

Speech Articulation of Low-Dose Oral Contraceptive Users

*Elis a Maria Meurer, †Giana Valeria Fagundez Fontoura, ‡Helena von Eye Corleta, and §Edison Capp, *†‡Porto Alegre, Brazil, and §Heidelberg, Germany

Summary: Objectives. In the female life cycle, hormonal fluctuations may result in impaired verbal efficiency and vocal worsening during the premenstrual phase. Oral contraceptives may interfere with vocal range. Voice, resonance, and articulation variations clarify speech content. To investigate the phonoarticulatory sounds produced by oral contraceptive users aged between 20 and 30 years.

Study Design. This is a cross-sectional study.

Methods. Our study included four groups of women (n = 66): two groups used low-dose oral contraceptives and two groups did not use any oral contraceptives. Questionnaires and sound records were used. Acoustic analysis was performed using the Computerized Speech Laboratory program, *Model 4341* (Kay Elemetrics Corp, Lincoln Park, New Jersey). The statistical analysis of the SPPS database, version 13.0, was performed by means of generalized estimating equation.

Results. In the groups that did not use oral contraceptives, sustained vowel tones were more acute in the two phases and cycles of women older than 25 years (w/oOC1, 175 ± 74 to 190 ± 55 Hz; w/oOC2, 194 ± 56 to 210 ± 32 Hz). At the midfollicular phase (Fph) and midluteal phase (Lph) of the two cycles, the speed of the speech was slower in this group (w/oOC1: Fph, 5.3 ± 1.6/s and Lph, 5.4 ± 1.4/s; w/oOC2: Fph, 4.5 ± 1.7/s and Lph, 4.8 ± 1.1/s). In both groups that used oral contraceptives, there was a higher modulation frequency in the sentences when compared with nonusers (OC1, 33 ± 10 Hz; w/oOC1, 28 ± 10 Hz; OC2, 34 ± 10 Hz; w/oOC2, 27 ± 10 Hz). Vocal intensity was closer between the OC1 (62 ± 4 dB), w/oOC1 (61 ± 3 dB), and OC2 (63 ± 4 dB) groups when compared with the w/oOC2 (67 ± 6 dB) group.

Conclusions. We demonstrated hormonal influences on speech articulation of contraceptive users and nonusers.

Key Words: Menacme–Menstrual cycles–Oral contraceptives–Speech articulation–Isolated emissions–Connected speech–Acoustic records.

INTRODUCTION

During menacme, the reproductive phase of the female life cycle, the dynamic interaction between the hypothalamic-pituitary-ovarian axis and the genital tract establishes menstrual cycles at intervals of around 4 weeks.¹ The duration of these cycles depends on the time required for follicular maturation (variable) and the functional duration of the corpus luteum (from 10 to 16 days), thus determining the cyclicity of menstruations. Ovulation occurs between these two phases and, if there is no fertilization, the endometrium lining is shed (menstruation).²

Reproductive capacity may be inhibited by the use of contraceptives containing estrogen and progesterone. These drugs are also used in the treatment of disorders such as premenstrual tension syndrome or premenstrual dysphoric disorder,^{3,4} as well as acne, hyperandrogenism, increased menstrual bleeding, primary dysmenorrhea, and so forth.

Sex steroids have an influence on the motor processes of human verbal expression.^{5,6} Verbal expression may be a

fundamental resource of communication in interpersonal relationships and professional activities, such as teaching, radio and television journalism, sales, and entertaining activities (singing and performing arts). Vocal characteristics help to identify people and also provide tips on their health, lifestyle, and emotional state.^{7,8} Our best vocal performance occurs between 25 and 45 years.⁹

As a consequence of the synchrony between motor movements and vocal result, we can perceive changes in the voice (human sound waves), resonance (amplification and damping of the vocal sound waves), and articulation (variations of opening and closing of the vocal tract used to produce vowel and consonant sounds). The effects of these variations create supra-segmental features, such as intonation, vocal intensity, and verbal fluency (speed, rhythm, relationship between sound duration and intervals during emissions).^{10,11}

These processes are essential to clarify the content of the speakers' messages, being dependent on the integration of central and peripheral motor processes.^{5,12–14} Likewise, specific interconnections between the cortical hubs enable the production of different types of speech such as spontaneous speech, repetitive speech, or verbal reading. Gender and phases of menstrual cycles may also cause variations in the neural processes.¹⁵

During the reproductive phase of the female life cycle, hormonal variations may result in reduced verbal efficiency and temporary vocal worsening in the premenstrual or luteal phase.^{7,16–19} Women with symptoms of premenstrual syndrome showed increased jitter during this phase.²⁰ Oral contraceptives may interfere with the vocal range.^{3,21,22}

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From the *Graduate Program in Health Sciences, Department of Obstetrics and Gynecology, School of Medicine, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil; †School of Psychology, Universidade da Regi o da Campanha, URCAMP/Bag e Campus, Porto Alegre, Brazil; ‡Department of Obstetrics and Gynecology, Hospital de Cl nicas de Porto Alegre, School of Medicine, Universidade Federal do Rio Grande do Sul, Porto Alegre, Brazil; and the §Excellence Initiative, Department of Gynecological Endocrinology and Reproductive Medicine, University Hospital Heidelberg, Heidelberg, Germany.

Address correspondence and reprint requests to Edison Capp, Servi o de Ginecologia e Obstetr cia, Hospital de Cl nicas de Porto Alegre, Rua Ramiro Barcelos, 2400/11  andar, 90035003 Porto Alegre, Rio Grande do Sul, Brazil. E-mail: edcapp@ufrgs.br

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Emissions of prolonged vowel sounds and sound sequences differ from connected speech in sentences because of the influence of suprasegmental aspects and speakers' specific characteristics.^{23,24} With the purpose of addressing these peculiar aspects, the objective of the present study was to investigate acoustic variations of voice and speech in oral contraceptive users aged between 20 and 30 years old during isolated and contextualized emission tasks.

MATERIAL AND METHODS

Study design

We conducted a cross-sectional study.

Population and sample

The present study was approved by the Research Ethics Committee of the Research and Graduate Studies Group of Hospital de Clínicas de Porto Alegre (#03–230). This study is ethically and methodologically adequate according to the Guidelines and Regulatory Standards of Research Involving Human Subjects (Resolution 196/96 of the Brazilian National Health Council).

The sample consisted of women seen at the gynecology outpatient clinic of the Hospital de Clínicas de Porto Alegre. We included nonsmoking women who did not have vocal training in speech or singing and were native speakers of Brazilian Portuguese. None of the participants reported previous hormone therapy or other organic, neurologic, cognitive, or emotional limitations.

Sixty-six women of reproductive age were invited to participate in the study. Of these, 21 had never been pregnant before, had regular menstrual cycles, and had not been using hormonal drugs and contraceptives for more than 3 months. The other 45 women had been using oral contraceptives for 3 months or longer. After agreeing to participate and signing the written consent form, participants completed a questionnaire with the purpose of collecting data on their vocal and gynecologic history. Participants were divided into four groups:

- Women aged between 20 and 24 years, 11 months, and 29 days:
 - o Using low-dose oral contraceptive (containing estrogen 0.03, 0.02, or 0.015 mg): OC1 group;
 - o No oral contraceptive use: w/oOC1;
- Women aged between 25 and 30 years:
 - o Using low-dose oral contraceptive (containing estrogen 0.03, 0.02, or 0.015 mg): OC2 group;
 - o No oral contraceptive use: w/oOC2;

The next phase consisted of recording the following items: (1) noise level of the recording room for 15 seconds to exclude possible interferences from environmental noise on verbal records; (2) sustained utterance of the vowel “a” to investigate the fundamental voice frequency (f_0) and the ability to maintain the synchrony of vocal fold vibration (f_0); (3) five repetitions of verbal diadochokinesia (DDK) /pataka/ to investigate articulatory agility (DDK speed and DDK rhythm) and

vocal intensity (DDKi); (4) five repetitions of the vowel combination /iu/ to study the speaker's ability to reinforce sound groups derived from the fundamental voice frequency in the nasopharyngeal-oral route (F_{2max} and F_{2min}); and (5) the sentence “Irei a Gramado nas férias de inverno.” [I'm going to go Gramado over winter break] in six variations, which consisted of neutral, exclamatory, and interrogative (prosodic) intonations and expressing sadness, happiness, and anger (emotional intonations) to record the speakers' abilities regarding frequency variations (Nf_0 , Ef_0 , If_0 , Sf_0 , Hf_0 , Af_0 , and Ff_0) and vocal intonation (N_{std} , E_{std} , I_{std} , S_{std} , H_{std} , A_{std} , and F_{std}). This sentence refers to a gaucho tourist spot. Patients were instructed in producing the desired intonational intended as in previous studies.^{25,26} A demo model of intonation was only provided when demanded by the patient. The emission of this sentence using neutral intonation demonstrated the mean time of production of syllables (F_{speed}) and rhythm (F_{rhythm}).

Recordings were conducted during the follicular phase (days 5–8) and the premenstrual phase (days 18–23) for women with regular menstrual cycles. These recording sessions were repeated in two menstrual cycles. Oral contraceptive users recorded their vocal production after the third day they started a new pill pack.

We used a Sony MZR70-S1 MiniDisc Recorder (Sony Corporation, Tokyo, Japan), a Shure 16A microphone (SHURE Incorporated, Evanston, Illinois), and a Sony Recordable Mini Disc–74 Minutes (Sony Corporation). This cardioid, uni-directional, polar-pattern microphone had frequency response between 50 and 15 000 Hz. In the range between 500 and 8000 Hz, the variation was less than 4 dB with a peak between 6000 and 7000 Hz for high-fidelity recording. The microphone was placed 10 cm from the mouth of the participants, who remained standing during the recording to facilitate their verbal emission processes. The emissions were trained whenever training was requested by the participants to avoid interference of individual differences such as, for example, professional activity. The records were repeated until analyzable patterns were achieved according to the recorder sensor. Continuous analysis of the results was performed using the *Motor Speech Profile* program, *model 4341*, coupled to the *Computerized Speech Laboratory* software (Kay Elemetrics Corp, Lincoln Park, New Jersey).

Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) 13.0 for Windows. The final analysis was performed using generalized estimating equations (GEE) considering differences of 30% between the variables for a beta error of 0.10, effect size of 1, and significance level of 0.05.

RESULTS

All participants completed a questionnaire with the purpose of collecting data on their vocal history and their perception of vocal changes (Table 1). In all groups, the habit of talking a lot was reported (43% SCO1, 68% CO1, 43% CO2, and 82% SCO2). In three groups, the habit of talking fast was reported (43% SCO1, 64% CO1, 48% and CO2).

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