

RESEARCH PAPER

Tobacco use in popular movies during the past decade

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Objective: The top 50 commercially successful films released per year from 1991 to 2000 were content coded to assess trends in tobacco use over time and attributes of films predictive of higher smoking rates. **Design:** This observational study used media content analysis methods to generate data about tobacco use depictions in films studied ($n = 497$). Films are the basic unit of analysis. Once films were coded and preliminary analysis completed, outcome data were transformed to approximate multivariate normality before being analysed with general linear models and longitudinal mixed method regression methods.

Main outcome measures: Tobacco use per minute of film was the main outcome measure used. Predictor variables include attributes of films and actors. Tobacco use was defined as any cigarette, cigar, and chewing tobacco use as well as the display of smoke and cigarette paraphernalia such as ashtrays, brand names, or logos within frames of films reviewed.

Results: Smoking rates in the top films fluctuated yearly over the decade with an overall modest downward trend ($p < 0.005$), with the exception of R rated films where rates went up.

Conclusions: The decrease in smoking rates found in films in the past decade is modest given extensive efforts to educate the entertainment industry on this issue over the past decade. Monitoring, education, advocacy, and policy change to bring tobacco depiction rates down further should continue.

The prevalence of tobacco use in popular media and its impact on youth has generated both research and advocacy over the past decade.^{1–10} Smoking in films is a public health concern as recent studies suggest that tobacco use in popular media influences initiation of smoking among youth.^{11–16} However whether tobacco use in popular films has increased, decreased, or stayed the same over the past decade is debated. Inconsistencies in the published literature on this topic are linked to methods used and movie content analysed.^{1–10} Findings reported depend on sample size, study time frame, data collection, coding, and data analysis, with most studies deficient on one or more of these attributes.

The Thumbs Up! Thumbs Down! (TUTD) data set is the most comprehensive data set collected on this topic, with ample sample size, adequate time frame, and reliable measurement methods.¹⁰ For this study, data from the first 10 years of the project (1991 to 2001) have been transformed and re-analysed using multivariate statistical techniques to examine (1) trends over time, (2) predictors of smoking in films, and (3) main and interaction effects among predictors. Use of an adequate sample, robust measures, and appropriate analytic models represent more valid methodological approaches than have been reported in comparable studies.

METHODS

The sample consists of 497 movies released between 1991 and 2001, representing the top 50 movies per year for 10 years released based on domestic box office (DBO) gross, the amount of money made by the film in the first year of release. Ratings are based on data from World Wide Box Office¹⁷ and Movies.com Box Office Report.¹⁸ Other data on movie ratings, genre, film length, leading actors, and production facts are gathered from the Internet Movie database.¹⁹ Slightly fewer than 500 films are in the final sample because of missing data.

All movies were reviewed in video format for accuracy and ease of confirmation of coded content. To assure accuracy, each movie was viewed in its entirety and coded by three reviewers. Kappa reliability scores were over 0.85. Concordance coding, where there is agreement between

coders, was used to determine final scores entered. For this media content analysis, films are the basic unit of analysis and tobacco use incidents and attributes of films the main variables coded.^{20 21}

Dependent variables

Tobacco incidents per minute are defined as total incidents of tobacco use divided by length of film in minutes. Thus 0.17 would mean that for a 120 minute film there would be approximately 21 smoking incidents or one incident for every 5–6 minutes of film.

Independent variables

Attributes of films include the year the film was released. Film ratings follow MPAA guidelines where "1" is G (no restrictions), "2" is PG (parental guidance), "3" is PG-13 (parental guidance and children under 13 not admitted without adult companion) and "4" is R (under 17 not admitted without adult companion). For mixed model regression analyses these film ratings each were recoded to "1" if true or "0" if not true for the specific film. Genre of film is also coded in two ways. First the primary genre of film is coded in six categories where "1" is action/adventure, "2" is horror/thriller, "3" is drama, "4" is family, "5" is comedy, and "6" is fantasy/sci-fi. For mixed model regression analyses these film genres were each re-coded to "1" if true or "0" if not true for the specific film. Finally number of lead actors who smoke within each film was coded.

Power transformations of dependent variable of tobacco use incidents per minute were carried out using square root transformations, as distributions are positively skewed with most films having low or no smoking while a few films may have much higher rates than average.²² The general linear model technique was used to assess the relative contribution of film attributes such as year of release, rating, and genre, as predictive of the amount of smoking in the films. Then a mixed models regression analysis used a random effects

Abbreviations: DBO, domestic box office; MPAA, Motion Picture Association of America; TUTD, Thumbs Up! Thumbs Down!

Table 1 Tobacco incidents in films by year released

Year of release: May–April (no. of films)	Total tobacco incidents		Tobacco incidents/min		Square root tobacco incidents/min	
	Mean	SD	Mean	SD	Mean	SD
1991–92 (50)	34.58	55.396	0.236	0.253	0.406	0.269
1992–93 (50)	15.64	20.880	0.131	0.155	0.286	0.225
1993–94 (50)	25.24	33.323	0.196	0.206	0.364	0.256
1994–95 (50)	23.72	31.470	0.183	0.228	0.332	0.272
1995–96 (50)	26.14	61.124	0.150	0.209	0.286	0.264
1996–97 (50)	21.28	24.893	0.182	0.206	0.342	0.257
1997–98 (50)	22.46	22.939	0.193	0.197	0.370	0.239
1998–99 (52)	15.346	23.599	0.132	0.198	0.255	0.262
1999–00 (50)	15.52	22.964	0.143	0.233	0.263	0.275
2000–01 (45)	15.318	18.853	0.129	0.155	0.274	0.240
Average	21.539	34.824	0.168	0.207	0.318	0.259

model to account for the random fluctuations around the mean of the outcome variable (tobacco use incidents per minute of films) across years of the film sample.^{23–24} Fixed effects represent predictors of tobacco use rates and were included in mixed models regression analyses.

RESULTS

In the TUTD data set used in this analysis, approximately 75% of films have some tobacco use. Of films with tobacco use, one third of the films had very low use (1–9 incidents), one third had moderate tobacco use (10–29 incidents), and one third (or 25% overall) had high or “problematic” rates of tobacco use (more than 30 instances). These findings are consistent with other studies.

In table 1 means and standard deviations (SD) of both transformed and untransformed variables representing average number of smoking incidents per film per year and then smoking incidents per minute of film per year are presented. In the left and middle columns of table 1 average rates of smoking per minute of film range from 0.129 in 2000–01 (mean = 15.34 incidents per film or one incident every 7–8 minutes) to 0.235 in 1991–92 (mean = 34.58 incidents per film or one incident every 3–4 minutes). Total incidents of smoking are included here as this measure is intrinsically meaningful but further analyses are carried out on the

standardised measure of smoking incidents per minute of film. Large fluctuations between years as well as high variance around the means are seen in untransformed variables.

For the general linear models analysis with smoking incidents per minute of film as the dependent variable, there are significant effects for MPAA rating ($F = 3.85$, $p < 0.01$), indicating more smoking for R rated films, and for year of release ($F = 2.68$, $p < 0.01$) indicating overall smoking decreased slightly over time. One interaction effect, genre X year of release ($F = 1.44$, $p < .05$) was significant, as action/adventure and drama in particular show increases in smoking over time. Based on an adjusted r-square, the overall model explains 21% of the variance in tobacco use rates, a moderate effect.

In table 2 results from analyses using longitudinal linear mixed models are presented. Model 1 uses the total sample of films from all MPAA rating categories ($n = 497$). Model 2 includes only films from G, PG and PG-13 categories ($n = 289$), to test whether trends in youth oriented films mirror more general findings. Both models reveal a negative coefficient for rate of change indicating that over the 10 years data were collected, tobacco use in films sampled decreased, although the actual rate of decrease is modest. At the same time, positive coefficients for drama and R rated films for the total sample indicate that even as tobacco use in films was

Table 2 Generalised effects mixed model regression for incidents of tobacco use per minute of film (square root transformation)

Fixed effects	Model 1 (total sample)			Model 2 (G, PG, PG-13 films)		
	Estimate	t Value	Sig	Estimate	t Value	Sig
Rate of change	-0.011	-2.863	0.004*	-0.014	-3.104	0.002*
Action	0.103	1.486	0.138	0.102	1.605	0.11
Comedy	0.048	0.887	0.376	0.045	0.937	0.349
Drama	0.156	2.054	0.041*	0.154	2.218	0.027*
Horror	-0.149	-0.619	0.536	-0.157	-0.714	0.476
Sci-fi	0.139	1.251	0.212	0.144	1.415	0.158
PG-13	-0.006	-0.036	0.971	-0.007	-0.048	0.962
R rated	0.511	2.122	0.034*	-	-	-
Action X PG-13	0.129	0.699	0.485	0.135	0.8	0.424
Action X R	-0.323	-1.293	0.197	-	-	-
Comedy X PG-13	0.115	0.643	0.521	0.118	0.724	0.47
Comedy X R	-0.29	-1.17	0.242	-	-	-
Drama X PG-13	0.106	0.556	0.578	0.112	0.641	0.522
Drama X R	-0.323	-1.278	0.202	-	-	-
Horror X PG-13	0.29	0.96	0.337	0.303	1.101	0.272
Horror X R	-0.112	-0.328	0.743	-	-	-
Sci-fi X PG-13	-0.049	-0.222	0.824	-0.052	-0.262	0.793
Sci-fi X R	-0.507	-1.783	0.075	-	-	-

Model 1 ($n = 497$): $R^2 = 0.431$ (adjusted = 0.155).

Model 2 ($n = 289$): $R^2 = 0.40$ (adjusted = 0.12).

* $p < 0.05$.

What this paper adds

To assess the issue of smoking rates in films, this paper takes a larger sample of commercially successful films and a more analytically sophisticated approach than previous papers on the subject. Both analysis of trends over time and modelling of predictive factors of smoking rates in popular movies over the past decade are reported. It is shown that smoking rates edged slightly downwards at the end of the last decade rather than increasing, the latter a common perception among anti-smoking advocates. Objective analysis of a valid data set is an important facet of advocacy work with the entertainment media to try to bring rates of tobacco use in movies down.

decreasing overall, films with these attributes had an increase in tobacco use. Translated into real rates this means that over a 10 year period, for all films considered, there was an average annual decline of 0.99 incidents of smoking per film, while for youth oriented movies there was an average annual decline of 1.26 incidents of smoking per film. The first model explains 15% of the variance in tobacco use rates. In the second model the rate of decrease is slightly higher and only the attribute of being a drama counters the overall downward trend. This model explains 12% of the variance.

Rates of tobacco use per minute of film was highly positively correlated with the number of lead actors who smoked, both for the total sample ($r = 0.083$, $p < 0.01$, two tailed) and for youth oriented films ($r = 0.81$, $p < 0.01$, two tailed). Because of the high intercorrelation between these two variables, number of lead actors was not used as an independent variable in multivariate models, in order to better understand the effects of other independent variables. Rates of smoking in films sampled were not correlated with box office gross ($r = -0.089$, NS)

DISCUSSION

Results suggest that although the rates of tobacco use in films over the past decade have declined overall, this trend is not strong. More interesting is that despite yearly fluctuations and a slight significant downward drift, rates of smoking in films have been relatively stable over the past decade. Smoking rates in R rated films and dramas went up over the decade. An important factor explaining why some movies have more tobacco use is the number of celebrity actors who smoke.²⁵

These downward trends, particularly in youth oriented films, may be linked to changing norms about tobacco use, changes in policies within entertainment production companies, and possibly entertainment industry responses to anti-tobacco consumer demands and consumer advocacy groups. There is some evidence moreover that rates have gone back up in films released between 2001 and 2003, but whether this is a short term fluctuation or long term trend cannot be determined at this time.¹⁰

For rates to continue to decline it is important that efforts continue to be made to induce celebrities, entertainment industry professionals, and executives to work to reduce tobacco depictions on screen. Rigorous media monitoring to account for these trends also needs to continue to be supported.

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APPENDIX

More detailed explanations of methods and analysis can be found in the Appendix. To view the Appendix please visit the Tobacco Control website—<http://www.tobaccocontrol.com/> supplemental

REFERENCES

- 1 **Terre L**, Drabman RS, Speer P. Health-relevant behaviors in the media. *J Appl Soc Psychol* 1991;**21**:1303–1319.
- 2 **Russo-Hazan A**, Liptons HL, Glantz SA. Popular films do not reflect current tobacco use. *Am J Public Health* 1994;**84**:98–1000.
- 3 **Stockwell TF**, Glantz SA. Tobacco use is increasing in popular films. *Tobacco Control* 1997;**6**:282–4.
- 4 **McIntosh WD**, Bazzini DG, Smith SS, et al. Who smokes in Hollywood? Characteristics of smokers in popular films from 1940 to 1989. *Addict Behav* 1998;**23**:395–98.
- 5 **Everett SA**, Schnuth RL, Tribble JL. Tobacco and alcohol use in top grossing American films. *J Community Health Sci* 1998;**23**:317–24.
- 6 **Dalton MA**, Tickle JJ, Sargent JD, et al. The incidence and context of tobacco use in popular movies from 1988 to 1997. *Prev Med* 2002;**34**:516–23.
- 7 **Kacirk K**, Glantz S. Tobacco use in movies in 2000, exceeded rates in the 1960's. *Tobacco Control* 2001;**10**:397–8.
- 8 **Ng C**, Drakake B. Tobacco at the movies: tobacco use in PG–13 films. Report by the Massachusetts Public Interest Research Group (MassPIRG); 2002. <http://www.pirg.org/tobacco> [Accessed 10 Dec 2003].
- 9 **Glantz SA**, Kacirk KW, McCulloch C. Back to the future: smoking in movies in 2002 compared with 1950 levels. *Am J Public Health* 2004;**94**:261–3.
- 10 **American Lung Association of Sacramento**. Emigrant trails – California. Tobacco use in the movies annual report card. *Thumbs Up! Thumbs Down!* Annual reports 1991–2003. <http://www.saclung.org/thumbs/htm> [Accessed 10 Dec 2003].
- 11 **Di Stefan JM**, Gilpin EA, Sargent JD, et al. Do movie stars encourage adolescents to start smoking? Evidence from California. *Prev Med* 1998;**28**:1–11.
- 12 **Pucci LG**, Siegel M. Exposure to brand-specific cigarette advertising in magazines and its impact on youth smoking. *Prev Med* 1999;**29**:313–20.
- 13 **Sargent JD**, Dalton MA, Beach ML, et al. Effect of cigarette promotions on smoking uptake in adolescents. *Prev Med* 2000;**30**:320–7.
- 14 **Sargent JD**, Beach ML, Dalton MA, et al. Effect of seeing tobacco use in films on trying smoking among adolescents: cross sectional study. *BMJ* 2001;**323**:1–6.
- 15 **Sargent JD**, Tickle JJ, Beach ML, et al. Brand appearances in contemporary cinema films and contribution to global marketing of cigarettes. *Lancet* 2001;**357**:29–32.
- 16 **Dalton MA**, Sargent JD, Beach ML, et al. Effect of viewing smoking in movies on adolescent smoking initiation: a cohort study. *Lancet*, 2003. <http://image.thelancet.com/extras/03art1353web.pdf>.
- 17 **Worldwide Box Office, Domestic Box Office Summaries**. <http://worldwideboxoffice.com>, [Accessed 10 Dec 2003].
- 18 **Movies.com** Box Office Report. <http://movies.go.com/boxoffice/iindex.html> [Accessed 12 Feb 2004].
- 19 **Internet Movie Data Base (IMDB)**. Comprehensive data on popular movies, actors, and directors. <http://www.imdb.com> [Accessed 10 Dec 2003].
- 20 **Berelson B**. *Content analysis in communications research*. New York: Free Press, 1952.
- 21 **Krippendorff K**. *Content analysis: an introduction to its methodology*. Beverly Hills, California: Sage Publications, 1980.
- 22 **Fox J**. *Applied regression analysis, linear models, and related methods*. Thousand Oaks, California: Sage Publications, 1997:60–7.
- 23 **Neter J**, Kutner MH, Wasserman W, et al. *Applied linear statistical models*. New York: McGraw-Hill Higher Education, 1996.
- 24 **Verbeke G**, Molenberghs G. *Linear mixed models for longitudinal data*. New York: Springer Verlag, 2000.
- 25 **Mekemson C**, Glantz SA. How the tobacco industry built its relationship with Hollywood. *Tobacco Control* 2002;**11**(suppl 1):81–91.

Web-only Appendix

Tobacco use in popular movies during the past decade

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This appendix is in depth review of the literature on trends in tobacco depictions in films, an explanation of research methods used, and research findings not reported in the published article.

Literature on smoking prevalence in films

Despite many studies on this topic, whether tobacco use in popular films has increased, decreased or stayed the same over this and past decades is debated. Studies using data from films released before the 1990's show weak or indiscernible trends.^{1,2,4} Specifically while one study found that rates were increasing at the end of the 1990's¹ two studies found neither an increase or decrease in smoking in the decades preceding the 1990's.^{2,4} Studies that assess trends in the 1990's are even more inconsistent.^{3,5,6,7,8,9,10}

Inconsistent findings for trends of tobacco depictions in films are linked with methodologies used as well as with actual movie content analyzed. Sample size, the study time frame, how data were collected and coded, and how data were analyzed influence findings reported. The following chart shows 9 published studies that report trends in rates of smoking in movies over time. Sample, timeframe, measures, coding, analysis and findings are briefly described. Additionally the methodological rigor of each of these study components is ranked positively (+) or negatively (-).

Table 1 : Summary of studies on trends of smoking in popular films

Study	Sample	Time	Measure	Coding	Analysis	Findings
1. Terre,	20 top	1977-	5 minute	Two	ANOVA/ F	High late

Drabman Speer, 1991	DBO* per year	1988	intervals of smoking events	coders per film/ inter-rater reliability	values but data analysis poorly described	70's /Dipped mid 80's/ increase late 80's
	+	+	+	+	+ -	
2. Russo-Hazan, Liptons, Glantz, 1994	2 films per year randomly selected from top DBO	1960-1990	5 minute intervals of smoking events	Not described	Chi squares / data not analyzed according to level of measurement used	No change in rate of smoking in films
	-	+	+	-	-	
3. Stockwell, Glantz, 1997	5 films per year randomly selected from top DBO	1990-1996	5 minute intervals of smoking events	One coder per film	Chi squares/data not analyzed according to level of measurement used	Smoking in films is increasing
	-	-	+	-	-	
4. McIntosh Bazzini, Smith Wayne, 1998	20 films per decade randomly selected from 20 top DBO per year = 10% sample(n = 100 films) Per decade sample size too small (n= 20) for comparative statistical analysis	1940-1989	Number actors smoking	Three raters per film/ High inter-rater reliability reported	No clearcut statistical analysis despite percentage of smokers declining by more than half between 1950's and 1980's	No systematic trend: increase 1950's (31%) / decrease 1980's (12%)
	-	+	-	+	-	
5. Everett, Schnuth, Tribble, 1998.	10 top DBO* per year	1985 – 1995	5 minute intervals of smoking events	Two raters per film	Spearman rho coefficients assess relationship between year of film and proportion	No change in rate of smoking in films

					pro-smoking, anti-smoking events	
	+	+	+	+	+	
6. Dalton Tickle, Sargent Beach Ahrens Heatherston, 2002	25 films per year	1988- 1997	Tobacco exposur e time	Two coders per film	Descriptive statistics, t- tests, data transformed	No change in rate of smoking in films
	+	+	+	+	+	
7. Kacirk, Glantz, 2001	5 films per year randomly selected from top DBO	1960- 2000	5 minute intervals of smoking events	Not described	Regression analysis used but explanation of statistical methods unclear	Smoking in films is increasing
	-	+	+	-	-	
8. Ng, Drakake 2002	Top 10 PG- 13 films per year	1996- 1999	Length of tobacco use in minutes	Not described	Compare simple averages rather than use a statistic/ no trans- formation of skewed data/ data analysis incorrect	Smoking in films is increasing
	-	-	+	-	-	
9. Glantz, Kacirk, McCulloch, 2004	2 films per year 1950- 59/5 films per year 1960-2002, randomly selected from top DBO	1950- 2002	5 minute intervals of smoking events	One coder per film	Non parametric method / no data transformatio ns/ questionable treatment of outliers	Smoking in films is increasing
	-	+	+	-	-	

*DBO Domestic Box Office

While most studies reviewed used valid measurement strategies and considered rating of the films selected,^{1,3,5,7,8} a number of deficiencies were found. Small sample sizes lower study external validity and limit statistical analyses,^{2,3,7,9} while short time frames make trend analysis questionable.^{3,8} With one exception⁷ none of the studies made corrections or power transformations for non normally distributed or asymmetric data. Statistical methods used in some studies were not well explained,^{1,7,9} and in some cases were incorrect.⁸ For example, one study that claimed that smoking rates in the PG-13 movies doubled between 1996 and 1999 collected data which appear to be valid, but then through a faulty statistical treatment invalidated the study findings. Positively skewed annual distributions in this study were not transformed to correct for non normality in the data set and simple averages rather than a statistic such as a t-test or ANOVA were used to compare annual distributions. When the data were re-analyzed with these adjustments no significant differences in smoking rates were found in the time frame observed. In another study not only were sample sizes very small per year considered, but rather than transforming data, outliers were discarded without sufficient explication or rationale to assure the statistical validity of procedures used.⁹

It should be noted that those studies which had the strongest methodologies found no increase in smoking in the early to mid 1990s compared to the 1980s,^{5,6} while those studies with the weakest methods report an increase in the 1990s.^{3,7,8,9}

Methodological Considerations

Dependent variables for this analysis are total number of tobacco incidents in films observed, or tobacco incidents per minute defined as total incidents of tobacco use divided by length of film in minutes. Tobacco incidents are counted as smoking events in

a frame while a frame is defined as the duration the camera is focused on a particular person, object, or action. Incidents are any incident of cigarettes, cigars and chewing tobacco in films, or depictions of smoking paraphernalia such as cigarette packs, ashtrays, or brand name advertisements. Thus when the camera goes to another frame, if there is smoking in that frame, even by same person, it is considered another smoking incident. However within one frame there can be multiple persons smoking: these are considered multiple incidents.

All movies were reviewed in video format for accuracy and ease of confirmation of coded content. Initial content coders for the Thumbs Up! Thumbs Down! data base were youth volunteers aged 14 - 22, who were recruited annually, trained extensively on coding films and filling out the review forms.¹⁰ To assure accuracy, each movie was viewed in its entirety and coded by three reviewers. If inter-rater reliability rates indicated substantial disagreement on the number of incidents or characteristics of incidents a fourth review was carried out either by TUTD staff or a veteran youth reviewer.

Concordance coding, where there is agreement between coders, was used to determine final codes entered for all films in the sample.

For the phenomenon studied, tobacco use in films considered on an annual basis, distributions are skewed as most films released have low or no smoking while a few films may have much higher rates than average. Distribution of the original variable tobacco use per minute of film is positively skewed with skewness of 1.7. For a standard normal distribution, the skewness should be close to zero. The kurtosis of the distribution is 2.8. For a standard normal distribution, the kurtosis should be close to 3. For this type of distribution non transformed mean scores are poor indicators of central tendency, and

outcomes based on these scores tend to be biased upward. Therefore prior to multivariate analyses, power transformations of dependent variables of total incidents of tobacco use and tobacco use incidents per minute of films were carried out using square root transformations. Specifically the standard practice is to transform a positively skewed distribution using the descending ladder of powers from taking square root to the Log X.

¹¹ Thus we transformed the values of smoking minutes per film by the square root of each value which improved the normality distribution thus allowing utilization of standard statistical analyses.

After the transformation we also tested for the assumption of homoscedasticity or constant error variance for the transformed variable tobacco use per minute. Results for the Breusch-Pagan/ Cook-Weisberg test for heteroscedasticity, the coefficients transformed back to per minute coefficients, were $\chi^2(1) = 1.14$; $\text{Prob} > \chi^2 = 0.2859$, which implies that the constant error variance assumption holds. Q-q plots are shown before and after the transformation of this variable and show deviation from normality (Figure 1) and then the normalized scale after transformation (Figure 2).

These tests show that this measure meets assumptions for use in General Linear Models and regression methods used.

Figure 1

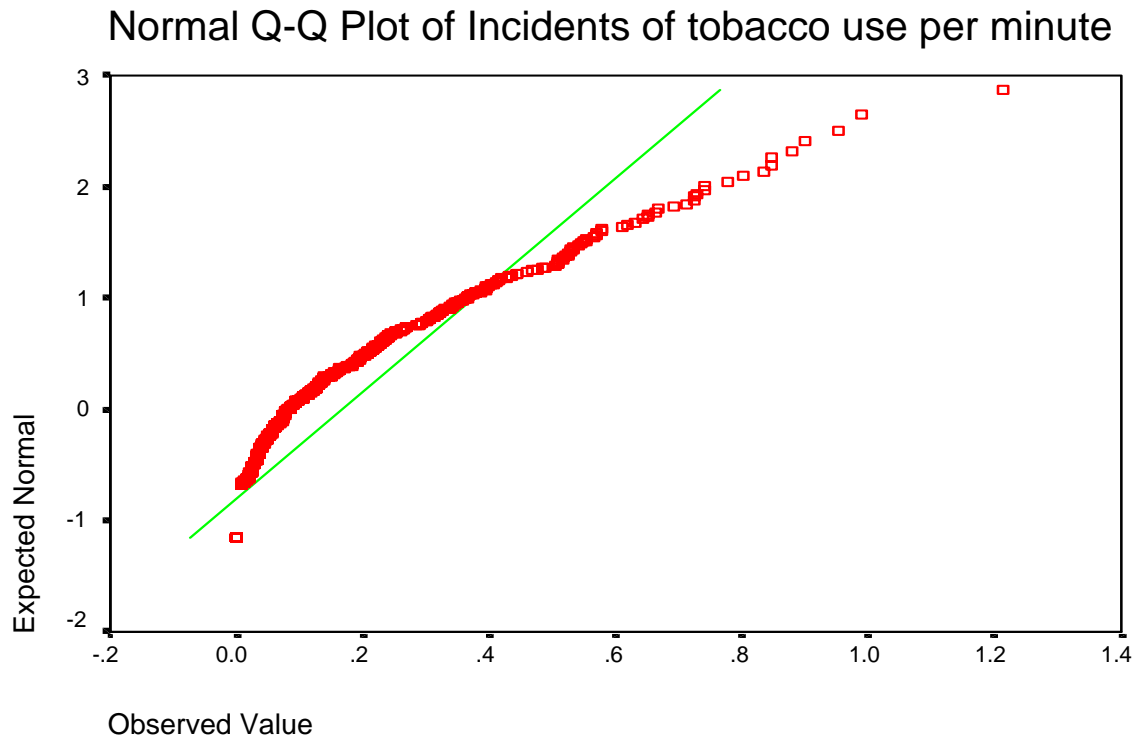
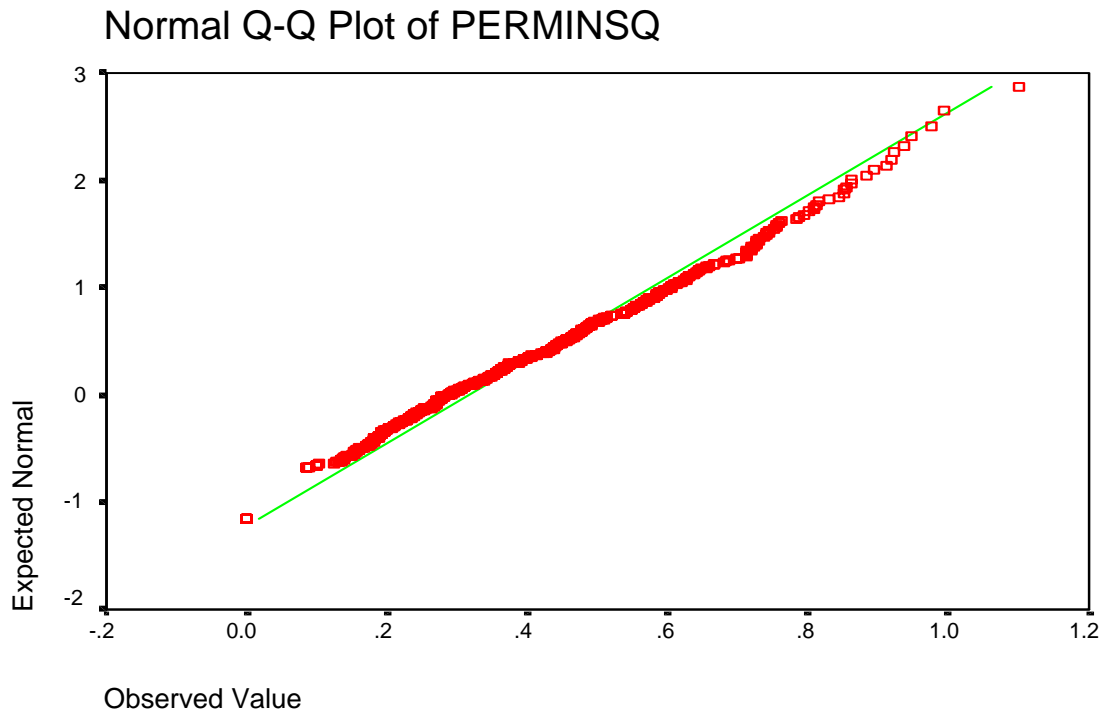


Figure 2



Findings

Based on Motion Picture Academy of American (MPAA) rankings, only 26 films (5.3%) reviewed were rated ‘G’. Ninety-two films (18.5%) were rated ‘PG’, 170 films (34.3%) were rated ‘PG-13’, and 208 films (41.9%) were rated R. Most films were either action adventure (153, 30.8%), comedy (32, 26.6%, or drama (85, 17.1%) with the remaining 25 percent classified as family, horror, science fiction or mystery

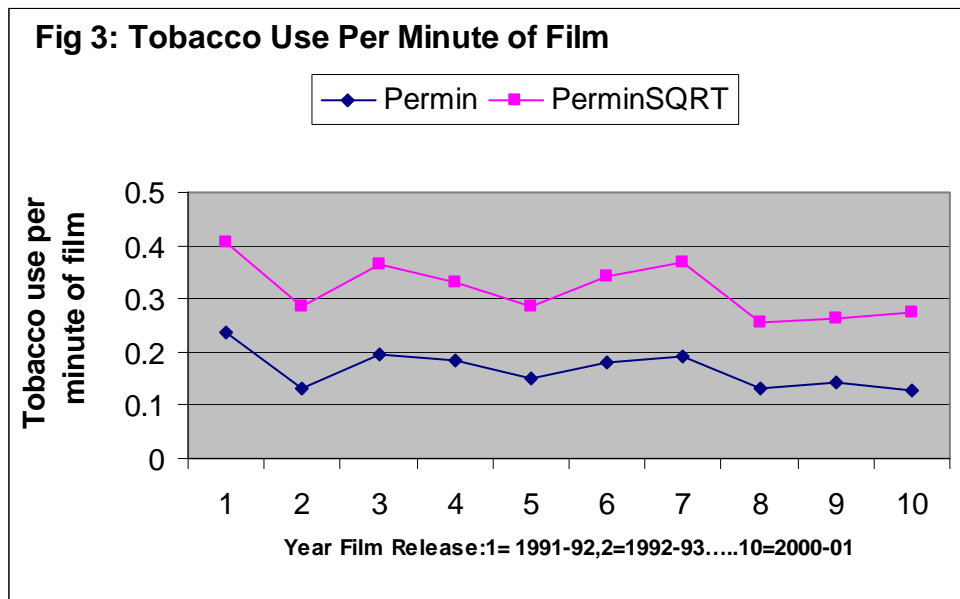
Figure 3 shows the number of smoking events per minute of film, the upper rate indicating the square root value. Table 2 is the General Linear Models analysis with tobacco use per minute of film as the dependent variable.

Table 2: General Linear Model: Main and Interaction Effects: Dependent Variable Tobacco Use Per Minute of Film (PERMINSQRT)

Model: Between Subjects				
Source of Variance	Sum of Sqares	df	Mean Square	F
Corrected model(1)	14.214	137	0.104	1.959***
Intercept	6.911	1	6.911	130.513***
Rating	0.613	3	0.204	3.858**
Genre	0.33	6	5.15E-02	1.04
Year of Release	1.278	9	0.142	2.681**
Rating X Genre	0.555	11	5.05E-02	0.953
Rating X Year of Release	1.805	26	6.94E-02	1.311
Genre X Year of Release	3.437	45	7.64E-02	1.442*
Rating X Genre X Year of Release	1.805	37	4.88E-02	0.921
Error	18.905	357	5.30E-02	
Total	83.36	495		
Corrected Total	33.119	494		

p < .05, **p < .01, *** p < .001

Model: R Squared = .429 (Adjusted R- squared = .210)



The estimates of change in smoking over the ten year period are based on the Mixed Methods Regression analysis findings and indicate the expected change in smoking per minute associated with a unit change in our independent variable X. Overall the rate of change is $-.011 \times 90$ or .99 minutes per movie for a ninety minute movie. For youth oriented movies the rate change is based on $-.014 \times 90 = 1.26$ minutes per movie for a ninety minute movie. This means that over the decade reviewed there was one fewer smoking scene on average per year and for PG -13 this rate was 1.26 fewer scenes per year on average.

Discussion

This study showed that in the time frame of the study 1991 – 2000, a very high fluctuation in smoking in films from year to year in the early part of the decade flattened out by the end of the decade, and then rates started to decline. This finding contradicts a number of other studies on the topic that have reported that rates of tobacco use in films has been increasing during the 1990's. There are many reasons why some studies might report that tobacco use in films is increasing or is higher in the last decade, especially if there are differences in the time frame of the study or differences in sampling techniques. If fewer films are selected, as higher grossing films tend to be R and PG- 13 ratings, they have higher rates of tobacco use both in regards to frequency and overall use. Our study shows that rates in r-rated films are increasing. A larger sample includes more G and PG films where rates of tobacco use have generally been low in the decade studied. PG -13 films also showed a decrease with the exception of dramas classified as PG-13, where tobacco rates went up.

Recent findings reported by the American Lung Association Sacramento Emigrant Trials, the organization that has sponsored the Thumbs Up! Thumbs Down! data set since 1991, indicate that in Years 2001 – 2003, the overall rate of smoking in films has edged up slightly over the previous three years.¹⁰ However they do report that For PG-13 films the actual rates of tobacco use per minute did not change, but increased production of PG-13 films at present may increase youth exposure to tobacco depictions. As these rates fluctuate from year to year it is premature to suggest that tobacco use in the movies is on the upswing. These more recent rates are not equal to the higher rates of tobacco use found in films released in 1990 through 1993.

While this study is important for advocacy work in regards to reducing tobacco use on the screen, data presented are not sufficient to model youth exposure rates either real or potential to tobacco depictions on screen. To do that one would need to conduct cross sectional research with youth audiences to monitor what they watch and how that impacts behavior.^{12, 13}

Cinema today is a high volume, high impact enterprise. Hundreds of films are produced per year with only a percentage going into general release or staying in release long enough to be seen by large numbers of persons. A strength of the current study is a larger sample than previous studies which allows more statistical power and more precise estimates. Compared to previous studies findings reflect more truly what industry norms are as regards smoking in films. However we realize that even this sample may be deficient as it only those films that attained some commercial success are sampled. More data and further analyses will allow expansion of these models. Of importance is the continuation of data collection efforts that allow for sufficient sample size and high

quality measures that enable accurate analysis of trends. Support of media surveillance methods enable public health advocates to make informed observations about the state of popular entertainment. In the case of tobacco depictions in films, given their role in influencing youth smoking, it is important rates continue to decline, and efforts made to induce celebrities to reduce their on screen smoking. Whether this is done through continued advocacy to raise consciousness among persons in the entertainment community to voluntarily reduce depictions, or through policies adopted by the entertainment community to limit tobacco use in films, such as a revised MPAA rating, remains to be seen.¹⁴⁻¹⁷ Both methods could have the beneficial effect of reducing tobacco use on screen which in turn might help to reduce tobacco use among the most vulnerable film viewers, children and adolescents both in the US and abroad.

References

1. Terre L, Drabman RS, Speer P. Health-relevant behaviors in the media. *J Appl Soc Psychol.* 1991;21(16):1303-1319.
2. Russo- Hazan A, Liptons HL, Glantz SA. Popular Films do not reflect current tobacco use. *Am J Public Health.* 1994;84(6): 998-1000.
3. Stockwell TF, Glantz SA. Tobacco Use is increasing in popular films. *Tob Control.* 1997;6:282 –284.
4. McIntosh WD, Bazzini DG, Smith SS, Wayne SM. Who smokes in Hollywood? Characteristics of Smokers in Popular Films from 1940 to 1989. *Addictive Behaviors.* 1998;23(3):395-398.
5. Everett SA, Schnuth RL, Tribble JL. Tobacco and Alcohol Use in Top Grossing American Films. *J Community Health Sci.* 1998;23(4):317-324.
6. Dalton MA, Tickle JJ, Sargent JD, Beach ML, Ahrens MB, Heatherton TF. The Incidence and Context of Tobacco Use in Popular Movies from 1988 to 1997. *Prev Med.* 2002;34:516-523.
7. Kacirk K, Glantz S. Tobacco Use in Movies in 2000, exceeded rates in the 1960's Tobacco Control. 2001;10:397- 398.
8. Ng C, Drakake B. Tobacco at the Movies: Tobacco Use in PG –13 Films. Report by the Massachusetts Public Interest Research Group (MassPIRG); 2002. Available at: <http://www.pirg.org/tobacco> Accessed December 10,2003
9. Glantz, SA, Kacirk, KW, McCulloch, C Back to the Future: Smoking in Movies in 2002 Compared with 1950 Levels. *American Journal of Public Health, 94(2) :* 261- 263, 2004
10. American Lung Association of Sacramento Emigrant Trails – California. Tobacco Use in the Movies Annual Report Card. *Thumbs Up! Thumbs Down!* Annual reports [1991-2003] Available at: <http://www.saclung.org/thumbs/htm> Accessed March 2004.
11. Fox J. *Applied Regression Analysis, Linear Models, and Related Methods.* Thousand Oaks, CA: Sage Publications; 1997:60–67.

12. Sargent JD, Beach ML, Dalton MA, Mott LA, Tickle JJ, Ahrens MB, Heatherton TF. Effect of Seeing Tobacco Use in Films on Trying Smoking Among Adolescents: Cross Sectional Study. *Br Med J*. 2001;232:1-6
13. Dalton MA, Sargent JD, Beach ML, Titus-Ernstoff L, Gibson JJ, Ahrens MB, et al. Effect of viewing smoking in movies on adolescent smoking initiation: a cohort study. *The Lancet*. June 10, 2003. Available at: <http://image.thelancet.com/extras/03art1353web.pdf> .
14. Chapman S, Davis RM. Smoking in Movies: is it a problem? [editorial]. *Tob Control*. 1997;6:269-271.
15. Eszterhas J. Hollywood's Responsibility for Smoking Deaths [op-ed]. *New York Times*. August 9, 2002: <http://www.nytimes.com/2002/>
16. Lowe RK. Groups Demand Hollywood Take Action Against Tobacco. *The Los Angeles Times*. November 14, 2002. Available at <http://www.latimes.com>
17. Glantz S. Smoke Free Movies. Available at: <http://www.smokefreemovies.ucsf.edu>
Accessed December 10, 2003.