

S2 Table. Data extraction tables with detailed study characteristics, participant demographics, intervention details, and outcome data

Author	Title	Year of publication	Country	Samples types collected	Study design used	Study population	Sample Size	Clinical & Demographic Characteristics of participants	Exclusion criteria	Sampling method used	Age of participants	Number in patient group	Number in control group	Species tested	Medical condition of patient group (VVC/RVVC/Other	How many samples were finally analyzed?	Sample manipulations or preparation before analysis	Follow up period	Method used to measure Zinc	Statistical analysis method	Concn of zinc in each sample type in patient group (With units)	Concn of zinc in each sample type in control group (With units)	Baseline comparison (p value?)	Concn of zinc in each sample type in patient group (With units)	Concn of zinc in each sample type in control group (With units)	Post follow-up comparison (p value?)	Other results
Edman, J.; Sobel, J. D.; Taylor, M. L.	Zinc status in women with recurrent vulvovaginal candidiasis	1986	USA (Philadelphia, Pennsylvania)	Blood (plasma and erythrocytes)	Cross sectional Case-control study	Women with recurrent vulvovaginal candidiasis (RVVC) and healthy controls matched for age, race, and parity	29 RVVC patients; 20 controls	Mean age: RVVC group 35 ± 6.7 yrs (range 22–47); Control 34 ± 8.1 yrs (range 20–51). Majority Caucasian (~83%). Parity mean = 1 in both groups. None was pregnant, all were premenopausal, none of the controls had ever been diagnosed for acute VVC, comparable numbers Of subjects who were taking various levels of Zinc supplements, oral contraceptives and thyroid medications were included in both patient and control groups	Inflammatory diseases, recent MI or surgery, chronic debilitation or malabsorption, chronic infections other than candidiasis, corticosteroid use, pregnancy, postmenopausal women.	Purposive selection; controls matched for age, race, and parity	20–51 years	29	20	Candida albicans (documented by microscopy and culture on Sabouraud agar)	Recurrent vulvovaginal candidiasis (≥ 3 documented episodes in prior 12 months)	29 patient and 20 control blood samples (plasma and erythrocyte zinc analyzed)	Blood collected in zinc-free heparinized plastic syringes, plasma separated by centrifugation at 4 °C; RBCs washed and centrifuged $3 \times$ with saline; both stored in zinc-free Falcon tubes at -70 °C. Blood samples were collected between 8-10am after an overnight fast.	None (cross-sectional, single measurement)	Atomic absorption spectroetry (Perkin Elmer Model 4000) after dilution (plasma) and wet ashing (RBCs)	Student's t-test (unpaired), χ^2 test, and ANCOVA for dietary zinc adjustment.	Plasma zinc: 81 ± 11.6 µg/dL over all; non-supplemented subgroup = 79 ± 12.4 µg/dL (range 58–110.3); supplemented = 95 ± 20.8 µg/dL (range 78–123.3). RBC zinc: 13 ± 1.5 µg/g (range 10.8–15.9).	Plasma zinc: 91 ± 14.2 µg/dL over all; non-supplemented = 91 ± 12.5 µg/dL (range 70.6–114.2); supplemented = 95 ± 20.8 µg/dL (range 78–123.3). RBC zinc: 13 ± 1.5 µg/g (range 10.8–15.9).	Plasma zinc: $p = 0.015$ (significant); RBC zinc: $p = 0.44$ (not significant).	Not applicable (no follow-up).	Not applicable (no follow-up).	Not applicable.	5/29 (17%) RVVC patients had plasma zinc < 70 µg/dL (vs 0/20 controls, $\chi^2 = 3.42$). Dietary zinc intake was similar between groups (8 ± 2.5 mg vs 7 ± 2.2 mg, $p = 0.19$). Suggests mild zinc deficiency may be associated with RVVC.

Shahverdi, Zohreh; Valaei, Naser; Alemi, Yeganeh	Recurrent vulvovaginal candidiasis and plasma Zinc levels	1993	Iran (Loghman Hakim hospital location implied)	Plasma	Case-control study	Female patients with RVVC	80 total (40 cases + 40 controls)	Groups matched for age, number of pregnancies, and other factors	Not specified in abstract	Not specified (volunteers for control group)	Not specified (but matched between groups)	40	40	Not specified (Candida species not mentioned)	RVVC (Recurrent Vulvovaginal Candidiasis) - at least 3 episodes in one year despite standard fungicide treatment	80 (all enrolled)	Not specified	None mentioned (cross-sectional design)	Atomic absorption spectrophotometry	Chisquare analysis, Odds ratios	55±21 µg/dl	62±23 µg/dl	P<0.09 (not statistically significant at p<0.05)	Not applicable (no follow-up)	Not applicable (no follow-up)	Not applicable	Odds ratio: 1.7 times higher chance of low plasma zinc in patient group vs control
Böhler, K.; Meisinger, V.; Klade, H.; Reintaller, A.	Zinc levels of serum and cervicovaginal secretion in recurrent vulvovaginal candidiasis	1994	Austria (University of Vienna)	Plasma (serum) and cervicovaginal secretions	Cross-sectional controlled comparative study	Non-pregnant women with regular menstrual cycles	36 total (21 recurrent VVC; 15 controls)	Age 20–49 years, mean 33.7; culture-negative for Candida & other STIs (BV, Trichomonas vaginalis, NG, Chlamydia, mycoplasma, Ureaplasma) at investigation; regular cycles	Symptomatic infection, Ingestion of Zinc supplements with 7 days prior to the test, sexual intercourse within 3 days prior (semen has high zinc levels)	Not explicitly stated; but convenience/clinical recruitment implied	20–49 years (mean 33.7)	21 with recurrent VVC	15 healthy women	Candida species excluded by culture; not specified in this paper	Recurrent Vulvovaginal Candidiasis (RVVC) – ≥3 episodes in prior 12 months	35 total: 20 recurrent VVC + 15 controls	Plasma and cervicovaginal samples were centrifuged (plasma), stored at –20°C (plasma), and diluted 1:5 with deionized water before zinc measurement by flame atomic absorption spectrophotometry	Not applicable for zinc measurements (cross-sectional at baseline only)	Flame atomic absorption spectrophotometry	Wilcoxon 2-sample test; Spearman correlation	Plasma Patient group: 109 µg/dL (SD 17.7) Cervical vaginal secretion: 41 ± 30.2	Plasma: Control group: 107 ± 12.8 Cervical vaginal secretion: 42 ± 29.6	Plasma: P value = 0.71 Cervical vaginal secretion = 0.80	Not applicable	Not applicable	Not applicable	The correlation between plasma and cervicovaginal zinc levels was r = –0.05 in the recurrent VVC group and r = –0.07 in the control group.

BAL TACI, ABD ULKERİM KASIM	The Relationship Between Vulvovaginal Candidiasis and Serum Zinc Levels in Pregnant Women	1998	Turkey (Firat University Faculty of Medicine)	Blood samples (serum)	Cas-control study	Pregnant women with vulvovaginal candidiasis	25 total (15 cases + 10 controls)	All pregnant women; no other demographics specified	Not specified	Not specified	Not specified	15	10	Not specified (Candida species not mentioned)	VVC (Vulvovaginal Candidiasis) - acute, not recurrent	25 (all enrolled participants)	Not specified	None (cross-sectional study)	Atomic absorption spectrophotometer (Shimadzu ASC-6100)	Student's t-test; results expressed as mean ± standard deviation	62.36 ± 8.26 µg/dl (serum)	80.11 ± 7.15 µg/dl (serum)	t = -4.84, P < 0.001 (statistically significant)	Not applicable (no follow-up)	Not applicable (no follow-up)	Not applicable	Leukocyte counts: Patient 7300±1927/mm³ vs Control 9700±803/mm³ (t=-2.74, P<0.05). Lymphocyte %: Patient 16.09±4.43% vs Control 22.26±2.40% (t=-2.59, P<0.05). Normal serum zinc range: 70-150 µg/dl; patient group below normal. Parallel decrease in lymphocyte ratio with zinc deficiency noted.
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BAL TACI , ABD ULK ERİM KASIM	Effect s of zinc suppl ement ation to the treat ment of vulvo vaginal candi dias is in reduci ng recurr ence	199	Turkey	Serum samples	Randomized Controlled Trial (RCT)	Non-pregnant women aged 18-37 years with symptoms of vulvovaginal candidiasis	68	Sexually active women aged 18-37 years presenting with vulvovaginal candidiasis symptoms, with Group I having a mean age of 25.87 ± 5.30 years and Group II having a mean age of 24.61 ± 6.44 years.	Pregnancy, age outside 18-37 years, chronic systemic diseases, and use of oral contraceptives or other medications.	Random assignment to two groups	18-37 years (mean ~26 years)	35 (Group II - Zinc supplementation)	33 (Group I - Placebo)	Candida albicans (causing vulvovaginal candidiasis)	VVC (Vulvovaginal Candidiasis) - all participants had symptomatic vulvovaginal candidiasis	At baseline 68 samples (Group I = 33, Group II = 35), at 30 days 60 samples (Group I = 30, Group II = 30), and at 90 days 54 samples (Group I = 26, Group II = 28).	Serum samples collected and processed for zinc level measurement	90 days (with measurements at baseline, 10 days, 30 days, and 90 days)								The study enrolled 68 women with vulvovaginal candidiasis randomized to either fluconazole 150 mg/day alone (Group I, n=33) or fluconazole 150 mg/day plus zinc sulfate 50 mg for 30 days (Group II, n=35), with follow-up at 10, 30, and 90 days. At 10 days (baseline), reinfection rates were similar between groups (Group I: 15.15%, Group II: 14.28%) with comparable KOH and culture negativity rates. At 30-35 days follow-up, Group II showed superior outcomes with a reinfection rate of 6.66% compared to 21.42% in Group I, though this difference was not statistically significant. At 90 days, reinfection rates were 22.72% in Group I versus 10.71% in Group II. Most importantly, the total reinfection rates across the entire study period demonstrated a highly significant difference ($p<0.005$), with Group I experiencing a 48.48% total reinfection rate compared to only 28.57% in the zinc supplementation group (Group II), indicating that zinc supplementation significantly reduces recurrence of vulvovaginal candidiasis when added to standard antifungal therapy.
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Špaček, J.; Jilek, P.; Buchta, V.	The levels of calcium, iron and zinc in patients with recurrent vulvovaginal candidiasis during attack and remission and in healthy controls	2005	Czech Republic	Blood serum samples	Cohort study (multicenter, observational)	Women with recurrent vulvovaginal candidiasis (RVVC) and healthy controls	74 total (44 RVVC patients + 30 healthy controls)	RVVC patients: age range 17-51 years (mean 31.7); Controls: age range 21-44 years (mean 33.7). All RVVC patients had primary idiopathic form with no known causes. No pregnant women or patients with proven immunomodulation included.	Pregnant women, patients with proven immunomodulation	Not specified for randomization; patients recruited from special outpatient department of gynecological clinic	RVVC patient: 17-51 years (mean 31.7); Controls: 21-44 years (mean 33.7)	44 RVVC patients	30 healthy women	Candida species	RVVC (Recurrent Vulvovaginal Candidiasis) - defined as four cultured attacks of VVC during previous 12 months	88 samples from RVVC patients (44 during attack + 44 during remission) + 30 from controls = 118 total samples	Blood samples processed same day with no delay. Serum extracted for metal analysis.	Patients followed during attack and remission periods. Controls and remission samples taken between 21st-23rd day of menstrual cycle; attack samples taken regardless of cycle.	Flame atomic absorption spectrometry (Solaar 959, Unicam Mannheim, Germany)	Student's t-tests: paired analysis for attack vs. remission; non-paired analysis for patient vs. control. $P < 0.05$ considered significant.	Baseline zinc concentration (attack phase) in the patient group: $13.25 \pm 2.69 \mu\text{mol/L}$. Zinc concentration in the patient group during remission: $13.16 \pm 2.28 \mu\text{mol/L}$.	Zinc concentration - control group $17.52 \pm 5.62 \mu\text{mol/L}$	Attack vs Control: $P \leq 0.001$ (highly significant); Remission vs Control: $P \leq 0.001$ (highly significant)			Attack vs Remission: not significant (n.s.) - no significant difference between zinc levels during attack and remission	RVVC patients' values clustered near the lower limits (approximately 75% of zinc values were just above lower normal limit). Calcium: Attack $2.21 \pm 0.35 \text{ mmol/L}$, Remission $2.23 \pm 0.36 \text{ mmol/L}$, Control $2.38 \pm 0.47 \text{ mmol/L}$ (both $P \leq 0.001$ vs control, attack vs remission n.s.). Magnesium: Attack $0.79 \pm 0.14 \text{ mmol/L}$, Remission $0.82 \pm 0.14 \text{ mmol/L}$, Control $0.87 \pm 0.17 \text{ mmol/L}$ ($P \leq 0.001$ for attack vs control and remission vs control; $P \leq 0.01$ for attack vs remission). Iron: Attack $17.53 \pm 8.74 \mu\text{mol/L}$, Remission $17.22 \pm 7.78 \mu\text{mol/L}$, Control $13.68 \pm 5.14 \mu\text{mol/L}$ (all comparisons n.s., but trend toward elevation in patients). All measured metals were within normal reference ranges despite significant differences.
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Zangeneh, M.; Siadat, S. D.; Jamshidi, M.; Alijani, M.; Farhudi, B.; Valizadeh, M.	Zinc level of serum in recurrent vulvovaginal candidiasis.	2008	Iran (Islamic Azad University, Tehran; Pasteur Institute of Iran)	Plasma (blood samples)	Case-control study	Women with recurrent vulvovaginal candidiasis	104 total (53 cases + 51 controls)	Age matched; controls were healthy age-matched women	Not clearly specified in visible text	Not specified	Control group: 15-50 years (mean 33.12 ± 5.37); Patient group age mentioned in table	53	51	Candida albicans (mentioned in introduction)	RVVC (Recurrent Vulvovaginal Candidiasis) - at least 4 episodes within previous 12 months	104 (all enrolled)	Blood samples centrifuged immediately for 15 min, plasma kept at -70°C until analysis	None (cross-sectional study)	Atomic Absorption Spectrophotometry; data analyzed using SPSS; Zn measured photometrically	Student's t-test; p-value <0.05 considered significant	57.33 ± 74.0 µg/dl ⁻¹ (plasma)	93.38 ± 74.0 µg/dl ⁻¹ (plasma)	P < 0.05 (statistically significant difference)	Not applicable (no follow-up)	Not applicable (no follow-up)	Not applicable	Study concluded that zinc deficiency might play a role in susceptibility to recurrent vulvovaginal candidiasis. The control group showed no significant difference between case and control group (p > 0.05). 88% of control group and 94% of patient group showed no significant differences in zinc concentrations (p > 0.05). Mean plasma zinc concentrations were 57.33 µg/dl in patient group vs 93.38 µg/dl in control group.
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Hosseini, Seyed edeh Sedigh; Josha ghani, Hamidreza; Shokhi, Taher eh; Ahmadi, Alireza; Mehr bakhs h, Zahra	Antifungal Activity of ZnO Nano particles and Nystatin and Down regulation of SAP1-3 Genes Expression in Flucanazole-Resistant Candida albicans Isolates from Vulvovaginal Candidiasis	2020	Iran	Vaginal swabs	Descriptive-analytic cross-sectional study	Women with vulvovaginal candidiasis (VVC) attending Sayad Shirazi Obstetrics and Gynecology Hospital	280 women with VVC	Women aged 18-46 years suffering from burning, itching, malodorous and cheesy vaginal secretions with confirmed VVC diagnosis. Samples collected from married women.	Not explicitly stated	Consecutive sampling from hospital gynecology department	18-46 years	196 C. albicans isolates identified (70% of 280 samples); divided into 10 flucanazole-resistant and 186 flucanazole-susceptible isolates	No healthy control group - used standard reference strain C. albicans ATCC10231	Candida albicans (confirmed by phenotypic methods and ITS genotypic methods)	VVC (Vulvovaginal Candidiasis); subgroup: 168 (85.71%) susceptible, 18 (9.13%) susceptible dose-dependent (SD), 10 (5%) flucanazole-resistant	280 vaginal samples collected; 196 (70%) positive for C. albicans; all analyzed for susceptibility; 10 flucanazole-resistant isolates used for detailed gene expression studies	Morphological identification using germ tube test, CHROMagar Candida, Cornmeal agar with Tween 80. DNA extraction by phenol-chloroform-isoamyl alcohol method. RNA extraction using TRIzol reagent. RT-PCR for ERG11 gene. Real-time PCR for SAP1-3 gene expression analysis.	no patient follow-up, laboratory-based study	This study tested zinc oxide nanoparticles (ZnO-np) as an antifungal agent in vitro	Rest software (ver. 2009) for target/reference gene ratio testing; SPSS (ver. 16) with one-way ANOVA; 2 ⁻ ΔΔCt method for gene expression analysis; P≤0.05 considered significant	Not measured	Not measured	Not measured	Not measured	Not measured	Not measured	ZnO nanoparticles synthesized by sol-gel method, tested at sub-MIC concentrations ranging 0.02-12 µg/mL (later specified as 2-18.1 µg/mL for gene expression studies). MIC range: 0.02-269 µg/mL; MIC50: 5 µg/mL; MIC90: 11.3 µg/mL. Sub-MIC concentration used: 11.1 µg/mL (concentration allowing >50% cell viability). Final concentration for gene expression studies: 3±1.7 µg/mL (also reported as 5±1.3 µg/mL). Fluconazole susceptibility: 10/196 (5%) resistant, 18/196 (9.13%) SDD, 168/196 (85.71%) susceptible. ERG11 gene: Detected in all 10 fluconazole-resistant isolates (397 bp band), not in susceptible isolates. SAP gene expression in untreated isolates: SAP1: 10/10 (100%) resistant strains, 18/18 (100%) SDD, 148/168 (88%) susceptible; SAP2: 9/10 (90%) resistant, 15/18 (83%) SDD, 148/168 (88%) susceptible; SAP3: 6/10 (60%) resistant, 12/18 (67%) SDD, 118/168 (70%) susceptible. Mean SAP1-3 expression significantly higher in resistant vs susceptible strains (P<0.001). Nystatin MIC: Range 0.6-32 µg/mL; MIC50: 3 µg/mL; MIC90: 8 µg/mL; Sub-MIC: 4 µg/mL; concentration for gene studies: 3±1.3 µg/mL. Gene
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Murina, F.	The role of female intimate hygiene practices in the management of vulvovaginal candidiasis: A randomized, controlled open-label trial	2023	Italy	Not applicable - this was not a zinc measure ment study	Multicenter, clustered, randomized, controlled open-label trial	Women with vulvovaginal candidiasis (VVC)	200 women randomized (220 recruited)	192 completed the trial (97 in Group 1 receiving clotrimazole 2% vaginal cream plus acid pH thymol and zinc-containing cleansing wash, and 95 in Group 2 receiving clotrimazole alone). Both groups had comparable baseline characteristics : Group 1 had mean age 27.5±6.3 years, BMI 21.5±5.2 kg/m², and Sobel score 8.2±1.1, while Group 2 had mean age 27.3±6.3 years, BMI 22.3±4.8 kg/m², and Sobel score 8.3±1.1	Pregnant, lactating, postmenopausal women; trichomonas vaginitis; history of repeated vaginal candidiasis; taking contraceptive pills, broad-spectrum antibiotics, or oral vaginal-related vaginitis drugs in past two weeks	Permuted randomized	18-45 years	Group 1: 97 (completed); Group 2: 95 (completed)	Not applicable - both groups were treatment groups	Candida species (mainly Candida albicans) - confirmed by blastospores/hyphae on microscopy or positive vaginal culture	VVC (Vulvovaginal Candidiasis) - moderate to severe (Sobel score ≥2)	192 participants (97 in Group 1, 95 in Group 2)	Not applicable - clinical trial with symptom assessment	15 ± 3 days	Not applicable - zinc was not measured in this study	GraphPad StatMate v2.00; Chi-square and Student's t-tests (paired and unpaired); p<0.05 considered significant	Not measured - zinc was an ingredient in the cleansing wash, not measured in samples	Not measured	Not applicable for zinc concentration	Not measured	Not measured	Not applicable for zinc concentration	The study measured two primary symptom outcomes using patient self-reported Visual Analogue Scale (VAS) scores: pruritus (itching) and burning sensation. Participants were provided with daily diaries at Visit 1 (baseline) and instructed to mark the severity of pruritus and burning on a 10 cm VAS ranging from 0 (no pruritus/burning) to 10 (highest pruritus/burning) each day until the final visit. These self-reported VAS scores were collected at baseline and assessed at three timepoints: Day 6 (end of clotrimazole treatment), Day 10, and Day 15 (final visit, 15±3 days after baseline). The diaries were returned at Visit 2, and data were analyzed using GraphPad StatMate version 2.00 with Student's t-tests (paired and unpaired) for between-group comparisons of continuous VAS data, with p<0.05 considered statistically significant. Additionally, VVC diagnosis was confirmed at baseline through clinical assessment using the Sobel scoring system (semiquantitative measure scoring pruritus, erythema, edema, and excoriation from 0-3 each, with total score ≥2 required for enrollment) and microbiological
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Roselletti, Elena; Pericolini, Eva; Nore, Alexandre; Takacs, Peter; Kozma, Bence; Sala, Arian; De Seta, Francesco; Comar, Manola; Usher, Jane; Brown, Gordon D.; Wilson, Duncan	Zinc prevent vaginal candidiasis by inhibiting expression of an inflammatory protein.	2023	Hungary	Clinical assessment (no biological samples collected for analysis)	Retrospective cohort study	Women with recurrent vaginal infections (RVVC or RBV)	10 enrolled, 8 completed	Women with history of recurrent vaginal infections attending outpatient clinic. Demographics recorded: age, BMI, previous pregnancies, deliveries, operations, menstruation cycle, hormonal therapy, relationship status, sexual partners in last 12 months, episodes of vaginitis over previous 12 months	Postmenopausal state (≥ 12 consecutive months amenorrhea or FSH ≥ 30 mIU/mL), local or systemic hormone therapy within past 6 months, cytological atypia, prior radiation treatment, history of breast/ovarian/other gynecological cancer, pelvic organ prolapse $>$ stage 2, recent use (3 months) of any vaginal product or douching	Convenience sampling from outpatient clinic	Not specified in detail	8 completed (6 RVVC + 2 RBV)	0 (no control group - single arm intervention study)	Not specified (clinical diagnosis of RVVC)	RVVC (n=6) and RBV (n=2). Recurrent infection defined as ≥ 3 vaginal infections in the last 12 months	8 women completed the study (2 dropped out)	N/A - clinical intervention study	3 months	Zinc administered as intervention (not measured). Zinc-containing vaginal hydrogel (JUVIA vaginal gel; Fempharma, LLC) containing 20 μ M zinc sulphate heptahydrate	Microsoft Excel 2019; Paired t-test; $P < 0.05$ considered significant	N/A - zinc levels not measured (zinc gel intervention)	N/A - no control group	N/A	N/A - zinc levels not measured	N/A	N/A	N/A	Zinc Gel Intervention Protocol: Self-applied 2 ml intra-vaginally via vaginal applicator nightly for 2 consecutive weeks, then twice per week. Gel composition: Water, hydroxyethyl cellulose, 20 μ M zinc sulphate, lactic acid. Primary Outcome (Reinfection within 3 months): RVVC group: 5/6 women (83%) had NO reinfection. RBV group: 0/2 women (0%) showed improvement - both had reinfection. Treatment failure definition: Reoccurrence within first 3 months. Follow-up: Women asked to return to clinic if symptoms appeared. Detailed gynecological exam at enrollment and follow-up visit. Conclusion: Zinc gel effectively prevented reinfection in 83% of women with RVVC but had no effect on recurrent bacterial vaginosis, supporting the specificity of zinc's mechanism against fungal (not bacterial) infections.
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Abid, Hawazin Ahmed	Reveal the role of garlic silver nanoparticles and garlic zinc nanoparticles on candida albica isolated from women with vulvovaginal candidiasis	2024	Iraq	Vaginal swabs	Cross-sectional laboratory study (experimental/in vitro antimicrobial testing)	Married women with vulvovaginal candidiasis attending Salah al-Din General Hospital	120 clinical samples collected	Women aged 20-50 years with vaginal candidiasis. Initial diagnosis and follow-up examinations conducted with assistance of female gynecologist	Not explicitly stated	Conservative sampling from patients attending hospital gynecology department	20-50 years	69 positive samples (57.5% of 120)	No control group - this was not a comparative clinical study	Candida albicans (isolated and confirmed by microscopy, culture, and molecular methods)	VVC (Vulvovaginal Candidiasis)	120 samples examined; 69 (57.5%) positive for Candida; 10 isolates used for nanoparticle testing	Swabs collected, direct microscopy with 10% KOH, cultured on Sabouraud Dextrose Agar with chloramphenicol at 37°C for 48 hours. DNA extracted using Mo Bio Power Soil DNA Isolation Kit. Real-time PCR performed for virulence genes (ALS1, HWP1, ACT1).	Sample collection period: February to May 2024 (no patient follow-up)	Not applicable - zinc was not measured in patient samples. This study tested zinc nanoparticles (ZnO NPs) as an antifungal agent against Candida isolates in vitro.	descriptive statistics (mean ± SD) used for inhibition zone measurements	Not measured	Not measured	Not measured	Not measured	Not measured	Not measured	Not measured	Garlic-synthesized zinc oxide nanoparticles (ZnO NPs) at concentrations of 250 ppm and 500 ppm tested against Candida isolates in vitro. Molecular findings: 9/10 (90%) isolates had ALS1 gene (Cq: 24.402-29.437), 10/10 (100%) had HWP1 gene (Cq: 14.748-29.562), 7/10 (70%) had ACT1 gene (Cq: 23.699-28.23). Antifungal activity: Garlic-synthesized AgNPs showed inhibition zones of 8.04±3.47 mm at 250 ppm and 21.25±3.18 mm at 500 ppm. Garlic-synthesized ZnO NPs showed inhibition zones of 8.99±2.24 mm at 250 ppm and 19.57±2.54 mm at 500 ppm. Silver nanoparticles were slightly more effective than zinc nanoparticles at the higher concentration (500 ppm). Both nanoparticle types demonstrated concentration-dependent antifungal activity against Candida albicans, with AgNPs showing slightly superior efficacy at 500 ppm concentration
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