reproductive status, menstrual-cycle phase and hormonal exposure may affect glandular tissue and the conditions under which an elastographic measurement is obtained. Consequently, a difference between two measurements may reflect physiological variation, acquisition conditions or actual tissue-property differences. These possibilities should be distinguished before an observed association is attributed to hormonal contraception.

Hormonal contraceptives are not a single uniform exposure. Formulations, doses, routes of administration, progestin types and duration of use can differ. A study that combines all contraceptive methods into one category may obscure relevant differences. The comparison group also requires a clear definition, including current non-use and, where relevant, recent past use or other hormonal medication.

Wojcinski and colleagues studied 22 healthy women aged 18–33 years using weekly real-time sonoelastography measurements over two consecutive menstrual cycles. Ten participants did not use hormonal medication and 12 used oral contraceptives. In non-users, elasticity changed during the cycle and parenchyma was harder in the luteal phase; statistically significant cycle-dependent changes were not observed in the oral-contraceptive group. The authors also reported a group difference in parenchymal elasticity [1]. This is direct evidence relevant to the present question, but the sample was small and the findings should not be interpreted as a universal effect of all hormonal contraceptives.

Professional recommendations on ultrasound elastography describe technical and interpretive considerations that are important when comparing studies or planning clinical research [2–4]. The purpose of this narrative review is to summarize the directly relevant evidence, outline plausible explanations for variation, and identify design and reporting features needed for a stronger comparative study. It does not present new patient data or claim that an experiment has already been performed by the author.

## Review approach

A focused narrative search was used to identify publications addressing breast sonoelastography, hormonal contraception, menstrual-cycle-related tissue variation and professional guidance for ultrasound elastography. Searches targeted biomedical indexing records and publisher pages using combinations of terms including "breast sonoelastography", "real-time sonoelastography", "breast tissue elasticity", "menstrual cycle", "oral contraceptives", "strain elastography" and "shear-wave elastography".

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Guidance documents from European and international ultrasound organizations were considered where relevant.

Sources were retained when they directly informed breast tissue elasticity, hormonal or menstrual-cycle variation, or the technical conduct and interpretation of elastography. The synthesis prioritizes the directly relevant longitudinal study and established methodological guidance. Bibliographic details were checked against the available publication records. Full text was not available for every source, and the search was not intended to be exhaustive.

This review has no registered protocol, duplicate screening process, formal certainty grading or quantitative pooling. It should therefore be read as a narrative synthesis rather than a systematic review. The absence of a study from this focused selection does not demonstrate that no other relevant evidence exists.

**What the evidence establishes**

The most directly relevant evidence identified is the longitudinal study by Wojcinski and colleagues [1]. Its repeated measurements across two cycles allowed the investigators to consider within-person variation rather than relying on a single scan. The study reported that breast parenchymal elasticity changed during the menstrual cycle in women not taking hormonal medication, with greater stiffness in the luteal phase. The oral-contraceptive group did not show statistically significant cycle-dependent variation under the study conditions. The authors also reported that parenchyma was generally softer in non-users than in users. This finding supports further investigation of the relationship between hormonal exposure and measured tissue elasticity. It does not, by itself, prove that contraceptives cause a particular change in tissue structure, predict disease, or establish a diagnostic threshold. A small sample may yield imprecise estimates and may not represent the range of ages, formulations or clinical circumstances encountered in routine practice. The elastography guidance documents provide methodological context rather than direct evidence of a contraceptive effect [2–4]. They emphasize that elastography results depend on the technique, acquisition quality, equipment and interpretation framework. Thus, studies using different platforms or measurement protocols may not be directly comparable even when they use similar terminology.

Table 1 summarizes the selected evidence and the limits of inference. The distinction between direct biological observations and methodological guidance is important: the former informs the research question, while the latter informs how future measurements should be obtained and reported.

**Table 1. Selected evidence and its applicability to breast sonoelastography**

| Source | Population / document | Contribution | Limit of inference |
|---|---|---|---|
| Wojcinski et al., 2012 [1] | 22 healthy women aged 18–33; repeated | Reported cycle-related elasticity changes in non-users | Small sample; specific population and protocol; cannot |

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| Source | Population / document | Contribution | Limit of inference |
|---|---|---|---|
| | measurements across two cycles | and no significant cycle-dependent change in oral-contraceptive users | establish a universal causal effect |
| Bamber et al., 2013 [2] | EFSUMB guidance on basic principles and technology | Provides technical principles for ultrasound elastography and measurement interpretation | General methodological guidance, not a study of hormonal contraceptives |
| Cosgrove et al., 2013 [3] | EFSUMB guidance on clinical applications | Discusses clinical use and limitations of elastography across applications | Recommendations do not establish a contraceptive-specific breast effect |
| Lee et al., 2014 [4] | Guideline for performance of breast ultrasound elastography | Supports standardized performance and interpretation of breast elastography | Does not quantify hormonal exposure effects |

Table 1 should be interpreted as an evidence map rather than a pooled comparison. The study by Wojcinski et al. provides the direct observation relevant to hormonal exposure, whereas the remaining documents provide technical or interpretive guidance. The table does not support a causal conclusion or a universal elasticity threshold because the directly relevant study included only 22 participants and the guidance documents were not designed to test contraceptive effects.

Hormonal fluctuations across the menstrual cycle can coincide with changes in breast tissue composition and mechanical behavior. The longitudinal observations reported by Wojcinski and colleagues are consistent with the possibility that cycle phase affects elastographic measurements in women not using hormonal medication [1]. The absence of statistically significant cycle-dependent changes in their oral-contraceptive group may reflect altered hormonal variation, but the study does not establish a single mechanism. The result should be treated as an observation requiring replication, not as proof that every contraceptive formulation stabilizes breast elasticity.

Future studies should define the timing of scans relative to menstrual-cycle phase for participants not using hormonal contraception and document contraceptive formulation, route and duration for users. If cycle phase cannot be reliably determined, that limitation should be reported. Analyses should distinguish within-person changes over time from between-group differences, because these answer different questions.

Age, parity, lactation history, menopausal status, body composition and other clinical characteristics may influence breast tissue and may differ between groups. These variables can confound a comparison if they are unevenly distributed. Eligibility criteria

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and baseline characteristics should therefore be defined in advance. A study should not assume that groups are comparable merely because both consist of women described as being of reproductive age.

Current and recent hormonal treatments should be recorded in a reproducible manner. Where clinically appropriate, researchers may also document relevant reproductive history and medications that could influence hormonal status. Data collection should be proportionate to the research question and conducted with informed consent and appropriate privacy safeguards.

Elastographic measurements can vary with probe pressure, region-of-interest placement, motion, tissue depth, image quality and device-specific processing. Strain elastography estimates relative deformation under compression, while shear-wave elastography estimates mechanical properties from shear-wave propagation. Their outputs and units are not interchangeable. Investigators should specify the method and avoid combining results from different techniques as though they represented the same measurement. A standardized protocol should define patient positioning, target region, number of repeated acquisitions, criteria for accepting or rejecting measurements, and the summary statistic to be analyzed. If quantitative shear-wave measurements are used, the unit and device-specific output should be reported. If qualitative strain scoring is used, the scoring system and assessor training should be described. Reliability and repeatability should be assessed where feasible.

B-mode ultrasound remains important for describing tissue architecture and identifying the region to be assessed. Elastography should be interpreted alongside the conventional ultrasound image and the clinical context, not as a stand-alone diagnostic result. The target region should be clearly defined so that measurements are comparable across participants and visits. Strain elastography evaluates relative tissue deformation during compression and is sensitive to how pressure is applied. Shear-wave elastography generates quantitative estimates related to tissue stiffness and may reduce some operator-dependent aspects, but it remains affected by acquisition quality and system characteristics. Neither approach removes biological variability or guarantees direct comparability between devices. The selected method should match the research objective and available equipment. If both methods are used, results should be reported separately and their roles specified. The protocol should avoid presenting a measurement as a clinical cut-off unless that threshold has been validated for the intended population and purpose.

A future comparative study should define the primary question before recruitment: whether mean or median elasticity differs between women currently using a specified hormonal contraceptive and a clearly defined non-user group, whether elasticity changes over time, or whether the pattern differs by contraceptive formulation. These objectives require different sampling and analysis plans. A cross-sectional comparison cannot fully characterize within-person cycle-related variation, while repeated measurements require a plan for correlated observations. The protocol should establish eligibility criteria, recruitment setting, contraceptive exposure definitions, scan timing and primary outcome. Sample size should be justified using an appropriate expected difference and variability estimate from prior evidence or a pilot study, rather than an arbitrary number. The analysis

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plan should identify how age and other relevant covariates will be handled, how missing measurements will be treated, and which comparisons are primary versus exploratory.

Operators should receive standardized training, and image acquisition should follow a written protocol. Where possible, image assessment should be blinded to contraceptive group. Repeated acquisitions can help estimate measurement reliability, but the number of measurements and the rule for combining them should be prespecified. Reports should include the distribution of measurements and uncertainty estimates, not only a statement that groups differ or do not differ.

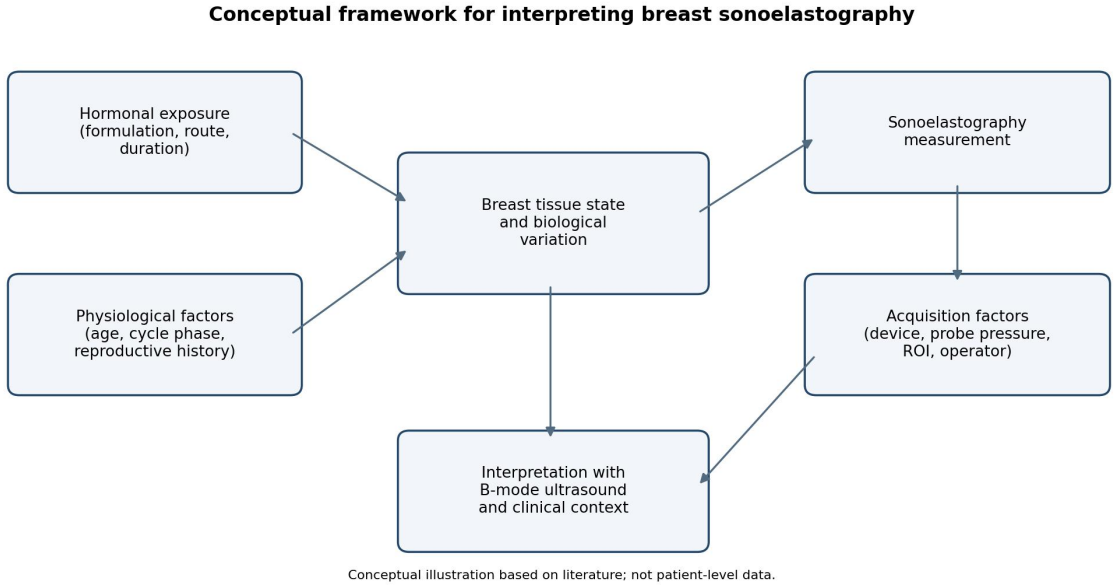



**Figure 1. Conceptual framework for factors influencing breast sonoelastography measurements.**

Figure 1 summarizes biological and technical factors that should be considered when comparing groups. It is a conceptual diagram derived from the reviewed literature, not a plot of observed participant data.

The next priority is replication in a larger and more diverse sample. A multicenter design could improve generalizability, provided that equipment differences and protocol variation are controlled or explicitly modeled. Studies should record the specific contraceptive formulation, duration of use and relevant changes in exposure. Grouping all hormonal contraceptives together may be convenient but can obscure meaningful heterogeneity. Longitudinal designs are particularly useful when the question concerns change across the menstrual cycle or after initiation of contraception. Repeated measures should be scheduled consistently, and analysis should account for the fact that observations from the same participant are correlated. A separate cross-sectional study may address group differences at a defined time point, but should not be used to infer within-person change. Future publications should report the ultrasound platform, transducer, elastography mode, acquisition settings, region-of-interest method, number of valid measurements,

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quality-control criteria and assessor experience. The statistical analysis should include effect estimates and confidence intervals where possible. A non-significant result should not automatically be interpreted as evidence of no effect, particularly in a small study.

Clinical interpretation should remain conservative. At present, the evidence reviewed here does not establish a validated sonoelastographic threshold for hormonal contraceptive exposure, nor does it demonstrate that a measured difference predicts breast disease. The research value lies in clarifying normal physiological variation and improving measurement design before considering any change to clinical decision-making.

The principal limitation of the directly relevant evidence is the small sample in the longitudinal study. Its findings may not apply to all contraceptive formulations, age groups, ethnic populations, ultrasound systems or clinical settings. A single study cannot establish the size, consistency or clinical importance of an association. Differences in measurement methods and acquisition protocols further limit comparison across publications. This article is a focused narrative review, not a systematic review. The search was selective, there was no formal risk-of-bias assessment, and no meta-analysis was conducted. Some source material was assessed through indexed records or publication summaries where full text was not available. Accordingly, the review cannot claim to have captured every relevant study or provide a pooled estimate of effect. The article also does not report original participant data. No new sample, mean elasticity value, p-value or clinical outcome is presented as though it had been measured by the author. The conclusions are limited to the selected literature and methodological implications.

## Conclusion

Available evidence indicates that breast tissue elasticity measured by sonoelastography may vary with menstrual-cycle phase and hormonal status. The small longitudinal study identified differences in cycle-related patterns between women using oral contraceptives and women not using hormonal medication, but these findings require cautious interpretation and independent replication. They do not establish a universal causal effect of hormonal contraception or a clinical diagnostic threshold. A stronger evidence base will require larger samples, explicit contraceptive exposure definitions, standardized acquisition protocols, careful recording of physiological variables and appropriate longitudinal or cross-sectional analysis according to the research question. Until such data are available, sonoelastographic differences should be interpreted in their technical and physiological context, without overstating their clinical meaning.

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Journal of Advances in Drug Research

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