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## Health Outcomes Related to Early Adolescent Depression

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### Abstract

**PURPOSE**—The aim of the present study was to examine whether early adolescent major depressive disorder was associated with negative health outcomes in young adulthood after controlling for depression at the time of follow-up. In addition, indicators of medical and social costs associated with these health consequences were measured.

**METHODS**—705 adolescents participating in a longitudinal study of children varying in risk for depression due to maternal depression were assessed for a history of depression at age 15, depressive disorders at age 20, and a variety of health outcomes at age 20.

**RESULTS**—Results showed that even after controlling for the effects of concurrent depression at age 20, early adolescent depression continued to be associated with poorer interviewer-rated health, poorer self-perceived general health, higher health care utilization and increased work impairment due to physical health, although not with limitations to physical functioning or the presence of chronic medical conditions.

**CONCLUSIONS**—Depression during early adolescence has consequences for health and associated costs during young adulthood. The implications of these findings for screening and treatment of adolescent depression are discussed.

### Keywords

depression; adolescence; health outcomes; young adulthood; functional impairment; health care costs

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Owing to its high prevalence and chronic nature, depression has been ranked by the World Health Organization as the single most burdensome disease in the world [1]. Although part of the burden on society is attributable to direct treatment costs, a significant portion of the cost of depression is indirect, related to the increased costs of treatment and lost productivity resulting from comorbid health conditions associated with depression [2]. Recently, the association between depression and health outcomes has received significant empirical attention, with many studies suggesting that screening and treatment for depression is a cost-effective method of limiting expenses for comorbid health conditions [2,3]. Carefully designed studies have established the presence of a bidirectional relationship between depression and chronic illness across a variety of diseases, including cancer, heart disease, diabetes, arthritis, and asthma [4,5,6,7,8,9,10,11]. Several mechanisms that may account for this relationship have

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been proposed, including physiological mechanisms, shared etiological factors, and poor health behaviors.

However, most of the research on this topic has been limited to adult and aging populations, and the health implications of depression during adolescence have been largely ignored [12, 13]. This gap in the literature is noteworthy given that depression is as prevalent among adolescents as it is among adults [14]. Additionally, despite the widespread perception that adolescence is a period of good health [15], approximately one third of adolescents struggle with potentially debilitating medical conditions, including asthma, chronic headaches, and allergy-related respiratory distress [16,17].

Although research on adolescent health and depression has been scarce, there is preliminary evidence to suggest that depression during adolescence may be associated with poor health outcomes. Cross-sectional epidemiological surveys have suggested that a major depression over the past 12 months is associated with chronic illness and poor self-reported health among older adolescents [12], although not all studies examining chronically ill adolescents have supported that conclusion [18]. Given that the stress of coping with chronic illness may also contribute to the development of depression [15], cross-sectional evidence alone cannot clarify whether depression plays a causal role in the development of disease.

The few longitudinal studies that have examined the association between adolescent depression and health outcomes in early adulthood have reached somewhat different conclusions. Bardone and colleagues [19] followed a sample of women from ages 15 to 21 to examine the health consequences of several psychiatric disorders during the transition to adulthood. Although depression was associated with chronic illness in early adulthood, it was not associated with subjective health ratings or sexual health variables. However, the analyses did not control for mental health status at age 21, introducing the possibility that depression at the time of follow-up may have influenced the association with illness either through direct effects on health or by introducing a negative reporting bias. Consequently, it is unclear whether the observed associations with chronic illness were a function of current depression or a result of earlier depressive episodes.

In contrast to the relatively weak associations found by Bardone and colleagues, a longitudinal investigation conducted by Lewinsohn, et al. [15] found evidence for a robust bidirectional relationship between self-reported illness and depression over a one-year period. Depression at baseline was a strong predictor of functional impairment due to illness or injury at follow-up, and was marginally significant in predicting new disease onset. However, given that the follow-up period was relatively short, only limited change in health status was observed, and the prediction of illness onset did not reach significance. Longer follow-up periods are necessary to examine the full impact of depression on disease processes. Additionally, depression at the time of the follow-up was not controlled for, again introducing the possibility that the negative health outcomes reported resulted from concurrent depression.

The aim of the present study was to clarify the ambiguities in previous research examining the relationship between depression and health outcomes in young adulthood. Specifically, the analyses were designed to control for concurrent depressive diagnoses in order to clarify the effects of early adolescent depressive episodes. In addition, this study built upon previous research by measuring the impact of depression on indicators of healthcare utilization and work impairment, an important topic of research among adults that has not yet been explored in adolescent samples. Our primary hypothesis was that early experiences with depressive disorders (by age 15) would be associated with poorer health outcomes at age 20, even when depression at the time of follow-up was taken into account. Furthermore, we hypothesized that

these lasting effects on health would be associated with an increased utilization of medical services and greater work role impairment due to physical illness in young adulthood.

## Method

### Participants

The sample for the present analyses consisted of 705 adolescents (342 males and 363 females) involved in a study of maternal and offspring depression. The participants were selected from a study of children born between 1981 and 1984 at Mater Misericordiae Mothers Hospital in Brisbane, Queensland, the Mater-University Study of Pregnancy (MUSP) [20]. When the children were 15, the present investigators selected 900 families with diverse experiences in severity and chronicity of maternal depressive symptomatology (including no or minimal depression), oversampling for maternal depression. Selection was based on scores on a depression questionnaire given to mothers during pregnancy and three additional times over the following 5 years. The complete sampling procedures and details of the sample have been previously published [21]. From a sample of 816 families who participated at age 15, 705 (86%) participated in the age 20 follow-up (2 were deceased, 52 refused, 58 could not be contacted or scheduled).

The youths who participated at age 20 did not differ from those in the age 15 study who did not in terms of maternal age at child's birth ( $t(814)=-1.68, p=.09$ ), or youth depression history by age 15 ( $\chi^2(1)=1.32, p=.25$ ). The youths who did not participate at age 20 had less maternal education at the time of the pregnancy ( $t(809)=-2.23, p=.03$ ), lower family income at age 15 ( $t(783)=-2.11, p=.04$ ), and were more likely to be male ( $\chi^2(1)=8.63, p=.003$ ). Families with a history of maternal depression were somewhat more likely to participate at age 20 ( $\chi^2(1)=3.56, p=.06$ ).

### Procedures

Women who agreed to participate in the MUSP birth cohort study upon their initial prenatal clinic visit were asked to complete questionnaires assessing a series of health and psychosocial variables for themselves and their child when the child reached the age of 5. Further details about the MUSP procedures have been reported elsewhere [20].

In both the age 15 and age 20 waves of data collection, families included in the current study participated in interviews and completed questionnaires. Teams of two trained interviewers, blind to the mother's psychiatric history, conducted parent and child interviews separately, in private locations. All interviewers were advanced graduate students studying clinical psychology and had prior experience administering research and clinical interviews. At both age 15 and age 20, all participants gave their written informed consent (assent) and were compensated for their time. All procedures were approved by the UCLA Institutional Review Board, Emory University Investigations Committee, and University of Queensland Ethics Review Committee.

### Measures

**Illness at age 5**—During the age 5 wave of MUSP data collection, mothers completed questionnaires related to the health of their child. Mothers were asked if their child had any diagnoses of chronic health conditions or any symptoms lasting at least three months, responding yes/no for several medical conditions (including asthma, bronchitis, seizures, anemia, heart defects, overweight, cancer). Responses to these items were converted into a binary variable representing the presence or absence of any chronic health conditions.

**Youth depression**—History of depressive disorders at age 15 was assessed using the Schedule for Affective Disorders and Schizophrenia for School-Age Children-Revised (Epidemiologic Version) for the DSM-IV (K-SADS-E) [22]. As is customary when diagnosing children and adolescents, this semi-structured interview was administered separately to the mother and the child, and final diagnostic decisions were made by the clinical rating team based on all available sources of information. A sample of 75 interviews was randomly selected for reliability analyses, with a Kappa of .82 for current major depression, dysthymia or subclinical depression, and .73 for past major or subclinical depression. Of the youths retained in the present sample, 99 (14%) met criteria for a lifetime history of major depression or dysthymia by age 15.

At age 20, the Structured Clinical Interview for DSM-IV [20] was used to assess for diagnostic status between ages 15 and 20. Independent judges' ratings of taped interviews yielded significant Kappas for current (.83) and past (.89) depression. Sixty-seven youths met criteria for current MDE or dysthymia at age 20.

**Health at age 20**—Health outcomes at age 20 were assessed by both interview and self-report measures. Using a semi-structured interview measuring ongoing chronic stress across multiple domains of functioning (UCLA Chronic Stress Interview) [24], interviewers assessed participants' general health over the previous six months. The interview consists of both general questions (e.g. "How has your health been in the past six months?") and specific probes (e.g. treatment required for any reported medical conditions). Detailed, behaviorally-specific anchoring points were used to rate the quality of each participant's health on a 5-point scale, where 1 signified exceptionally good health, 3 signified chronic difficulties that were not life-threatening, and 5 indicated a severe, life-threatening problem. Inter-rater reliability yielded an intraclass correlation of .77. Validity for this health measure is supported by comparing interviewer ratings with information obtained from other sources. For instance, interviewer and self-rated health were moderately correlated ( $r=.41, p<.001$ ). Similar patterns of convergent validity have been obtained across the other interview domains. In addition to assessing overall health, the interviewers assessed chronic disease status, represented as a binary variable in the current analyses, by coding for the reported presence or absence of several medical conditions, including asthma, diabetes, and epilepsy.

Participants also completed the SF-36 Health Survey [22], a well-validated [26] measure of health-related quality of life. Three health subscales were used in the present study: Physical Functioning, which measures difficulties completing 10 daily activities (including climbing stairs, carrying groceries, and walking) due to health problems; General Health Perceptions, which measures one's overall perception of health; and Role Limitations-Physical, which assesses impairment in work and household responsibilities due to physical health problems. Participants also reported the number of consultations they had with various health professionals over the past year. Contact with mental health professionals was not included. Items were coded so that high scores represented worse health outcomes.

## Results

### Data Analytic Procedures

Hierarchical ordinary least-squares and logistic regression analyses were used to investigate hypotheses regarding continuously distributed and dichotomous outcomes, respectively. Given that childhood health problems have been shown to predict the development of depression during late adolescence and early adulthood [27], all analyses controlled for chronic illness at age 5, as reported contemporaneously by the mother. The effects of socioeconomic status were controlled by including maternal education and family income in the first block of each analysis, as social class gradients in health status have been observed as early as age 23 [28].

The second block of each analysis controlled for current diagnoses of depression or dysthymia at the time of follow-up.<sup>1</sup> The third block tested the effects of youth depression history by age 15. Descriptive statistics and correlations between all variables are listed Table 1. Given that our sample was selected to oversample children of depressed mothers, we tested the effects of maternal depression for each outcome. Of the youths in the current analyses, 318 (45%) had a mother with a history of depression by youth age 15. However, neither the main effect of maternal depression nor interaction effects with youth depression were significant, so for the purpose of simplicity, maternal depression status is excluded from the presentation of results.<sup>2</sup> The results of all regression analyses are presented in Table 2.

**UCLA Chronic Stress Interviewer-rated health**—Chronic illness by age 5 ( $\beta=.21$ , 95% CI=.07,.34) and age 20 depression ( $\beta=.28$ , 95% CI=.13,.43) were significant predictors of interviewer-rated health. After controlling for the covariates, depressive diagnoses by age 15 continued to significantly predict health status at age 20 ( $\beta=.16$ , 95% CI=.04,.29).

**SF-36 General Health Perceptions**—Chronic illness by age 5 ( $\beta=1.72$ , 95% CI=.71,2.74) and age 20 depression ( $\beta=3.08$ , 95% CI=1.90,4.26) were significant predictors of self-perceived health. Depression by age 15 also significantly predicted general health perceptions ( $\beta=1.10$ , 95% CI=.17,2.02).

**SF-36 Physical Functioning**—The variables did not make a significant contribution to the prediction of limitations in physical functioning.

**Chronic disease at age 20**—None of the predictor variables were significant predictors of chronic disease status at age 20, although depressive history by age 15 approached significance ( $\beta=.48$ , 95% CI=.98,2.67,  $p=.06$ ).

**Medical care utilization**—Current depression ( $\beta=1.77$ , 95% CI=.96,2.58) significantly predicted health care utilization. After controlling for concurrent depression, prior depression remained a significant predictor ( $\beta=1.26$ , 95% CI=.62,1.90).

**SF-36 Work Role Limitations-Physical**—Current depression at age 20 was associated with greater work impairment ( $\beta=.86$ , 95% CI=.57,1.14). After controlling for age 20 depression, a history of depression by age 15 continued to be a significant predictor of health-related work impairment ( $\beta=.38$ , 95% CI=.15,.60).

## Discussion

Building on prior research, this paper addressed the question of whether adolescents with a history of depressive disorders remain at risk for negative health outcomes in young adulthood even when current depression is taken into account. The analyses suggested that both

<sup>1</sup>The analyses were repeated using youth BDI scores at the time of follow-up rather than depressive diagnoses. As would be expected, the associations with BDI scores were somewhat stronger than those with diagnostic status, as many youths report some level of symptomatology but do not meet criteria for diagnosis. In addition, BDI scores may be more strongly associated with questionnaire measures of health due to shared method variance. Overall, the same general patterns of results were obtained, although the association between depression at age 15 and self-reported health no longer reached significance when controlling for BDI at age 20.

<sup>2</sup>Previous research [36] has suggested that offspring of depressed parents have a higher risk for medical problems and mortality. The discrepancy between these findings and our present results may be attributable to the fact that the previous research used an older sample (mean age of 35 years). The medical problems found to have an elevated rate among offspring of depressed parents in their sample (i.e. cardiovascular and neuromuscular disease) are unlikely to be fully developed by age 20, when the health outcomes of our sample were measured. Also, their study did not separately examine the effects of maternal versus youth depression histories, and it is possible that effects attributed to being a child of a depressed parent were mediated by the offspring's own depressive history. Future research using this sample will address whether there is a relationship between the severity or chronicity of maternal depression and youth outcomes, including health status.

objectively- and self-rated general health during the transition to adulthood may be compromised among individuals who have experienced depressive disorders, and that these detriments to health are associated with higher medical costs and work impairment. However, depression by age 15 did not predict physical functioning or reported chronic disease status.

Early depressive diagnosis was associated with lower ratings of health by objective interviewers, as well as the youths themselves, even after the effects of current depressive diagnoses were controlled. These results suggest that the health consequences associated with a history of early-onset depression are not simply the result of concurrent depression or negative reporting biases in individuals inclined towards depression. Were age 20 depression not controlled, the effects of early depression would have been stronger across all measured variables, and associations with chronic disease status would have been significant. Given the bidirectionality of the relationship between depression and health, it is likely that these analyses represent a conservative test of the effects of early depression. The fact that current depression was a strong contributor to most of the measured health outcomes highlights the importance of controlling for concurrent diagnoses when testing the long-term health outcomes of adolescents with psychiatric morbidity.

In contrast, our findings did not support an association between adolescent depression and self-reported limitations to physical functioning or chronic illness. Although these findings may initially seem inconsistent with the conclusions on general health, they are not entirely at odds with the idea that depression has negative health consequences. While adolescents with a history of depression have poorer overall health, possibly reflecting higher rates of short-lived illnesses, they did not report higher rates of chronic illnesses that would likely impede their daily physical functioning. The lack of association with chronic disease at age 20 may be accounted for by the relatively early age at which these outcomes were measured. Many of the chronic illnesses on which depression has been shown to have the greatest impact, such as heart disease, are unlikely to be fully developed by early adulthood. However, the precursor conditions to some of these diseases, such as atherosclerosis, are believed to begin during adolescence [29], and it is possible that early depression has an effect on chronic illness and associated impairment in physical functioning that will be apparent when later adulthood health is measured. Longitudinal studies following adolescents into later adulthood are needed to fully address these issues.

Perhaps most importantly, the data provided support for the hypothesis that adolescent depression is associated with medical and social costs in young adulthood. Even after the effects of concurrent depressive diagnoses were considered, young adults who had experienced depression in early adolescence reported more visits to medical professionals and greater impairment in work functioning due to their physical health. These results are similar to those obtained among adult populations [2,8] and suggest that screening and treatment for depression may be a cost-effective method of limiting medical expenses [2,30]. However, more explicit tests of this hypothesis are needed.

These findings echo those established among adult populations, which have shown that depression is a risk factor for onset and recurrence of a variety of health problems [4,5,31, 32], as well as for mortality and impairment among ill populations [31,33,34]. Katon [7] proposed a theoretical model for the association between depression and health, suggesting that early adversity, biobehavioral factors, genetics, life stress, poor self-care, and the burden of chronic illness all contribute to a bidirectional loop between depression and disease. This model recognizes that factors predisposing individuals towards depression, such as genetics, childhood adversity, and life stress, may also predispose individuals towards other pathways to poor health outcomes, including negative health behaviors, difficulty collaborating with physicians, and maladaptive physical environments. In addition, medical illness may contribute

to the onset or maintenance of depression through direct physiological mechanisms or illness-related decreases in quality of life. Similarly, depression may lead to the onset or maintenance of physical illness through pathophysiological or biobehavioral pathways. Although a full test of this model has not yet been completed, each component has received some empirical support among adults. It is critical that future research tests the applicability of this model to adolescents so that appropriate interventions can be developed.

Research examining potential mechanisms of the association between depression and health among younger populations has been more limited. There is evidence to suggest that adverse health behaviors could be one mechanism through which adolescent depression influences adulthood health. Correlational and longitudinal studies have shown that depression is associated with higher rates of smoking, alcohol abuse, unhealthy eating, and infrequent exercise [12,35]. Some research has also suggested that direct physiological mechanisms may be involved. A 6-year longitudinal study of younger adolescents found that depressed mood during middle school predicted obesity in high school, even after controlling for behavioral and environmental mechanisms (i.e. obesity at baseline, parental obesity, socioeconomic status, and reported physical activity). Further research is needed to examine the relative contributions of environmental, behavioral, and physiological mechanisms that may explain the connection between depression in early adolescence and negative health consequences in adulthood.

Although the present study indicated a prospective relationship between prior depressive disorders and later health status, the direction of causality is doubtless bidirectional. Just as there is evidence that depression leads to adverse health outcomes, there is also evidence that adolescents with medical problems are at an increased risk of developing depression [15]. Unfortunately, the nature of this dataset did not allow for a full test of the effects of health problems on the development of future depressive episodes. This reverse direction of association is important to consider, particularly given the limitations to our measure of health conditions prior to our measurement of depression. The current findings should be interpreted with caution until replicated by studies using more stringent controls of pre-existing health conditions. It should also be noted that causality in either direction cannot be definitively established, given that this area of research does not lend itself to randomized trials.

Several limitations to the present analyses are noted. First, the majority of the data was obtained through self-report. Although efforts were made to include observer-rated data, it was not possible to corroborate health status through examination of medical records. However, the inclusion of a control for depression at the time of follow-up limits the concern that our results were influenced by systematic depressive biases in self-reporting. Given the strong association between age 20 depression and several of the health outcomes of interest, it is likely that inclusion of a statistical control for depression at age 20 has yielded conservative estimates of the effects of early depression. In addition, measurements of youth health status at age 15 were not available, and the control measure of prior health was taken from childhood. It is possible that this early childhood measurement did not adequately capture the illness status of the youths prior to the initial depressive episode. Furthermore, it was not possible to verify the reported childhood illnesses by examining medical records. Additionally, the amount of variance accounted for in some of the models was small, highlighting the fact that depression is only one of many important risk factors for negative health outcomes. Finally, the sample was oversampled for maternal depression, so estimates of depression and health problems in our sample should not be taken as general population estimates.

The present study makes a contribution to the study of health and depression by using a prospective, longitudinal design to test the consequences that clinically significant depression in early adolescence has for health in young adulthood. The inclusion of a control for concurrent

depression, as well as multiple measurements of health outcomes, are additional strengths of the present study. Overall, our findings suggest that early adolescent depression may be related to poorer health, although the exact mechanism remains to be clarified. These results highlight the importance of building more complex pathophysiological models of depression and illness among adolescent populations. The finding that adolescent depression is associated with higher medical costs and work impairment in young adulthood also suggests that screening and treatment for depression during adolescence may be a cost-effective method of preventing poor health outcomes and limiting the costs associated with depression.

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**Table 1**  
Descriptive Statistics and Correlations Between Predictor and Outcome Measures

Variable (Mean, SD or %)	1	2	3	4	5	6	7	8	9	10	11	
1. Mother education (completed grade 10)	—											
2. Family Income (35,000-45,000)	.14**											
3. Child Illness at age 5 (12%)	-.07	-.08*	—									
4. Current depression at age 20 (9.5%)	-.03	-.03	.14**	—								
5. Age 15 depression (14%)	-.05	-.08*	.07	.18**	—							
6. CSI Interviewer-rated health (2.3, .57)	-.04	-.03	.15**	.19**	.11**	—						
7. SF-36 General Health (13.8, 4.1)	-.01	-.08	.17**	.28**	.13**	.41*	—					
8. SF-36 Physical Limitations (2.0, 3.6)	-.04	-.04	.03	.07	.07	.17**	.24**	—				
9. Age 20 Chronic Disease (22.5%)	.03	-.04	.01	.06	.08*	.33**	.19**	.09*	—			
10. Visits to health professional (3.1, 2.8)	.01	-.01	.09*	.23**	.18**	.35**	.33**	.18**	.26**	—		
11. SF-36 Work impairment (.42, .99)	-.04	-.01	.08	.26**	.18**	.22**	.30**	.31**	.07	.31**	—	

Note:

\* Correlation is significant at the 0.05 level (2-tailed).

\*\* Correlation is significant at the .01 level (2-tailed).

**Table 2**  
Results of Regression Analyses Predicting Health Outcomes

Predictor	$\beta$ (95% CI)	SE	<i>p</i>
<b>Interviewer-Rated Health</b>			
Mother Education	-0.01 (-0.04, 0.03)	.02	.75
Family Income	0.00 (-0.02, 0.02)	.01	.96
Age 5 Chronic Illness	0.21 (0.07, 0.34)	.07	.002
Age 20 Depression	0.28 (0.13, 0.43)	.08	>.001
Age 15 Depression	0.16 (0.04, 0.29)	.06	.01
<b>SF-36 Self-Rated Health</b>			
Mother Education	-0.07 (-0.22, 0.36)	.15	.61
Family Income	-0.11 (-0.26, 0.04)	.08	.16
Age 5 Chronic Illness	1.72 (0.71, 2.74)	.51	.001
Age 20 Depression	3.08 (1.90, 4.26)	.60	>.001
Age 15 Depression	1.10 (0.17, 2.02)	.47	.02
<b>SF-36 Physical Limitations</b>			
Mother Education	-0.09 (-0.36, 0.17)	.13	.49
Family Income	-0.05 (-0.19, 0.09)	.07	.50
Age 5 Chronic Illness	0.20 (-1.13, 0.72)	.47	.67
Age 20 Depression	0.60 (-0.48, 1.68)	.05	.28
Age 15 Depression	0.62 (-0.22, 1.45)	.06	.15
<b>Visits to Medical Professional</b>			
Mother Education	-0.09 (-0.11, 0.29)	.10	.40
Family Income	0.01 (-0.10, 0.11)	.05	.93
Age 5 Chronic Illness	0.46 (-0.24, 1.15)	.35	.20
Age 20 Depression	1.77 (0.96, 2.58)	.41	>.001
Age 15 Depression	1.26 (0.61, 1.90)	.33	>.001
<b>SF-36 Work Role Impairment</b>			
Mother Education	-0.31 (-0.10, 0.03)	.04	.38
Family Income	0.01 (-0.03, 0.04)	.20	.73
Age 5 Chronic Illness	0.12 (-0.13, 0.36)	.12	.34
Age 20 Depression	0.86 (0.57, 1.14)	.14	>.001
Age 15 Depression	0.38 (0.15, 0.60)	.11	.001
<b>Age 20 Chronic Illness</b>			
	$\beta$	OR (95% CI)	<i>p</i>
Mother Education	0.12	1.13 (0.96, 1.34)	.14
Family Income	-0.04	0.96 (0.87, 1.05)	.35
Age 5 Chronic Illness	-0.11	0.89 (0.49, 1.63)	.71
Age 20 Depression	0.31	1.36 (0.73, 2.54)	.33
Age 15 Depression	0.48	1.62 (0.98, 2.67)	.06