DO ORAL CONTRACEPTIVES REALLY HAVE AN ADVERSE EFFECT ON VOICE QUALITY?

O. Amir¹, T. Biron-Shental²

¹Department of Communication Disorders, Sackler Medical School, Tel Aviv University, Tel-Aviv, Israel
²Department of Obstetrics and Gynecology, Sapir Medical Center, Kfar Saba, Israel

Abstract: Traditionally, oral contraceptives are considered to have adverse effect on women's voice quality. The purpose of this study was to evaluate the impact of oral contraceptives on voice quality, using acoustic analysis. Acoustic vocal parameters of seven women who use oral contraceptives and seven women who do not were measured repeatedly during the menstrual cycle. Repeated-measure analyses-of-variance were performed to test for group differences. Results did not reveal an adverse effect in the oral contraceptive users group. Moreover, amplitude and frequency perturbation, as well as noise-to-harmonics ratio values within the test group were found to be significantly lower than those observed among the control group; indicating a more stable voice quality.

Keywords: voice, vocal-quality, perturbation, hormones, oral-contraceptives

I. INTRODUCTION

The interaction between the human larynx and ovarian hormones has been previously demonstrated. Several researchers have discovered receptors for androgen, estrogen and progesterone in the gingival epithelium [1] and in the vocal folds [2,3]. The effect of these sex hormones on the human voice has been previously demonstrated in different cases of endocrine dysfunction. Such vocal changes include increase in vocal instability, hoarseness and pronounced lowered pitch [4].

Vocal changes related to hormonal balance were also reported in relation to the menstrual cycle in healthy women. Specifically, vocal changes were observed either at the premenstrual phase [5,6] or shortly prior to ovulation [7]. It should be noted that these changes in vocal quality were reported primarily among professional voice users and less so among non-professionals voice users. While the mechanism underlying these voice changes is not clear yet, it is assumed that the physiological changes which occur during the menstrual cycle impact voice quality. For example, the lowered pitch during the premenstrual phase is assumed to be the result of the edema and venous dilatation observed in the vocal folds at that time [4]. It was also suggested that changes in ovarian hormones levels could affect laryngeal neuromotor control [7], which in turn, could affect vocal stability and quality. It is interesting to note that the two phases along the menstrual cycle in which vocal changes were reported in the literature (premenstrual phase and prior to ovulation) are also marked by a significant and abrupt change in hormonal balance.

Oral contraceptives present an exciting setting in which hormones could interact with voice production. Most modern birth control pills are designed to maintain constant levels of estrogen and progesterone along the menstrual cycle therefore preventing ovulation. Because birth control pills maintain a steady hormonal balance, it seems logical to expect that women who use birth control pills will show diminished voice changes along the menstrual cycle, in comparison with women who do not use the pill. However, review of the literature on the effect of birth control pills on voice quality revealed only a limited number of studies which addressed this question. These studies included occasional reports of adverse androgenic voice changes (e.g. virilization, and mainly lowered pitch) among women who use the pill [8], and were explained by the relatively high hormonal doses used in birth control pills in the 1960s and 1970s [9]. Based on these studies, otolaryngologists, voice specialists and speech-language pathologists generally suggest that professional voice-users refrain from using oral contraceptives [10]. In addition, using the pill is typically regarded as a risk factor when clinically evaluating voice disorders.

Modern birth control pills, however, contain markedly lower doses of estrogens and progestrogens with less androgenic metabolites. Thus, smaller androgenic effect can be expected. In a previous study that evaluated voice quality among women who use low-dose oral contraceptive formulations, using subjective measures [8], no voice changes were reported as a result of using the pill. Recently, two preliminary studies were reported, that compared acoustic parameters of voices produced by women who use the pill with voices of women who do not [11,12]. Results of these studies revealed no adverse effect on the voices of those women who use the pill. Moreover, amplitude perturbation (shimmer) and frequency perturbation (jitter) values among the pill-users were reported to be lower than those observed among the non-users. The purpose of the present study was to expend on the scarce knowledge regarding the effect of modern low-dose oral contraceptives on the voices of healthy women, through the use of acoustic-analysis evaluation.

II. METHODOLOGY

A group of young and healthy women volunteered to serve as participants in this study. Seven women who...
used birth control pills (Pill group) and Seven women who did not (Control group) were selected from the initial group of 30 students at Tel-Aviv University according to the criteria described bellow. The Pill group had a mean age of 23.96 years (range: 22-26), a mean weight of 58.29 kg (range: 52-70) and a mean height of 166.8 cm (range: 160-174). Three of the seven women in the Pill group used the oral contraceptive Meliane© (Schering AG, Berlin, Germany) with 0.075 mg gestodene and 0.02 ethinylestradiol; and two women used Harmonet© (Newbridge CO. Kildare, Ireland) which has identical formulation to Meliane©. One women used Gynera© (Schering) with 0.075 mg gestodene and 0.03 mg ethinylestradiol, and one used Microdol© (Oragon International Inc., Roseland, NJ) with 0.15 mg desogestrel and 0.03 mg ethinylestradiol. Since the four preparations used by the women in the Pill group are so similar in composition, and because all these compositions are considered low-dose formulations, it was decided to regard them as one group. All women in this group reported no omission in pill taking during the time of the study and the three preceding months. The Control group consisted of seven women who did not use any hormonal contraceptive prior or at the time of the study and the three preceding months. The Control group reported no omission in pill taking during the time of the study and the three preceding months. The Control group, while F0 values were generally higher in the Pill group. All women were recorded repeatedly over a period of 28-32 days.

All women ruled out any speech or voice disorder and were also assessed by two experienced speech-language pathologists to confirm the diagnosis. None of the women had a history of formal voice or singing training, as well as smoking or substance abuse. In addition, no history of pregnancies, hormonal imbalances and neurological problems were reported. All women reported regular menses and menstrual cycle of 28-32 days.

All women were recorded repeatedly over a period of 35-40 days. While our preliminary observations did not reveal a significant effect for menstruation-cycle phase, we still decided to consider it as a possible confounding factor, based on previous reports in the literature [5-7]. Thus, each subject’s menstruation cycle was divided into six consecutive and equal intervals. The six intervals were defined such that interval 1 includes the days of the menses and interval 6 includes the four days preceding the following menses. The remaining days of the menstrual cycle were divided equally to four intervals: 2 to 5 respectively. Each woman was recorded at least twice during each interval, totaling approximately 20 recording sessions for each participant.

Each recording session consisted of two recordings of the Hebrew vowel /i/ (similar to the vowel in the word “heed”) and two recordings of the vowel /a/ (similar to the vowel in the word “father”) in isolation. Each vowel was produced for 3-5 seconds, in a random order that was changed between subjects and sessions. Recordings were performed individually in a quiet room. Signal was recorded onto TDK (Tokyo, Japan) data cartridges, using a Sony TCD-D100 (Tokyo, Japan) digital audio tape recorder and a Sony ECM-T150 headset-microphone. Sampling rate for the recording was set at 44.1 kHz. Acoustic analyses were performed after each recorded vowel was fed to a voice analysis computer program (Multi Dimensional Voice Profile-MDVP, model 5105, Ver. 2 [Kay Elemetrics, Lincoln Park, NJ]).

Four acoustic parameters were measured for each vowel production: mean fundamental frequency (F0), which quantifies the number of complete cycles produced by the vocal folds per second; Jitter, which quantifies instability (perturbation) along the voice sample; Shimmer, which quantifies instability (perturbation) along the voice sample; and Noise-to-Harmonics Ratio (NHR) which compares the ratio between the aperiodic to periodic components in the voice signal. Note that for Jitter, Shimmer and NHR, lower values typically represent a healthier voice, whereas higher values are generally associated with less stable and lower quality voice [13].

Statistical analyses were performed using four separate repeated-measure analyses of variance; one for each acoustic parameter. The two vowels (/i/ and /a/) and the six menstrual-cycle intervals (1 through 6) were treated as repeated factors, while Group (Pill versus Natural) was regarded as the between-subject factor.

III. RESULTS

A. Group Differences

Based on the individual data collected, group means were calculated for each acoustic parameter at all six intervals and two vowels. Table 1 presents these data. As can be seen, jitter, shimmer and NHR values in the Pill group were generally lower than those observed in the Control group, while F0 values were generally higher in the Pill group.

Statistical analysis revealed a significant group difference across all intervals and vowels for Jitter ($F_{1,12}$ = 6.29, $P = 0.027$), Shimmer ($F_{1,12}$ = 7.32, $P = 0.019$) and for NHR ($F_{1,12}$ = 5.47, $P = 0.037$). Group differences for the F0 parameter were found to be non-significant ($P > 0.05$); yet in most conditions, the Pill group had a slightly higher F0 mean values than the Control group.

B. Menstrual-Cycle Interval Differences

The effect of menstrual-cycle interval was tested across the six intervals for each parameter. No statistically significant differences were found among the six intervals for either of the acoustic parameters measured ($P > 0.05$). In addition, no significant Group X Interval was found for any of the parameters ($P > 0.05$).
Table 1. Mean and standard deviation (in parentheses) for Fundamental Frequency (F0), Jitter, Shimmer and Noise-to-Harmonics Ratio (NHR) of the Pill (P) and Control (C) groups for the Vowels /a/ and /i/ at Each of the Six Menstruation-Cycle Interval

<table>
<thead>
<tr>
<th>Vowel</th>
<th>Parameter</th>
<th>Group</th>
<th>Interval</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>/a/</td>
<td>F0 (Hz)</td>
<td>P</td>
<td>214.92 (17.29)</td>
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<tr>
<td></td>
<td></td>
<td>C</td>
<td>211.63 (29.37)</td>
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<tr>
<td></td>
<td>Jitter (%)</td>
<td>P</td>
<td>1.00 (.52)</td>
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<tr>
<td></td>
<td></td>
<td>C</td>
<td>1.34 (.35)</td>
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<tr>
<td></td>
<td>Shimmer (%)</td>
<td>P</td>
<td>3.33 (.13)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C</td>
<td>4.09 (.14)</td>
</tr>
<tr>
<td></td>
<td>NHR</td>
<td>P</td>
<td>.127 (.013)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C</td>
<td>.133 (.010)</td>
</tr>
<tr>
<td>/i/</td>
<td>F0 (Hz)</td>
<td>P</td>
<td>223.19 (26.15)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C</td>
<td>220.06 (25.67)</td>
</tr>
<tr>
<td></td>
<td>Jitter (%)</td>
<td>P</td>
<td>1.39 (.43)</td>
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<tr>
<td></td>
<td></td>
<td>C</td>
<td>1.87 (.40)</td>
</tr>
<tr>
<td></td>
<td>Shimmer (%)</td>
<td>P</td>
<td>2.80 (.62)</td>
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<tr>
<td></td>
<td></td>
<td>C</td>
<td>3.88 (.56)</td>
</tr>
<tr>
<td></td>
<td>NHR</td>
<td>P</td>
<td>.126 (.024)</td>
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<tr>
<td></td>
<td></td>
<td>C</td>
<td>.129 (.026)</td>
</tr>
</tbody>
</table>

C. Vowel Differences

Vowel difference between /a/ and /i/ was not defined as a primary research question in this study. However, since differences in fundamental frequency and other acoustic measures were previously demonstrated to be vowel related, it was decided to include Vowel as a possible confounding factor in the analyses. As expected F0 was significantly higher for the vowel /i/ compared to /a/ (\(F_{i,a} = 15.00, P = .002\)). This vowel difference is in keeping with previously established data [13]. Statistically significant vowel differences were also found for Jitter (\(F_{i,a} = 20.56, P = .001\)) and for NHR (\(F_{i,a} = 20.962, P = .001\)). Specifically, jitter values for the vowel /i/ were significantly higher than for the vowel /a/, while NHR values were significantly lower for the vowel /i/. These results are also in keeping with the literature [13], thus help to validate the current results. No vowel difference was found for the shimmer parameter (\(P > 0.05\)).

In order to approximate the follicular and secretory phases within menstrual cycle, data were rearranged, collapsing intervals 1 through 3, and 4 through 6. Statistical analyses of the modified set of data yielded identical results for all comparisons reported above, for group, interval and vowel differences.

IV. DISCUSSION

The results of the present study did not reveal an adverse effect of birth control pills on voice. Moreover, our results indicate that in all four acoustic parameters tested, women who use the pill performed better than the women in control group. Specifically, women in the pill group demonstrated reduced amplitude and
frequency perturbation (shimmer and jitter) and had lower NHR values which represent a clearer voice. Lower values of these three parameters are regarded as indication of a more healthy voice [13]. These results can be interpreted to show that the more stable voice quality presented by the women in the pill group could be attributed to a more stable hormonal balance which is maintained by the oral contraceptives they use. In contrast, women in the control group are affected by the natural changes in serum levels of estrogen and progesterone which occur during the menstrual cycle. The hormonal changes along the menstrual cycle induce histological changes in muscles, mucus and laryngeal glandular cells; hence these women’s voice quality is less stable [4].

Oral contraceptives are traditionally viewed by voice professionals as potentially hazardous for the female voice [10]. The main reason for this view is the concern from androgenic effect of progesterone derivatives on the female larynx. The most common effect caused by androgens to the female voice is virilization, which is primarily characterized by lowered pitch (F0). Our results indicate that women who use the pill did not exhibit any lowering in fundamental frequency. In fact, F0 values for the Pill group were generally higher than those observed in the control group, although these group differences did not reach statistical significance. The reason for the contradiction between the current results and the traditional view of oral contraceptives as a potential hazard, stem probably from the difference between the formulations used in pills in the past and the low-dose formulation which are commonly used presently. Based on these results, it is suggested that the traditional approach towards oral contraceptives as a potential risk factor for voice, should be reevaluated. It should be kept in mind, though, that our participants were not professional voice users or performers, hence it is possible that somewhat different results could be observed within that specific population.

The results presented here are in agreement with the Wendler et al study [8] who reported no adverse voice effect associated with low-dose pills. However, while their results were drawn from subjective evaluation made by listeners, the current results are based on acoustic measurements that are more reliable and are potentially sensitive to small physical differences. The current results are also in agreement with the two preliminary studies that were conducted using similar methodologies but utilizing a different voice analysis program [11,12]. The relation between the acoustic results presented here and subjective evaluation of voice quality should be also further explored.

V. CONCLUSION

The present study utilized acoustic tools to examine the effect of oral contraceptives on voice quality. Results challenge the traditional approach which views oral contraceptives as a potential risk-factor for voice. Based on the results presented here and in two recently published studies that used similar methodologies, it appears that low-dose monophasic oral contraceptives were not found to negatively affect voice quality. Instead, the four parameters that were included in the analysis improved among the women who used the pill. Obviously, further study is needed to better understand the interaction between female hormonal balance and voice quality, as well as the effect of different oral contraceptive formulations (for example, monophasic versus multiphasic) on voice production and quality.

REFERENCES