



Stages of physical dependence in New Zealand smokers: Prevalence and correlates☆



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HIGHLIGHTS

- Physical tobacco dependence develops through stages of wanting, craving and needing.
- Stages of physical dependence correlate with changes in brain addiction pathways.
- We describe the distribution of smokers across the stages of physical dependence.
- Multiple neural mechanisms may be involved in the progression of physical dependence.

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ABSTRACT

Background: Physically dependent smokers experience symptoms of wanting, craving or needing to smoke when too much time has passed since the last cigarette. There is interest in whether wanting, craving and needing represent variations in the intensity of a single physiological parameter or whether multiple physiological processes may be involved in the developmental progression of physical dependence.

Aim: Our aim was to determine how a population of cigarette smokers is distributed across the wanting, craving and needing stages of physical dependence.

Methods: A nationwide survey of 2594 New Zealanders aged 15 years and over was conducted in 2014. The stage of physical dependence was assessed using the Levels of Physical Dependence measure. Ordinal logistic regression analysis was used to assess relations between physical dependence and other variables.

Results: Among 590 current smokers (weighted 16.2% of the sample), 22.3% had no physical dependence, 23.5% were in the Wanting stage, 14.4% in the Craving stage, and 39.8% in the Needing stage. The stage of physical dependence was predicted by daily cigarette consumption, and the time to first cigarette, but not by age, gender, ethnicity or socioeconomic status.

Conclusion: Fewer individuals were in the craving stage than either the wanting or needing stages. The resulting inverted U-shaped curve with concentrations at either extreme is difficult to explain as a variation of a single biological parameter. The data support an interpretation that progression through the stages of wanting, craving and needing may involve more than one physiological process.

What this research adds: Physical dependence to tobacco develops through a characteristic sequence of wanting, craving and needing which correspond to changes in addiction pathways in the brain. It is important to neuroscience research to determine if the development of physical dependence involves changes in a single brain process, or multiple processes. Our data suggests that more than one physiologic process is involved in the progression of physical dependence.

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Recent clinical studies have found that physical dependence to tobacco develops through a characteristic sequence of stages (DiFranza, Ursprung, & Carlson, 2010, DiFranza, Ursprung, & Biller, 2012). Prior to the development of physical dependence, tobacco users do not experience withdrawal symptoms if use is discontinued. As physical dependence develops, during abstinence tobacco users initially experience only a mild ‘Wanting’ for tobacco (DiFranza, 2015). As

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physical dependence intensifies, abstinence triggers a stronger and intrusive desire to use tobacco that interrupts the user's thoughts: 'Craving'. In the final stage, abstinence triggers a desire to use tobacco that is so strong that it is impossible to ignore and the tobacco user feels the need to use tobacco just to function normally: 'Needing' (DiFranza, Sweet, Savageau, & Ursprung, 2011). This symptom progression of wanting, craving and needing correlates with structural and functional changes in addiction pathways in the smoker's brain (Huang et al., 2013, Huang et al., 2014). Physical dependence is also important clinically as it correlates with the number of smoking days per month, daily cigarette consumption, lifetime cigarette consumption, and perceived difficulty in abstaining or quitting (Christophi, Pampaka, Paisi, Ioannou, & DiFranza, 2016).

The use of the term 'stages' to describe the development of physical dependence implies that wanting, craving and needing are qualitatively distinct from one another, just as childhood, adolescence and adulthood are qualitatively distinct. If wanting, craving and needing are distinct symptoms, it would suggest that the development of physical dependence may involve more than one biological process with one leading to the next. On the other hand, if wanting, craving and needing are simply differences in the intensity of a single symptom (the desire to smoke) this might make it possible to attribute physical dependence to a single biological process.

Population distributions on simple biological measures typically demonstrate a central tendency with tails at either extreme. However, prior studies have found fewer smokers in the Craving stage than in the Wanting or Needing stages, a distribution that we contend is difficult to explain on the basis of a single biological parameter (DiFranza et al., 2011, DiFranza, Ursprung, & Biller, 2012; Christophi et al., 2016). As two studies employed convenience samples, this distribution might reflect sampling bias. Ours is the first study of the stages of physical dependence in a nationally representative sample of adult smokers.

1. Methods

1.1. Participants

The Health and Lifestyles Survey (HLS) is a nationwide in-home, face-to-face survey approved by the New Zealand Ethics Committee. In 2014, 2594 New Zealanders aged 15 years and over were surveyed. The response rate accounting for non-dwellings, non-contactable and refusals was 75.1%.

1.2. Sampling procedure

The survey used a multi-stage, stratified, clustered and random probability sampling method, including an oversample of Māori and Pacific peoples (Health Promotion Agency, 2014). The New Zealand 2013 Census of population and dwellings uses a primary sampling unit of meshblocks and these were used as part of an area-based sample frame for the HLS, excluding such things as remote offshore islands (Statistics New Zealand, 2014). Up to ten visits would be made to a household to solicit participation by a household member. Eligible respondents were selected using a probability proportional to size sampling method. People were interviewed in their home using a computer-assisted personal interview system.

1.3. Questionnaire

The stages of physical dependence were assessed using the Levels of Physical Dependence which has been validated in adolescents and adults and shown to correlate with structural changes in smokers' brains (DiFranza, Ursprung, & Biller, 2012; Huang et al., 2013, Huang et al., 2014, Christophi et al., 2016). Three items were structured hierarchically on the common stem, "Please tell me if the following statements describe you at all." Each item was read to the participant until

they stated 'Yes' that the statement did describe them. A "yes" response skipped the subject out to another set of questions.

1. If I go too long without smoking, I just can't function right, and I know I will have to smoke just to feel normal again. (yes/no) [Needing]
2. If I go too long without smoking, the desire for a cigarette becomes so strong that it is hard to ignore and it interrupts my thinking. (yes/no) [Craving]
3. If I go too long without smoking the first thing I will notice is a mild desire to smoke that I can ignore. (yes/no) [Wanting]

Subjects who answered yes to the first question were categorized as Needing; those who answered yes to the second question were categorized as Craving; those who answered yes to the third question were categorized as Wanting; those who answered no to all three items were categorized as having no physical dependence.

1.4. Data analysis

Using STATA 13.0, predictors were fitted in an ordinal logistic regression analysis using a proportional odds model comparing: No dependence versus all others, Wanting versus Craving and Needing; Craving versus Needing. The model determined the odds of being at a higher stage of physical dependence proportional to the effect of predictors, here including daily cigarette consumption, time to first cigarette in the morning, age, gender, ethnicity and number of quit attempts in the last 12 months.

Three adjustments were made to the data. First, each respondent was given a selection weight, which adjusts for the survey design. Second, data were adjusted for different response rates in the meshblocks surveyed. Third, in order to ensure that the results were representative of New Zealand's resident population aged 15 years and over living in permanent, private dwellings, the survey data were benchmarked to the proportions for respective groups in the 2013 Census of population and dwellings for gender, age and ethnicity.

2. Results

The weighted proportion estimates of sample characteristics are shown in Table 1. The rate of current smoking (16.2%) is comparable to that from the New Zealand Health Survey (Ministry of Health, 2014). Among smokers, national prevalence rates for each stage of physical dependence adjusted by jack-knifed estimates are shown in Fig. 1.

Among 585 smokers, the stage of physical dependence correlated directly with daily cigarette consumption (0.357, $p < 0.05$) and inversely with time to first cigarette (-0.404 , $p < 0.05$). Age, gender, ethnicity and a quit attempt in the last 12 months were unrelated to the stage of physical dependence. The ordinal logistic regression model identified only two predictors of physical dependence: cigarette consumption and time to first cigarette. For each increase in cigarette consumption (1–5, 6–10, 11–20, 21–30, 31 or more) the relative odds of being in the next higher stage of physical dependence increased by 55% (odds ratio 1.55, 95% confidence interval 1.06–2.26, $p < 0.05$). For each increase in 'time to first cigarette' (within 5 min of waking, 6–30 min, 31 min–1 h, > 1 h) the relative odds of being at the next stage of physical dependence decreased by 40% (odds ratio 0.60, 95% confidence interval 0.417–0.852, $p < 0.05$). Age, gender, ethnicity and quit attempt in the last 12 months were unrelated to the stage of physical dependence.

3. Discussion

Three prior studies have reported on the distribution of smokers across the stages of physical dependence. In a sample of 349 American adolescent tobacco users (cigarettes and oral tobacco), 48% had no physical dependence, 26% were in the Wanting stage, 6% in the Craving stage, and 20% in the Needing stage (DiFranza et al., 2011). In the Cyprus

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